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An investigation of factors influencing selection of construction project managers for sustainable renovation projects

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Abstract: Over the years, extent to which project managers are assessed with green related parameters to stimulate selection is lacking. Poor leadership affects effective planning, execution and control thereby impacting project delivery. Sustainable renovation projects are generally complex in nature as new sustainable technologies are introduced to reduce energy demand of existing buildings. To establish the research gaps, an extensive review of the literature was undertaken. Given that a selection criteria that relates closely to a project manager for green renovation is lacking, the study designed a conceptual framework to explain the scope of the research. A quantitative approach was adopted to examine the agents that influence selection of project managers for green renovation projects. A questionnaire was used to gather data of factors that impact selection of project managers in green renovation projects in Ghana. The findings of a rigorous

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Dr John Dadzie is a Senior Lecturer in the Department of Building Technology of Kumasi Technical University, Ghana. He has over 22 years of teaching and research experience. He has published extensively in the area of sustainability, sustainable construction, sustainable renovation and technologies. His current research interests include innovative smart envelopes, management of green renovation projects and sustainable costing.
Dr Buccah G Sebitla is a specialist in resilience and sustainability, material culture, design history, social innovation, urban studies and spatial theory, Buccah's education and early years in practice were in architectural design. Since receiving his PhD, he has researched across diverse areas of sustainable design, especially in areas of materials selection and application for sustainable upgrades in existing structures. Within these, his focus has been on sustainable approaches to the contexts both for demand for designing of dwellings and for design upgrades. He has a strong interest in resilience and sustainability and understands design parameters as an integral part of an environment that is constantly being shaped and reshaped.

PUBLIC INTEREST STATEMENT

Existing buildings all over the globe are being upgraded with new sustainable technologies capable of reducing energy demand and greenhouse emissions. The situation is not different in Ghana as many existing buildings are retrofitted to improve energy savings. Unlike the conventional approach, sustainable renovations are generally complex with many interacting elements. Majority are often, not completed on time and to the required quality and cost. Thus, this paper examines the determinants for selection of project managers for green renovation projects. The results indicate actions that should be taken by clients and government agencies as knowledge of green renovation and sustainable technologies are vital to the selection of a project manager. Although, academic qualifications are critical, the overall concept of project management should be integrated with sustainable construction.

statistical analysis indicate adequate working experience, cost of green renovation project, duration of a green renovation project, academic qualifications and knowledge of sustainable technologies are critical to the selection of project managers. Others include ability to work effectively in a team, evidence of adequate green training, green renovation projects managed and understanding of conflict management. The findings reinforce theories underpinning construction project management as selection variables for effective project delivery are addressed. The findings inform government decisions to engage project managers for green renovation projects and provide literature for teaching and learning.

Subjects: Conservation - Environment Studies; Engineering Project Management; Clean Technologies; Building and Construction; Energy; Property

Keywords: Leadership; sustainable renovation; sustainable technology; existing buildings; policy

1. Introduction

The role of a project manager (PM) is critical to the continuous development of the concept of sustainability particularly sustainable renovation projects. By their very nature, sustainable upgrades are complex compared to the conventional building maintenance approach. Integration of new technologies in existing buildings is less predictable which can lead to inefficiencies at various levels (Bakhtiari et al., 2020). Often, the form of upgrade depends on cost of renovation, availability of technologies and technical skills (Belay et al., 2022). Thus, it is expected that project managers are carefully selected to handle such complex projects. The construction industry is criticised because of cost overruns, quality problems, health and safety concerns and delays (Durdyev et al., 2017; Gambo et al., 2021; Zamim & Shukla, 2021) and low productivity (Amede, 2022). Sustainable renovation actions to change poor energy patterns of existing buildings and systems are sometimes associated with health and safety issues, delays and cost overruns (Killip et al., 2018).

The level of technical skills required to manage such complex projects is theoretically a criteria that influences selection of PMs as discussed by Belay et al. (2022). Hwang et al. (2017) identified workers' experience, technology, design changes, workers' skill level, planning and sequencing of work as the most critical factors affecting productivity of green building construction projects. The variables generated by Hwang et al. (2017) fall within the context of the conceptual framework designed for this research. The authors added that differences in the criticality of the technical factors between green and traditional projects are remarkable, hence should draw practitioners' attention. Also, collaborative energy benchmarking and performance goal setting based on high level of skills provide a transparent decision-making environment, generally considered critical for effective management of projects (Gultekin-Bicer et al., 2018). Often, the skills of a PM augment that of a project team which ultimately confirm effective project delivery. This is due to the capacity attained by managing similar projects over a period of time. The level of expertise is usually tied to competency in the area of construction project management. An increase in the level of adoption of green construction management practices contributes to high-quality standards of highway engineering projects (Wu et al., 2019). Sharma and Kumar (2018) highlighted enthusiasm, high self-esteem, political sensitivity, ability to delegate and evidence of capacity to mobilise as factors influencing selection of project managers. A successful project manager should be able to delegate, that is, allow subordinates to participate in decision making, which is in tandem with effective project delivery. A project manager should be flexible, patient and persistent, with good communication skills, be a good planner with credible capabilities (Horváth, 2019). These factors in one way or the other ensure successful project delivery (Sharma & Kumar, 2018). Kondalkar (2020) discussed the concept of organisational behaviour and relates that to the functions of a project manager. This implies that to a large extent; a client expects a project management team to deliver on time and within budget. To be successful

as a project consultant requires strong commitment, capacity to work with different people and the ability to work effectively in a team (Dadzie et al., 2012; Sankaran et al., 2020).

A methodology for selecting project managers is broadly studied and reported in the literature. El-Sayegh et al. (2021) investigated key contractor selection criteria for green construction projects in the UAE and proposed a selection criteria. Moradi et al. (2020) presented a competency model for the selection and performance improvement of project managers in collaborative construction projects using behavioural characteristics. Hashempour et al. (2020) presented a comprehensive review that addressed means of optimising energy performance of existing buildings. Le et al. (2021) present a review of sustainable refurbishment to identify key lessons from selected successful refurbished projects. The review established three groups of lessons in terms of reasons, process and barriers in the selected refurbishment projects. The lessons deepen the role of project managers in ensuring that green renovations achieve environmental goals. Thus, a project managers' understanding of the concept of energy retrofit is likely to ease implemental shortfalls. To improve energy saving renovations, Liang et al. (2017) proposed an urgent need to develop a set of critical success factors (CSFs) as stakeholders influence the success of complex energy renovation projects. In line with that, the authors proposed an innovative social network analysis (SNA) method based on a two-mode social network analysis to integrate CSF analysis with stakeholders. North America, Europe and the Middle East were the focus of a study by Alizadehsalehi and Yitmen (2019). The authors designed a framework to link different aspects of a conventional project progress monitoring, with indicators of project performance control.

