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Stakeholder, Knowledge Dynamics and Sustainability of Commercial Building Projects in Nairobi City County Kenya

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Abstract

The construction industry contributes to social-economic development of countries worldwide. However, building projects account for 32 per cent of energy demand and 34 per cent of carbon emissions globally. Although transitioning to sustainable construction practice can mitigate the challenges, the process is slow especially in developing countries. The study purposed to examine stakeholder and knowledge dynamics and their influence on sustainability of building projects and was anchored on diffusion of innovation and stakeholder theories but moulded on positivism philosophy in addition to descriptive and explanatory design. The study population was 40 high-rise commercial building projects completed between the years 2016 and 2020 in Nairobi City. Census technique was adopted, and 240 respondents took part whereas 183 returned completed questionnaires. Descriptive and inferential analysis including hypothesis and diagnostic tests using SPSS Statistics version 26 were performed. The outcome indicated that stakeholder collaboration was moderate, but stakeholder dynamics influenced sustainability and had significant positive relationship with sustainability (b=.198, p=.000). Similarly, knowledge dynamics had significant positive association with sustainability (b=.450, p=.000). However, awareness of benefits was found to be moderate. The study outcome benefits the industry stakeholders, academia as well as policy makers in crafting relevant policy directions to positively impact the industry.

Keywords: Building Projects, Sustainability, Knowledge Dynamics, Stakeholder Dynamics, Sustainable Construction

Introduction

Construction as an industry has become one of the key sectors for socio-economic development globally (Almeida *et al.,* 2016). According to International Labour Organisation (ILO) (2019), the industry is a major contributor to global gross domestic product (GDP) and provides employment to approximately 7 per cent of the working population worldwide. Kenya National Bureau of Statistics (KNBS) (2024) indicates that the construction sector contributes 6.6 per cent to the GDP and provided employment to over 226 thousand jobs under the private sector and over 10 thousand in the public sector.

However, most construction projects require large capital, consume large amounts of energy and natural resources besides generating waste and emitting gases that harm the environment (UNEP, 2024). In mitigating construction challenges, sustainable construction practice has emerged as an innovation in the industry and delivers high performance buildings projects (Enshassi, Kochendoerfer & Ghoul, 2016). According to Bamgbade, Kamaruddeen, and Nawi (2015), sustainable construction has evolved from the key concepts of environmental, social and economic pillars of sustainable development model. Sustainable construction is therefore a process through which the construction industry contributes to sustainable development goals notably, goals 7 and 11 on energy efficiency and sustainable cities and communities respectively (UN, 2015).

The essence is to ensure efficiency in utilisation of resources and reduction of impact on human health and the environment throughout the life cycle of the project (Iyengar, 2015). According to Adebowale *et al.* (2019), sustainable building projects are integrated designs that optimises interconnected issues including choice of site, specific climatic considerations, form, shape and orientation of the building, lighting and thermal comfort systems, and material choice in their design, construction, management and deconstruction. Conversely, Chukwu *et al.* (2019) aver that sustainable building projects are healthier and use more resource efficient standards of construction, operation maintenance, renovations and deconstruction. The construction process which accommodates these elements focuses on environmental, social and economic pillars of sustainable development resulting in an innovative concept in the industry (Mensah & Casedevall, 2019). Hitherto, practitioners have relied on the convention system of delivering building projects that hinged on quality, time and budget as measures for success disregarding their effect on environment, social and economic aspects (Akadiri & Olomolaiye, 2012). However, Opoku and Fortune (2013), found that the requirement for sustainable development globally has led to the demand that the construction industry adopts sustainable construction practices as a method of providing building projects that are compliant to sustainability requirements.

Knowledge and Stakeholder Dynamics

According to Khaemba and Mutsune (2014), stakeholders in the construction industry in developing countries are advancing interest in sustainable building projects. Equally, Kanyaura and Mokaya (2015) acknowledge that developing economies are gradually joining the league of countries adopting sustainable construction practice. However, transformation to sustainable building projects has registered slow progress (Opoku, Ayarkwa & Agyekum, 2019; and Chan, Darko, Olanipekun & Ameyaw, 2018). Tunji-Olayeni, Kajimo-Shakantu and Osunrayi (2020) posit that provision of sustainable building projects is driven by key dynamics.