Ebrahimi et al. (2019) provided a roadmap for future efforts toward implementing BIM and sustainability for existing buildings. The authors proposed a BIM-based sustainable decision-making framework for handling sustainable retrofitting process within various disciplines. A case study incorporated with a definition function (IDEF0) model that details how to convert the BIM model of the NASA-Mars habitat project to a virtual reality and mixed reality model was presented by Alizadehsalehi et al. (2020). Also, a carbon accounting methodology and an efficiency assessment model that can measure the carbon emission characteristics and reduction potential was designed and presented. Thereafter, a decision-making framework for sustainable community renewal was suggested and linked to carbon emission mitigation. These methods among many others are for the overall improvement of sustainable renovation project and related reductions in carbon emissions however, that do not provide detailed information of factors that influence selection of PMs, particularly for green renovation projects. The literature presents a gap in relation to selection of PM for sustainable renovation projects. Therefore, the study seeks to investigate determinants impacting selection of project managers for green renovation projects.

2. Literature Review

2.1. Sustainable renovation of existing buildings and leadership

Sustainable renovation involves the use of strategies and technologies that improve the environmental overlook of existing buildings. Zhao et al. (2016) studied leadership characteristics and styles of project managers for green building projects. In that study, 30 project managers experienced in green construction were engaged in Singapore. Thus, 13 varying characteristics were categorised into two groupings: directive and task-oriented leadership and relationship-oriented leadership. The authors reported that leadership style of the project managers is more towards directive and task oriented. Yacob et al. (2018) presented a review of leadership qualities among building refurbishment project managers. The research identified potential leadership qualities among building refurbishment project managers. In addition, the relationship between uncertainty factors and performance of refurbishment projects as mediated by leadership qualities were determined. A major outcome of the study is that municipalities play an important role in reducing energy demand through renovations.

Veenstra and Kaashoek (2016) investigated stakeholders' drive as well as the desired market conditions towards energy neutral solutions in the Netherlands. The authors argue that a new type of experience seems to start mostly within smaller or new building contractors, some housing corporations and in rural areas where energy plans are developed and facilitated by local governments. Although municipal governments aim at a fossil free built environment, there is a general lack of continuous vision and leadership (Veenstra & Kaashoek, 2016). In Sweden, Larsson et al. (2015) explored the degree to which leadership styles affect project outcome. The analysis is based on a questionnaire survey of views of 162 project managers employed by the largest public infrastructure client. The results indicate project performance (in terms of cost, time, and quality) is affected by leadership, suggesting that a project manager's leadership style is a significant project success factor. Further, the results show that certain styles are appropriate in different situations, highlighting the importance of a contingency perspective.

Gram-Hanssen et al. (2018) focused on local governance strategies in 12 municipalities targeting homeowners' engagement in energy retrofitting in Denmark. The study mentioned that municipalities have developed promising local network-based ways to engage homeowners in energy retrofitting. Local and regional context for the programmes, including the local economic situation, is of great importance, and this context creates both potentials and challenges for the local programmes. In the United Kingdom, Martiskainen and Kivimaa (2019) stated that intermediaries inspire projects, connect different actors and facilitate learning between projects. Intermediaries are important for advancing projects through local actors and knowledge-networks, especially at a time when national policy support for low-energy housing remains limited and a wider transition to low-energy housing is not complete. Polzin et al. (2016) assess variables that encourage local authorities to engage with energy performance contracting for retrofitting in German municipalities and reports of the benefits of engaging an energy consultant.

Caputo and Pasetti (2017) stated that local administration is best placed to develop local energy plans in Italy. The authors argue that implementing methods and procedures proposed in the study could be used to improve performance of a PM. Fasna and Gunatilake (2020) discussed the roles and functions of stakeholders in implementing energy retrofits in the hotel sector. The authors identified decision-maker, performer, monitor/observer and supporter as the stakeholders in decision-making process. However, environmental challenges posed by overreliance on unsustainable energy sources compared to green energy sources is a major barrier to improving green construction (Abid et al., 2022). It is against this background that the selection of project managers with adequate understanding of sustainable renovation could contribute to a shift or reduce dependence on unsustainable energy sources.

2.2. Theoretical foundation, project manager and sustainability

PMBOK® (2017) defines a project as a temporary endeavor to create a unique product, service, or result. Levy (2018) defines project management as "application of knowledge, skills, tools and techniques to meet project requirements". Project management is accomplished through the application and integration of concepts such as project initiation, planning, executing, monitoring and controlling and closing. It is the process of planning, directing and controlling resources to ensure high level of project performance which is normally expressed in terms of time, cost, quality and stakeholder satisfaction (Meredith et al., 2020). Stanitsas and Kirytopoulos (2021b) identified sustainable competitiveness, stakeholder engagement, sustainable economic growth, social sustainability, resource conservation and environmental policy as the main enablers of project success. The identification of resource conservation and environmental policy is consistent with actions for fossil free built environment through effective management of the limited natural resources.

Sankaran et al. (2020) investigated how project managers influence the assignment of a built environment project team members. Based on the philosophy of critical realism, case studies were used to collect data through 70 semi-structured interviews in Australia, Scandinavia and South

Africa. Interviews were conducted with senior managers, project managers and project team members. The study found that project team members were often assigned by others.

Sang et al. (2018) studied the effects of project manager competency on green construction performance in China. The study identified the position of a project manager as an important factor determining the success of a project. The authors argued that with the deterioration of the environment, green buildings present better environmental outlook compared to conventional buildings.

Identifying stakeholder and social setting aid understanding of construction activities thereby resulting in sustainable built environment. Managers could influence relevant networks and sustainability outcomes, including those enhanced by collaborative networks (Stanitsas & Kirytopoulos, 2021b). Stanitsas and Kirytopoulos (2021a) explored the importance of the principal sustainable project management indicators with the aim of achieving sustainable construction projects. The study identified environmental indicators as the most important; however, economic, environmental and social/management sustainability indicators relate closely with integration of sustainability into project management practices of construction projects (Stanitsas et al., 2021).

2.3. Factors influencing the selection of a project manager

A project manager is a person assigned to lead a team that is responsible for achieving a set of project objectives. The selection of project managers is linked to basic requirements, experience, education, communication, computer and management skills and time management. Other factors include cost, resource, quality and project management skills, planning, interpersonal skills, decision making and team development (Afshari, 2017). A project manager must manage costs, time and resources and be able to plan and develop skills of a project team (Sadatrasool et al., 2016). Also, knowledge, legal skills, communication skills, social awareness, action management, financial management and ability to identify risk affect decisions to select project managers (Sadatrasool et al., 2016). The authors added that effective human resource management, procurement skills, time management, quality design and control and technical impact selection of a project manager. Sharma and Kumar (2018) discussed factors that influence selection of a project manager to include enthusiasm, high self-esteem and political sensitivity. Although Sharma and Kumar (2018) sought to reinforce findings of earlier studies, ability to delegate, team management and good communication skills were identified and included.

The position of Sharma and Kumar (2018) agree with that investigated by Sadatrasool et al. (2016). By proposing the joint use of the Fuzzy DEMATEL (FDEMATEL) and Fuzzy VIKOR methods, Chaghooshi et al. (2016) investigated many variables including site management capacity, technical level, level of leadership and personal qualities. Management capacity includes project, program and portfolio orientation, health, security, safety and environment. Earlier studies by Dodangeh et al. (2014) and Sadeghi et al. (2014) applied various selection criterion in developing selection tools and models. The basic requirements include project management skills, management and interpersonal skills. Sadeghi et al. (2014) relied on the competencies for project managers, records of past performance and behavioural parameters. Luțaş et al. (2020) identified the profile of an ideal project manager by presenting an overview of studies regarding the profile of a good project manager. In that regard, the authors analysed the perceptions of organisations' managers and human resource specialists. The empirical research provides evidence that persons involved in project managers' selection perceive the value of education, certification, experience or soft skills differently, based on their professional role. Second, it shows that project management certifications are relevant for project managers' selection and are much appreciated around the world. Although each project requires specific skills and competencies of a project manager, the research ascertains a preferred profile based on the perception of over one hundred respondents, involved in the selection process.

Alvarenga et al. (2019) identified important competencies for project success and investigated correlations. The authors surveyed project managers on the importance of 28 competencies for project success. Communication, commitment and leadership appear as the three most relevant drivers of success. Leadership as identified by Alvarenga et al. (2019) is tied to the research

questions and a framework in Figure 1. Podgórska and Pichlak (2019) analysed project managers' leadership competencies in Poland. Correlation and regression analysis show support for the influence of project manager's leadership competencies, as well as their emotional and managerial skills in relation to project success. Ling et al. (2020) explored how personality traits influence management styles of construction project managers in Singapore. In line with the research questions, the authors carried out a national survey and interviews of project managers. High in extraversion, agreeableness, conscientiousness and openness and low in neuroticism are the dominant personality traits of PMs. PMs adopt "team leadership" style in which they place high emphasis on both the work that they need to complete and the people they lead. Their agreeableness and conscientiousness may take a positive inclination over time.

Arguments by Ling et al. (2020) is consistent with the assertion by Ameer et al. (2021) as the authors monitored the impact of manager's personality traits on project success through effective professional commitment organisational project management maturity. Owusu-Manu et al. (2020) shifted from recent studies by providing an exploratory evidence of the mindset of project managers and leadership style. Similarly, Kwofie et al. (2015) identified critical project management competencies of architects in the Ghanaian construction industry. In Ghana, majority of architects act as project managers as there is no clear definition of the scope of a project manager. Majority of the studies are tied to traditional project selection approaches with few studies on the concept of green renovation. This presents a gap in the literature that the study seeks to bridge by introducing a new selection criteria for green renovation projects.

2.4. Project manager selection methods

El-Kholy (2022) developed a new method for subcontractor selection using the "Choosing by Advantages (CBA)" approach. Wen et al. (2021) designed a new method that focuses on fuzzy multiple decision-making methods in civil engineering. The outcome of the study addresses the issue of high error in decision making, which is a very common phenomenon in the construction industry. The models were examined using a case study in a project-based organisation for selecting the most suitable project construction manager. Education, planning, controlling, communication skills, experience, and so on, were used for the second round of a Delphi approach. The third round involves basic requirements, management skills, interpersonal skills and project management skills. Manaan et al. (2014) demonstrated a fuzzy-based method for assessing the performance level of a project manager (PM) at the construction phase of Mass Housing Building Projects (MHBPs). Seven competencies including knowledge of appropriate site layout techniques for repetitive construction works, dedication and knowledge of appropriate technology transfer were applied (Manaan et al., 2014).

Gharouni Jafari and Noorzai (2021) proposed a framework to determine the most appropriate project manager (PM) to enhance the performance of occupational groups (POGs) in large, medium and small road construction projects in warm regions. The occupational groups (OGs) in road projects were divided into three categories: workers, technicians, and engineers. Using the Pareto principle, 14 critical project manager competencies (PMCs) were extracted from a 70-item list developed by performing a comprehensive literature review. Two indexes were ranked in each size of road project using the analytic hierarchy process (AHP) technique. Mohammadi et al. (2014) developed an approach in the form of a hybrid Quality Function Deployment (QFD) and Cybernetic Analytic Network Process (CANP) model for project manager selection. This involves the use of QFD to translate the owner's project management expectations into selection criteria and the CANP to examine the expectations and selection criteria. The research involves the development of 18 selection features in response to the owner's three main expectations of time, cost and quality. Other factors include experience, academic achievement, communication skills, Microsoft project software experience and planning skills were the selection criteria adopted and applied to develop the model. The survey of literature shows that planning, project initiation skills, implementation and closeout are important in the selection of a project consultant (Moradi et al., 2021).

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Figure 1. Word cloud of determinants.