Various researchers have identified some of these dynamics as knowledge and stakeholder dynamics (Oke *et al.*, 2019 and Darko, Zhang & Chan, 2017).

Stakeholder Dynamics

Construction industry stakeholders have a major part to play in the acceptance of sustainable construction process as they can exert pressure and influence the outcome of any enterprise (Eijia-Botwe, 2016). Furthermore, the interaction between construction activities and the environment must be safeguarded through ethical responses, which concerns what humans ought to do and aims on behaviour, practices, and character traits humans ought to attain even if they are difficult (Palmer, McShane & Sandler, 2014). Additionally, Abidin and Powmya (2014), recognised climate change mitigation, health and safety, and conservation of natural resources as indicators engineered by stakeholders. Moreover, Akadiri and Fadiya (2013) and Low, Gao and Tay (2014) assert that pressure from market forces and international conventions to implement and report on agreed milestones especially in providing effective protection for the environment is ethical and an innocuous approach to avoiding violation of laws and regulations.

Knowledge Dynamics

According to Smit and Toit (2015), knowledge of the benefits of sustainable building projects should be made available to key stakeholders in the industry to effect change and stimulate implementation. Whereas sustainable construction process has advantages over the convention practise, industry stakeholders ought to be aware of them to embrace the new process (Zhang, Olanipekun & Bai, 2019). Moreover, Shi *et al.* (2013) stated that knowledge and understanding of sustainable construction benefits by stakeholders needs further development to drive implementation. Equally, Darko, Zhang, and Chan (2017) identified knowledge and awareness as key external dynamics. Additionally, Were, Diang'a, and Mutai, (2015) recommended scaling up education and training in addition to provision of funding for research in sustainable construction to grow implementation of sustainable building projects.

Commercial Building Projects

The primary aim of commercial building projects is to generate income; hence their performance standard must be very high (Collins, Junghans & Hugen, 2018). However, this building type incurs higher operational costs during occupancy (Goh & Sun, 2015). Operational costs associated with them varies between 72 and 81 percent of the total life cycle cost of the project (Wong, Perera and Eames, 2010). Collins *et al*. (2018) states that 30 percent of these costs are attributed to energy which can be easily controlled through incorporating sustainable design features. According to Hyland, Lyons, and Lyons (2013), building projects that demonstrate efficiency in energy utilisation can influence both sales and rental prices positively once they transition to operation phase.

The Kenyan construction industry has grown in the past few years due to attempt by government to lower construction costs through financial and non-financial incentives and the entry of institutional developers as well as increased foreign investment in the industry (Cytonn, 2017). However, the industry has faced challenges, including low completion rates, fragmented policies, laws, and regulations in the built environment besides low technological uptake (GoK, 2018). Moreover, the industry is faced with emerging issues including climate change, technological advancement, globalisation, and competition from foreign firms that

have embraced technological advancements (GoK, 2016a). Consequently, actions related to building projects have been captured in the national adaptation plan and other policy documents as nationally determined contributions (NDCs) (UNEP, 2019 & UNEP, 2020).

Nairobi City County has experienced a surge in the development of commercial building projects. For instance, according to Jones, Lang and Lasalle (2016) additional 160, 000 square metres of commercial space was delivered in the year 2016 alone. Moreover, demand for commercial space has continued to grow due to the city being a regional hub and the growth of professional services that demand high-grade office spaces (Cytonn, 2017). Some demands originate from multinational firms setting up regional offices in the city and require sustainable office spaces with an emphasis on environmental sustainability and affordable running costs besides creating a healthier user environment (Cytonn, 2018). According to Jones, Lang and Lasalle (2016), the influx of commercial buildings resulted in commercialisation of Upper Hill and Westland zones which were previously residential areas. The rapid transformation demands close management to safeguard environment and ensure efficiency in energy utilisation from inception to completion and operation of the building projects (UN-Habitat, 2010).

The Problem Statement

Globally, building projects account for 32 per cent of energy demand besides 34 per cent of carbon dioxide (CO_2) emissions (UNEP, 2025). Considering buildings are responsible for such high energy demand worldwide, efficiency in energy utilisation becomes key in determining sustainability of building projects (Morrissey, Dunphy & MacSweeney, 2014). Kitio (2018) estimates that over 70 per cent of available energy in the African continent is consumed by cities, while up to 50 per cent of national energy is consumed by capital cities. Additionally, 56 per cent of total national electricity consumption in the continent is attributed to buildings (Kitio, 2018). Butera, Adhikiri, and Aste (2014) estimate that by the year 2050, developing countries will account for 75 per cent of the new building stock thus energy demand will continue to rise.

According to Kenya Institute for Public Policy Research and Analysis (KIPPRA) (2018), commercial clients in Kenya consume about 70 per cent of available electricity. At the same time, the construction industry is set to grow steadily, with the building stock expected to increase to approximately 47 million square metres in the next decade (Chekata, 2018 & GoK, 2020). As a result, KIPPRA (2018) envisages increased demand for energy to service the new building projects. Buildings in Kenya have a high energy demand for lighting and cooling due to their tropical climatic settings. Consequently, the government has developed a strategic plan in which a key objective is to advance sustainability in the construction industry and targets to green 75 per cent of new and renovated public and large-scale private building projects by 2030 (GoK, 2016a). Despite planned strategy and other policy measures, most modern building projects are not planned to fit local climatic context in addition to building materials used have high inbuilt energies (GoK, 2020). Accordingly, non-compliance will lead to higher energy utilisation especially for space cooling to achieve satisfactory performance of the built form (UN-Habitat, 2010). Inefficient design and construction combined with inadequate materials, lack of thermal comfort considerations, as well as inadequate passive design principles results in building projects that are heavily reliant on artificial resources for provision of indoor comfort hence high energy consumption (Butera, Adhikari, & Aste, 2014).

Despite government strategic plans, and regulatory institutions, most new building projects in the city are conventional and lack sustainability features (GoK (2016b). Were, Diang'a, and Mutai (2015), reported that implementation of sustainable building projects is still very low. In addition, Green Building Information Gateway (GBIG) (2020), reported that from over 205,000 LEED-certified buildings globally, Kenya recorded only 5 while USA recorded over 137,000, UK recorded over 18,000, China recorded over 4,000, and South Africa recorded 21 green certified building projects. Conversely, Duggan and Goatman (2020) in assessing the African scenario report that over 700 building projects have been certified green across the continent and Kenya recorded 21 while South Africa recorded over 600. Hence the growth of sustainable building projects is slow, especially in developing economies, Kenya included. To accelerate the growth, it is pragmatic that underlying dynamics and their influence on sustainability of building projects be carefully examined. Sustainable construction practise as a delivery system for sustainable building projects has a potential of providing a cleaner environment and efficient resource utilisation in addition to addressing social-economic expectation of key stakeholders.

Previous studies identified, classified and occasionally ranked dynamics of sustainable building projects but did not determine their association with sustainability (Oke *et al*., 2019; Darko, Zhang & Chan, 2017 and Windapo, 2014). Moreover, despite studies having been carried out on drivers for sustainable building projects, limited attempts have been made in developing countries (Chan, Darko, Olanipekun, and Ameyaw, 2018). Consequently, the study purposes to examine key construction dynamics, that is stakeholder and knowledge dynamics and their influence on sustainability of commercial building projects in Nairobi City to help in proliferation of sustainability in building projects. If the current trend continues, the city will be infiltrated with unsustainable and inefficient building projects that will exhaust scarce resources and harm the natural environment. The outcome of the study will benefit industry practitioners, policymakers and academia in charting the future for sustainable development.

Objectives of the Study

The general objective of the study was to examine stakeholder and knowledge dynamics and their influence on sustainability of commercial building projects in Nairobi City County, Kenya. Specifically, the study purposed to examine the influence of stakeholder dynamics as well as investigate the effect of knowledge dynamics on sustainability of commercial building projects in Nairobi City County, Kenya.