2.5. Conceptual framework

Given the data from the literature review, the study argues that personal traits, green renovation, construction management features and construction characteristics influence selection of project

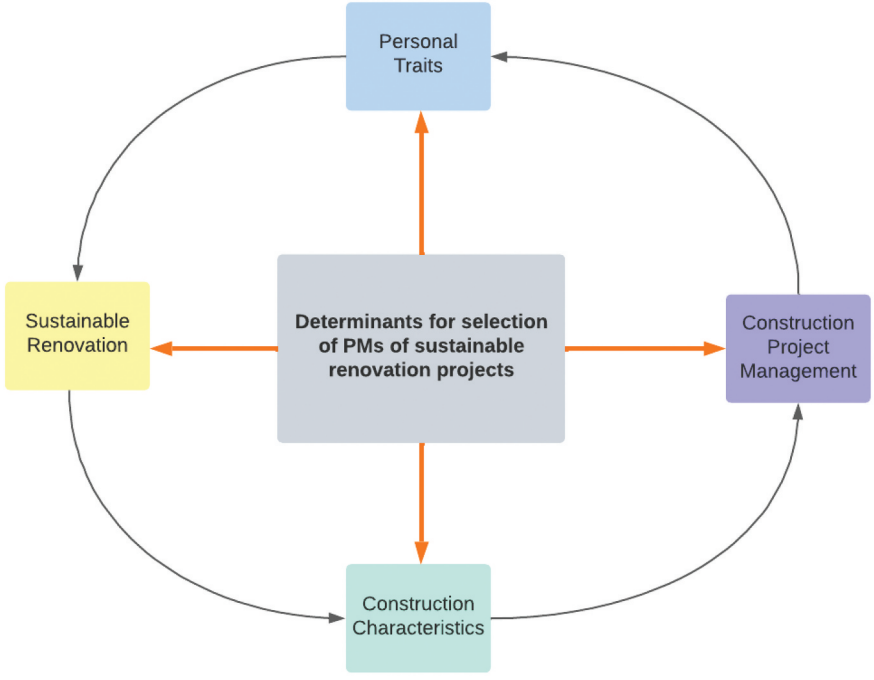


Figure 2. Conceptual framework.

managers. Figure 2 shows the relationship between the variables that were identified in the literature and tied to the research questions. The research understands that the gap in the literature is a lack of a combination the variables in Figure 2 in a single research work. These variables were explored in green renovation projects to understand the extent to which that influence PM selection.

3. Research Design

The study relied on the gaps in the literature to design the methodology as the gaps are tied to the research questions and hypothesis. The research gaps are quantitative in nature so an exploratory and quantitative framework in the form of structured questionnaire was adopted. A quantitative approach is consistent with the concept proposed by Sheard (2018) that aligns to the research questions. Figure 3 explains the research design process.

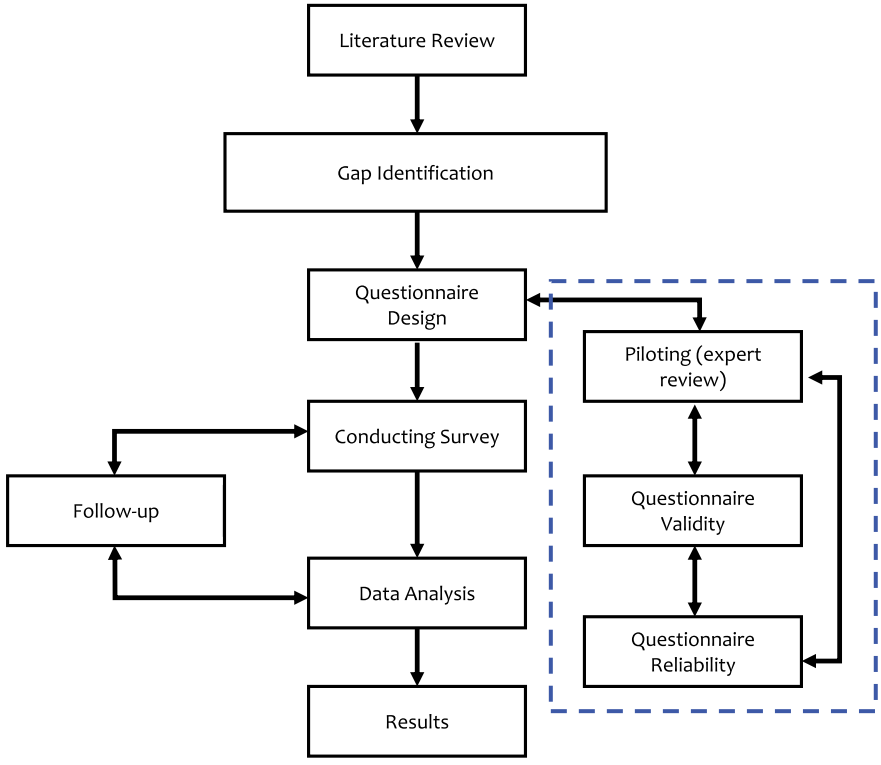


Figure 3. Research design flowchart.

3.1. Population and sample size

The population of the study comprises of district assemblies and professionals including architectural and quantity surveying consulting firms, construction firms and regulatory boards. The population is highly undefined as the study largest a very large sample of respondents. The aim is to capture the true position of all the various actors and project management experts to improve the quality of the study. According to the ministry of Local Government, there are 216 assemblies, 6 are metropolitans, 56 municipal and 154 are district assemblies. The population size of professionals is also undefined as many such bodies are not regularised.

3.2. Sampling

There are many types of sampling including convenience, snowball, and random approaches (Emerson, 2015), independent random sampling (Martino et al., 2018), cluster and stratified methods (Etikan & Bala, 2017). A random sampling approach is adopted to investigate the research gaps identified. Marinho and Couto (2022) applied a random sampling approach to

understand contribution to improvement of knowledge management in the construction industry based on stakeholders' perspective. After critical assessment of the survey participants, the population was fixed at 2160 to ease the sampling process. Using a confidence level of 95 per cent, the sample size, n was calculated using the Israel's (2009) formula as follows:

Adapting the formula: $n = \frac{N}{1+Ne^2}$

Where $N = 2160$, $e = 0.05$ for confidence level of 95%

$n = 2160/1+(2160(0.05)^2$

$n = 2160/6.4$

$n = 338$

3.3. Data collection

In line with the research questions, a quantitative approach is adopted to explore and discuss factors that influence selection of project managers for green renovation. The study is focused on projects that align to sustainable upgrade of existing buildings. District assemblies and regional coordinating officers and professional bodies in Ghana are the main respondents. A five-point Likert scale was used to understand factors that affect selection of PMs for sustainable upgrade projects. The respondents were asked to rate the items in relation to the degree of agreement or importance as 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree. The questions are in two major sections: part I focused on the demographic data of the respondents and part II addressed the factors that influence selection of project managers. A pilot survey of experts to test the variables for suitability as the concept of green renovation is new to many professionals. A total of 15 professionals were engaged online during the pilot stage of the study. Specific modifications to the variables were proposed that helped to restructure the survey for distribution. Thereafter, potential respondents were identified through personal contacts or referrals from staff of the district assemblies. The survey was sent to more than 450 professionals at the district and regional assembly level including professionals with adequate knowledge and understanding of green renovation. Those with no clear insight of the concept of sustainability and related impact of green renovation on the environment were excluded. Also, poorly answered survey questionnaires were rejected. The survey covered a period of 3 months as attempts to encourage more participants resulted in extension of the survey. The last month served as a mop-up to engage other professionals to participate. Within the two months, 110 professionals had responded, this was improved in the subsequent months. Overall, 125 professionals responded, providing a response rate of 28%.

3.4. Data analysis

Given the research questions, a Cronbach's alpha coefficient was used consistent with similar studies by Belay et al. (2022). According to Tavakol and Dennick (2011), a Cronbach's alpha coefficient should range between 0 and 1. Statistically, a value greater than 70% is required to reach acceptability level. By applying the steps provided by Gliem and Gliem (2003) in Table 1, the estimated Cronbach's alpha coefficient value of 0.71 for all the drivers was established, indicating consistency in the data set to allow for further statistical analysis. The most common formula is the use of means to determine the main drivers likely to trigger reductions in emissions. Calculated means provide the descriptive analysis of the data for detailed and further analysis, based on the maximum and minimum values. The means of each group are then assessed to produce the overall ranking for discussions and conclusions. Similar means are differentiated using the standard deviations. This is where standard deviation estimates become relevant as that forms the basis for ranking of similar means. The mean and standard deviation as applied in this study are consistent with similar studies related to environment and energy efficiency.

$$Mean = \frac{\sum_{i-1}^{5} W_i.X_i}{\sum_{i-1}^{5} Xi}$$

Table 1. Internal consistency of Cronbach's Alpha

Nr	Cronbach's alpha, α	Internal Consistency
1	Cronbach's alpha, α ≥0.8	Excellent
2	0.8>α≥0.7	Good
3	0.7>α≥0.5	Satisfactory
4	α<0.5	Poor

Note: Adapted from Gliem and Gliem (2003)

where: i—responses category of a Likert scale – 1,2, 3, 4, 5. Wi—is the weight assigned to ith response – (5 is Strongly agree, 4 for agree, 3 for neutral, 2 is disagree, 1 for strongly disagree); and X_i – frequency of the ith response. The Chi-squared test for the study is given by:

$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$, Where X^2= Chi-squared, O_i = observed value, E_i =expected value

Cronbach's alpha, $\alpha = \frac{C}{C-1}\left[1 - \frac{\sum xi^2}{xb^2}\right]$

where C, represents the number of items; X_i represents the variance of scores on each item; and X_b, represents the variance of the observed total test scores. SPSS Statistics Software (version 25) was employed to compute the Cronbach's Alpha, and the reliability coefficient was determined to show the internal consistency of the data.

The study presents many benefits to the construction industry and society in general. The societal benefits include enhanced relationship between existing building owners and project managers. Clearly, such a situation contributes to quality delivery of projects and ensures that shortfalls associated with sustainable construction projects are eliminated. The role of a project manager to the success of a green renovation project is expected to shift positively as understanding of the selection process is integrated in the overall concept of sustainable construction. Cost and delays associated with sustainable construction projects can be addressed with the selection of skilled PMs. The experience of a PM can boost team confidence and conflict management concerns that seem to hinder project delivery. Thus, the overall target of reducing the effects of greenhouse gases through sustainable renovation is achieved through the selection of PMs with green training and skills.

Table 2. Demographic results

Respondents	**Response received**	**%**
Project Managers	12	9.6
Civil and structural Engineers	21	16.8
Architects	23	18.4
Quantity Surveyors	16	12.8
Academics	21	16.8
District Assembly Professionals	32	25.6
Working experience	**Response received**	**%**
0–5 years	23	18.4
6–10 years	26	20.8
11–15 years	14	11.2
16–20 years	28	22.4
21–25 years	18	14.4
Above 26 years	16	12.8

4. Results

The literature review aided gap identification and hence relationship with the methodology, analysis and conclusions. The main problem is that sustainable renovation which covers installation of sustainable technologies and systems in existing buildings requires leadership to ensure success. Another concern is that many organisations, clients, and so on, are to some extent unaware of factors that influence selection of project managers for sustainable renovation projects. The conceptual framework provides adequate theoretical foundation. The benefits of the framework and the findings are that the role of a project manager, as a leader, is grounded in the literature. In this regard, competency in managing day-to-day onsite activities including team management, technologies, materials, and so on, is addressed. The study highlights continuous professional development of PMs on sustainable construction. By so doing, capacity to keep track of the effects of renovation on the environment is enriched. Consequently, actions to reduce carbon emissions to support environmental needs and well-being are adopted and implemented. The demographic results are presented in Table 2. Calculated means provide the descriptive analysis of the study for detailed and further analysis, based on the maximum and minimum values are presented in Table 3. The standard deviation estimates become relevant as that formed the basis of the ranking of similar means.

Table 3. Factors influencing selection of green renovation project managers

S/N	Factors	Mean	SD	variance	Rank
1	Academic qualification	4.88	0.853	0.7276	1st
2	Working experience	4.44	0.769	0.5914	4th
3	Relationship with clients	3.94	0.667	0.4449	13th
4	Human relations	3.52	0.718	0.5155	21st
5	Conflict management skills	3.72	0.832	0.6922	17th
6	Work effectively in a team	4.24	0.891	0.7939	8th
7	Records of project delays	4.18	0.946	0.8949	10th
8	Payment history	3.85	0.862	0.743	14th
9	Records of cost overrun	3.45	0.684	0.4679	22nd
10	Availability of funds	3.36	0.734	0.5388	23rd
11	Safety records	4.01	0.647	0.4186	12th
12	Green renovation projects managed	4.75	0.854	0.7293	2nd
13	Green certified	3.56	0.733	0.5373	20th
14	Interest in continuous green training	3.65	0.688	0.4733	19th
15	Understanding energy and Co2 emission savings	3.70	0.721	0.5198	18th
16	Cleaner construction records	4.23	0.869	0.7552	9th
17	Size of green renovation project	4.56	0.987	0.9742	3rd
18	Understanding of green renovation	4.36	0.88	0.7744	6th
19	Experience of workers	3.02	0.897	0.8046	24th
20	Type of technology for renovation	3.74	0.875	0.7656	16th
21	Quantity of technologies involved	3.81	0.779	0.6068	15th
22	Location of project	4.25	0.722	0.5213	7th
23	Cost of project	4.09	0.86	0.7396	11th
24	Project duration	4.41	0.786	0.6178	5th

4.1. Factors influencing selection of green renovation project managers

Table 3 presents the overall results of the study on the factors that influence selection of PMs for energy retrofit projects. The Table presents the factors, mean, standard deviation, variance, rank, p-value and the hypothesis. The aim of the study is to identify the best criteria that influence selection of project managers. The concept of green renovation is new hence the study argues for a system that can be used to select project managers to ensure efficiency and reduce project delays. Many conflicts on site can be controlled through the selection of the qualified project managers.