From these specific objectives, the null hypotheses were derived as follows:

H_{o1}: *Stakeholder dynamics have no significant influence on sustainability of commercial building projects in Nairobi City County, Kenya.*

H_{o2}: *Knowledge dynamics have no significant effect on sustainability of commercial building projects in Nairobi City County.*

Significance of the Study

Firstly, the study findings are of significance to the construction industry players including developers, project managers, professionals, and the consumers. Secondly, the findings are of benefit to policymakers since the study outcome can be used to redesign and implement policy to improve the built environment. Lastly, the results contribute to the project management knowledge area specifically on sustainability of building projects in a developing economy.

Scope of the Study

The study focused on high-rise commercial building projects completed in Nairobi City County between the years 2016 and 2020. This period had witnessed an influx of modern commercial building projects within the central business district and a migration to Upper Hill and Westland areas which had previously been predominantly residential areas. The study was conducted between October 2023 and February 2024.

Literature Review

Theoretical Review

The Diffusion of Innovation Theory

Research on diffusion of innovation can be traced back to studies by Rogers in 1960 that developed into production of "Diffusion of Innovation Theory" (Sharma & Misra, 2014). According to Mahat, Tah, and Vidalakis (2016), diffusion is a process that communicates new products, ideas or practice to social systems through certain channels over a period. While innovation is a product, idea or practice perceived as new by a unit of adoption (Rogers 2003). Consequently, diffusion of innovation is a process through which a new product or idea is communicated amongst members of a social system through specific channels over time (Rogers, 2003). According to Rogers (1995), the theory consists of five stages commencing with acquisition of awareness and knowledge leading to persuasion, then followed by decision, implementation, and finally confirmation. The current study considered sustainable building projects as paradigm shifts from the conventional building process, hence a new model in the industry (Mahat, Tah & Vidalakis, 2016).

Rogers (2003), posits that the spread of a new product is controlled by its perceived characteristics as well as the adopters, the social system, communication channels and timelines (Rogers, 2003). Moreover, the character of the new product is determined by its relative economic and social advantage over the product it is replacing. Sustainable building projects are considered to have relative advantage over conventional building projects (Yudelson, 2006). However, the process of implementing sustainability in building projects is much slower (Idris, Ismail & Hashim, 2015). According to Riazi *et al*. (2020), the slow speed of implementation is attributed to the character of the construction industry which is highly fragmented because of specific and specialised nature of each project.

The theory has been applied to various disciplines including education research, agriculture, public health, marketing, and communication (Taherdoost, 2018 and Dearing & Cox, 2018). Further, the theory has been applied considerably in the construction industry (Mahat, Tah & Vidalakis, 2016 & Mustapha, 2006). For example, Yudelson (2006) applied the theory to predict the development of sustainable building projects in the USA. Mollaoglu, Chergia, Ergen, and Syal (2015), aver that diffusion of sustainable building project guidelines in developing countries displays alignment with Rogers (2003) model. Consequently, the current study benefitted immensely from diffusion of innovation theory since the purpose of the study was to examine knowledge dynamics, a communication channel in the theory process and how they influence sustainability in building projects. Knowledge and awareness are key constructs in the current research and diffusion is considered a function of awareness and persuasion leading to adoption decision.

Stakeholder Theory

Stakeholder theory is derived from the term stakeholder which was unveiled by the Stanford Research Institute in 1963 to counter the notion that businesses were exclusively influenced by shareholders (Freeman, 1984; Mok, Shen, & Yang, 2015; Eijia-Botwe, 2016). The fundamental argument of the theory stipulates that the outcome of any organisation is controlled by the input of various interest groups (Sciarelli & Tani, 2013). According to Donaldson and Preston (1995), the theory can be viewed from descriptive, instrumental and normative perspectives. The descriptive perspective is critical for identification of key stakeholders and their interaction with the organisation (Henjewele, Fewings, & Rwelamila, 2013), while the instrumental perspective safeguards association between management process and successful performance of organisations (Amaeshi, 2010). The normative perspective stipulates that the theory is rooted in norms and traditions that assign stakeholders legitimacy on activities of the organisation. According to Donaldson and Preston (1995), from this latter perspective, stakeholders can influence the outcome of organisational objectives, or the organisations can affect the status of their stakeholders. The current study was anchored on the normative perspective as the functions of planning, designing, construction and management of sustainable building projects is a process that requires the engagement of multiple participants with diverse interests and incorporates the wider society (Freeman, 1984; Jones and Wicks, 1999).