In all, 24 factors were affirmed after the initial pilot study that identified over 30 variables. The pilot study reinforced the initial data by contributing to the rejection and modification of variables. Table 3 presents the factors that influence the selection of project managers or consultants. Academic qualification (mean = 4.88), green renovation projects managed (mean = 4.75), size of new green renovation project (mean = 4.56), working experience (mean = 4.44), project duration (mean = 4.41), understanding of green renovation (mean = 4.36), project location (mean = 4.25), work effectively in a team (mean = 4.24), cleaner construction records (mean = 4.23) and history of delays (mean = 4.18) ranked from 1st to 10th in that order. Least ranked factors include quantity of technologies involved (mean = 3.81), type of technologies (mean = 3.74), green certification (mean = 3.56), availability of funds (mean = 3.36) and experience of workers (mean = 3.02). The mean distribution of the main factors is presented in Figure 4.

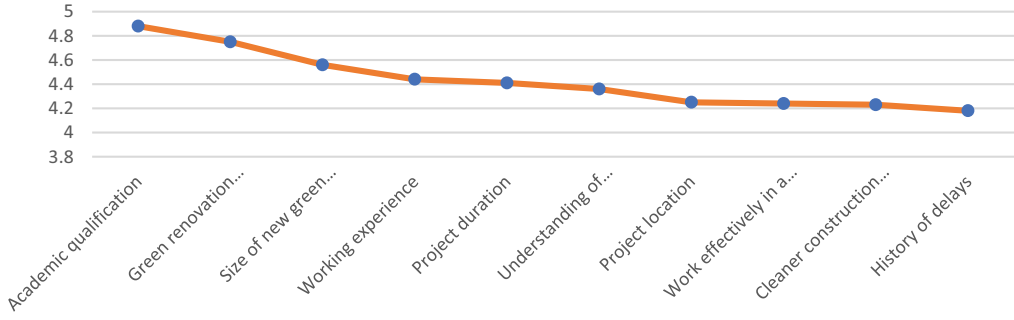


Figure 4. Mean distribution of main factors.

Also, Table 3 highlights conflict management skills, records of cost overruns and interest in continuous green training. The concept of green certification has not received much attention in developing countries compared to the developed. Hence, this results reflects the lack of understanding of green certification. Cost overruns is often regarded the domain of the quantity surveyor and not the project manager or consultant. It is evident the respondents considered cost overruns as a criteria however not as relevant as team management skills and academic qualifications.

Many variables influence the selection of project managers in various aspect of the construction industry. Often past experience relating to projects managed, the type of project among many others influence selection. However, the literature presents inadequate selection criteria for project managers for sustainable renovation. This study bridges the existing gap in the literature by addressing the problem that has existed for a long time. By the results, concept of energy efficient renovation is explored and tied to the goals of environmental sustainability. Chi-square test was employed to test significance in nominal responses provided by all the participants. This is necessary for this kind of study to establish the level of significance of factors that influence selection of project managers for green renovation projects. Hence, the decision of the analysis is that factors affecting selection with p value is less than 0.05 ($p < 0.05$) is statistically significant, the factors which p value is greater than ($p > 0.05$) not significant. Chi-square test results confirm the rejection of the null hypothesis that the factors do not affect selection of project managers for green renovation projects.

Table 4. Chi Square analysis

S/N	Factors	Chi Square (X^2)	df	Df/X^2	p-value
1	Academic Qualification	37.65	4	0.1062	0.0021[a]
2	Working experience	54.82	1	0.0182	0.0011[a]
3	Relationship with clients	68.23	3	0.0439	0.0002[a]
4	Human relations	45.92	2	0.0435	0.0032[a]
5	Conflict management skills	61.34	3	0.0489	0.0020[a]
6	Work effectively in a team	18.37	2	0.1088	0.0040[a]
7	Records of project delays	27.22	3	0.1102	0.0001[a]
8	History of payment	63.08	4	0.0634	0.0031[a]
9	Records of cost overrun	60.29	3	0.0497	0.0002[a]
10	Availability of funds	56.71	2	0.0352	0.0001[a]
11	Safety records	66.88	2	0.0299	0.0021[a]
12	Green renovation projects managed	19.65	3	0.1526	0.0014[a]
13	Green certified	40.36	3	0.0743	0.0031[a]
14	Interest in continuous green training	52.15	3	0.0575	0.0008[a]
15	Understanding of energy and CO2 savings	69.04	4	0.0579	0.0001[a]
16	Cleaner construction records	57.23	3	0.0524	0.0700[a]
17	Size of green renovation project	68.62	3	0.0437	0.0003[a]
18	Understanding of green renovation	62.06	2	0.0322	0.0004[a]
19	Experience of workers	87.66	2	0.0228	0.0003[a]
20	Type of technologies involved	56.38	1	0.0177	0.0000[a]
21	Quantity of technologies involved	47.15	3	0.0636	0.0003[a]
22	Location of project	59.52	4	0.0672	0.0005[a]
23	Cost of project	49.55	3	0.0605	0.0009[a]
24	Project duration	65.38	2	0.0305	0.0011[a]

Note: [a]At the 95% significance level.

Table 4 shows that for each of the independent variables $X^2est > X^2\beta$ at $p < 0.05$. This implies that the factors do affect selection of project managers hence rejection of the null hypothesis. There is a strong statistical relationship between the variables and selection of project managers. Details of the variables are presented in Figure 6 under four main sections. The study argues that the selection should consider personal traits, green renovations history, construction characteristics and project management records. Academic records, ability to serve as a team player, human relations etc., are under personal traits. Green renovations include history of renovations handled, understanding of the concept of green renovation, interest in continuous green training.

In all, 23 variables were assessed suitable for use in the selection of the PMs for green renovation projects. However, "cleaner construction record" had a p-value of 0.0700 > 0.050, thus was rejected as a factor that influences the selection of PMs. It is clear the respondents may not have clearly understood the meaning of the variable which represents cleaner production—that is any form of production that presents minimal environmental effects. The position is that project managers should have successfully delivered cleaner construction works to be considered for green/sustainable renovation positions. Other variables such as location, cost, duration and

expertise of workers ($p < 0.05$) indicate the relationship between past and new projects. Undertaking new renovation works demand careful assement of supply positions in relation to the location of a project. For example, cities centers/urban areas provide minimal space for transportation, delivery and storage. For such conditions, a project manager is expected to anticipate worse case scenarios and plan appropriately. Therefore, having a better understanding of a sustainable renovation location improves the functions of a PM. The p-value of 0.05 means the respondents agree that the null hypothesis should be rejected. Being rejected means the factor is critical to the selection of a PM for sustainable renovation projects.

5. Discussion

Academic qualification provides detailed information about the level or expertise of project managers. According to the results in Tables 3 and 4, the respondents consider training and academic background as vital criteria that should influence selection of project managers. To be successful at the expression of interest stage of a tender process, a consultant or project manager should present required and expected qualifications. Project managers without the appropriate qualification tend to perform poorly thereby negatively impacting the project in terms of cost, quality and safety (Van Tam et al., 2021). Critical verification of training and other forms of training in line with construction management ensures that delays and project failures are avoided (Alvarenga et al., 2019). The concept of green renovation makes the issue of academic qualification important as it is a unique area, new and relates closely with CO_2 emissions. The uniqueness of green renovation makes it necessary to have evidence of past projects managed and the level of success achieved. Having the qualification does not guarantee selection, however being able to present details of green renovation managed in the past presents a positive outlook.

Clients are often interested in the number of green renovation projects managed and the success rate. The respondents agree the nature of energy retrofit projects undertaken, records of systems adopted and the energy savings obtained should impact selection of PMs. The aim of the study is to ensure that PMs have the required expertise to manage people as an ineffective team is likely to fail. A lack of the necessary expertise tends to contribute to coordination challenges that could impact the overall cost of a project. Given the technologies adopted and the volume of works executed, clients are presented with the necessary data to aid decision making processes. On many sites, job complexity, goals and varying team members tend to trigger conflicts. Conflict management is the process of implementing steps that tend to identify the sources of conflict and strategies to control likely effects. The results show that a project manager's ability to control conflict is a necessary requirement. Often, this can be traced from previous projects undertaken and experiences from colleagues and workers. Studies indicate a relationship between effective conflict management and project performance as presented by Wang et al. (2022). Effective conflict management works in tandem with the ability of a project manager to work effectively in a team. This implies that the factors are interrelated as indicated in the conceptual framework in Figure 6. The success of a project is often a balance between all the leadership skills, team building and conflict management (Ojiako et al., 2021). Figure 6 shows all the variables as an expanded version of Figure 2.

The results indicate the size of green renovation as a factor that motivates selection of project managers. Identifying size of projects handled or managed by a potential project manager provides basis to connect experience gained to a new project. Sometimes new projects can be complex particularly energy conservation renovation projects, thus the size also relates to experiences and selection decisions (Hadad et al., 2013; Michałowski et al., 2021). For example, a project manager with no retrofit experience of pumps, motors, chillers, boilers and cooling tower systems may not be able to handle similar projects effectively. The results show that working experience of a project manager is critical to the success of a sustainable renovation project. This is highlighted in the concept of project management and connects strongly with the level of expertise of a project team as indicated in Table 3. In construction, learning experiences occur more or less in a team, nature of the job, skills, available support systems and the nature of client. The results indicate potential to improve the importance of integrating sustainable renovation in the overall

concept of sustainability and project management consistent with findings by Stanitsas and Kirytopoulos (2021a). There is a positive relationship between project methodology elements and the characteristics of project success. However, environmental factors, notably project governance, influence the use and effectiveness of a project methodology and its elements with a resulting impact on the characteristics of project success (Dadzie et al., 2012; El-Sayegh et al., 2021). Identifying all the important variables that influence a project promotes knowledge management of skills of PMs (Marinho & Couto, 2022).

A PM's ability to understand the functions and installation procedures of a sustainable technology is vital for the success of a green renovation project. For example, introduction of the underfloor air distribution system to ameliorate indoor air quality and reduce energy requires specialised skills due to the complex nature of the technology. A post occupation observation on the New York Times Building was that software-based features for finetuning the control systems that properly fitted impacted occupant satisfaction, ease of facility maintenance, operations and better building performance (Lee et al., 2013). This implies that the technical skills of the PMs contributed to the increase in the overall building performance. Also, Crespo et al. (2016) discussed design and monitoring of a micro-cogeneration facility located at the University of Vigo. The complex nature of the facility required proper documentation of all the technical details. Accordingly, the final material was converted into a teaching document to train research students.

5.1. Implications for Practice

Project managers play significant roles in the day-to-day management of green renovation projects. Majority of the works are focused on initiation, execution and control of all the activities of a project. Thus, project delivery depends on the competency of a PM which is often established at the selection stage. Moreover, the concept of sustainable renovation is critical to reducing energy demand as fossil fuel continue to dominate renewable energy sources. The practical implication is that a framework has been established to aid decision making processes throughout the preconstruction life cycle of sustainable renovation projects. Also, the variables serve as a policy tool that can be adopted to ensure that majority of green renovation projects are properly managed. By doing so, attention is shifted to renewable energy sources and systems to reduce carbon emissions. In addition, clients, institutions,

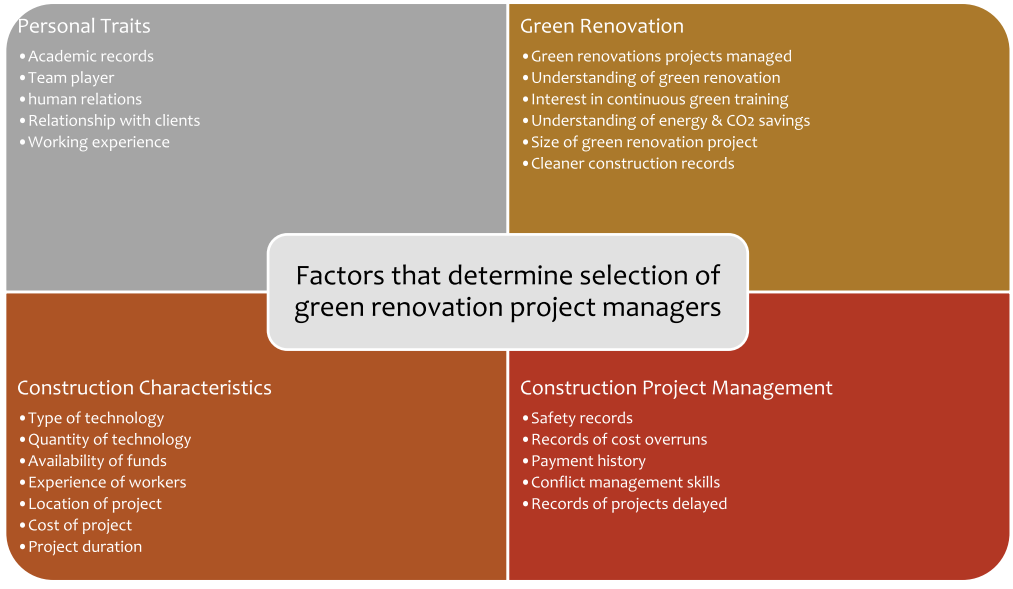
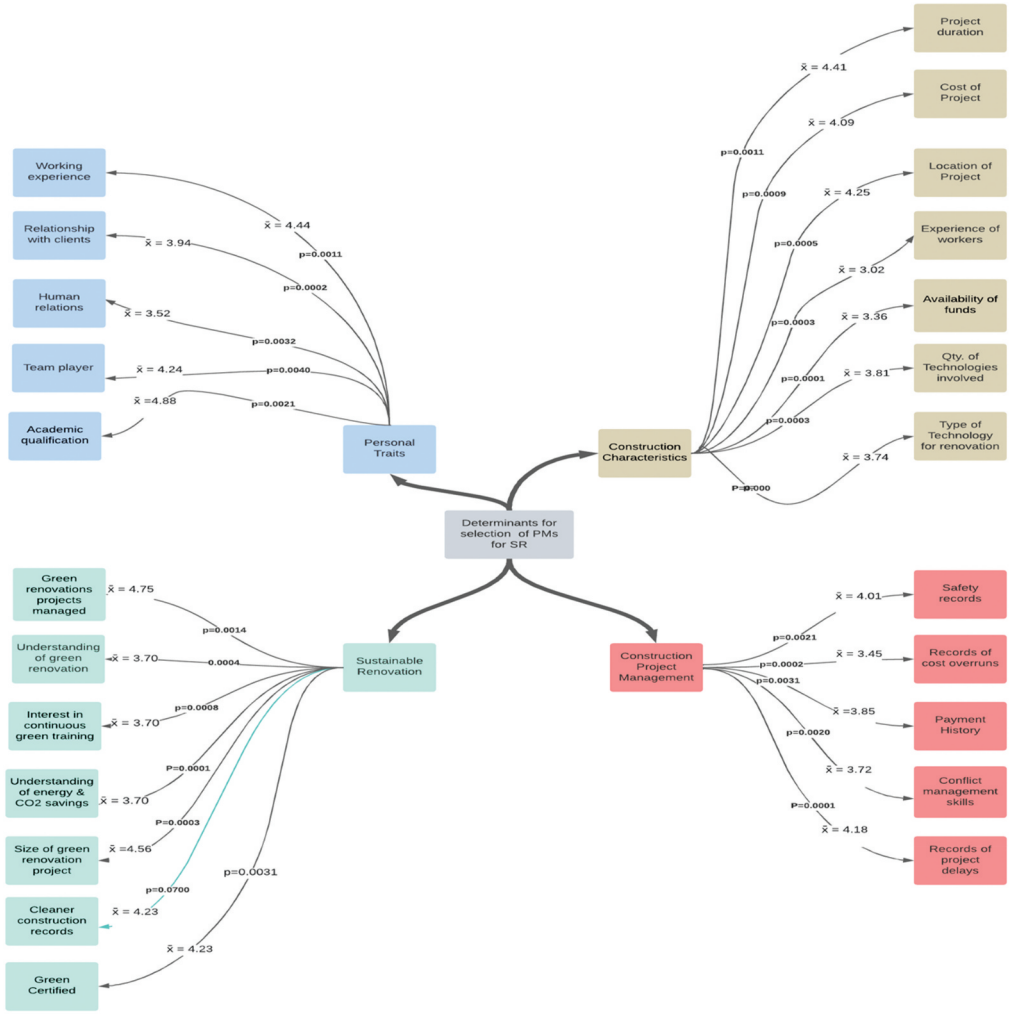


Figure 5. Green renovation PM selection Criteria.

Figure 6. Flowchart of established relationship.



agencies, government institutions, researchers etc. are provided with a theoretical structure to support teaching and learning and renovations decisions. The overall target is to ensure that sustainable technologies yield positive results. Given the nature of the job of PMs, identifying factors that can influence selection for energy saving projects is critical to the global economy. The findings are relevant as that indicate extent to which the concept of sustainability triggers employment through research. Consequently, as the factors are enforced through policy and regulations, awareness is created. Thus, interview panels and project coordinators are informed of the criteria to consider for sustainable renovation projects.

6. Conclusion

Past studies on selection of project managers are focused on conventional buildings, with no clear evidence of any concept that addresses green renovation. Indeed, the literature presents a lack of information on the factors that influence selection of project managers for green renovation. The main aim of the study is to investigate factors influencing selection of project managers for energy conservation refurbishments. The literature review provided secondary data of various factors although there is inadequate information on energy retrofit and selection of project managers. A survey design in the structure of a questionnaire ensured factors that influence selection of project managers are identified and investigated. As presented in Table 3, the main factors include academic qualification, green renovation projects managed, size of green renovation project, working experience, project duration, understanding of green renovation and project location.

The findings fill the gap in the literature and provide data for the selection of project managers. Policy makers are provided with a tool to follow in relation to appointment of project managers or consultants for green renovation projects. The study argued for improved relationship between the requirements of a PM and the success of sustainable renovation projects. Given the conceptual framework developed to guide the study, the findings in Figure 5 and Figure 6 ultimately confirm the main themes that were established. The framework was expanded to match determinants for selection of project managers.

7. Future research

The theory of green renovation of existing buildings is highlighted as factors that influence selection of project managers are identified. Further research is required to ensure effective project management by designing appropriate weighted average to develop a matrix rating tool. A green renovation selection tool for project managers is likely to strengthen the theory of sustainability and sustainable construction. Also, a mixed method approach can deliver diverging views that introduce new findings as compared to a quantitative approach. A qualitative aspect of the study is likely to produce interesting findings as non-numerical results aid understanding of the societal benefits of green renovation. Investigating reasons supporting decisions that influence selection of PMs using interviews, case studies and in-depth observation may unravel new concepts that are ignored in a survey questionnaire approach. A large scope of a comparative study of different countries can deepen the understanding of green renovation.

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