According to Atkin & Skitmore (2008), the theory is applicable in numerous disciplines including construction project management despite having its origins in strategic management. Hence, stakeholders can influence successful delivery of construction projects as their expectations are addressed through the project life cycle (Cleland, 1995). Lundin and Soderholm (1995) and Packendorff (1995), state that projects are temporary organisations, and their success is influenced by the participation of diverse groups or individuals. The current study was viewed through the stakeholder theoretical lens since the success of any construction project is influenced by the contribution from several participants. Subsequently, stakeholder dynamics was a major study variable.

Empirical Review

Sustainability of Building Projects

Factors influencing sustainability of building projects can be investigated from economic, social, and environmental pillars (Tayeh, Aisheh, and Abuzuhri, 2020). Furthermore, most green building rating systems consider energy efficiency as critical measure for sustainability yet hardly attained while water efficiency and indoor air quality are achieved more successfully (Berardi, 2011).

In view of fast-tracking implementation of sustainable practice in Nigeria, Olawumi and Chan (2020) prepared a framework for evaluating sustainability of building projects. The framework study included conceptualisation, case studies, and expert survey resulting in validation of the findings. The expert survey was carried out to ascertain validity and suitability of the instrument. Twenty experts including architects, engineers, project managers, quantity surveyors, estate valuers, contractors, and academicians submitted valid responses. Furthermore, the framework was subjected to construct and content validity and found to be comprehensive, credible, and appropriate. The study focused on development and validation

of a framework but neglected to evaluate factors influencing the production of sustainable building projects.

Tayeh, Aisheh, and Abuzuhri (2020) carried out a study in Gaza Strip targeting consultants to examine determinants of sustainability performance of building projects during construction phase. From the survey which registered a response rate of 88.57 per cent, 55 variables were subjected to factor analysis resulting into 3-factor clusters of economic, social, and environmental pillars. The study further reduced the initial 55 identified factors to 31. Only factor analysis was carried out thus the study did not determine association between the identified factors. The current research carried out multiple regression analyses to examine association and magnitude of influence between the study variables.

Awuzie, Monyane, Koker, and Aigbavboa (2021), evaluated dynamics of environmental sustainability performance of construction projects in South Africa. The study was limited to descriptive statistics and the finding indicated that the level of awareness was considerably high among stakeholders while other drivers for sustainable practice notably; policies, waste management, sustainable materials, and water and energy efficiency were highly regarded. This study focused on environmental sustainability pillar only while the current research considered all three pillars of sustainability. Moreover, the study analysed data at the level of descriptive statistics only therefore failing to determine association between variables.

Stakeholder Dynamics and Sustainability

Every so often stakeholders make demands on matters which they profess to be important as well as urgent to them usually influenced by perceived tangible and intangible benefits (Sripun, Yongvanit, and Pratt, 2017). Darko, Chan, Owusu-Manu and Ameyaw (2017) investigated major determinants for acceptance of sustainable building technologies. Twenty-one drivers were identified from literature review and formulated into research instrument. International experts submitted 104 valid responses from which descriptive and inferential analyses were carried out. From the initial 21 drivers identified, 13 were observed to be statistically significant from *t*-test of mean values. Although experts were drawn from various international backgrounds, Kendall's concordance test recorded consensus in the ranking of the drivers. Additionally, Mann-Whitney U-test indicated that there were no significant differences in the ranking of drivers. The study reported efficiency of water and energy utilisation during and after construction, reduced environmental impact, and provision for health, comfort, and satisfaction of occupants as key drivers. These are stakeholder-related indicators accordingly classified as stakeholder dynamics. Despite identification of drivers, this study failed to examine relationship between the drivers and sustainability of building projects.

Opoku *et al.* (2019) investigated impediments to environmental sustainability of construction projects in Ghana. Thematic data analysis was carried out and the top findings recorded were external pressure and response to local environmental conditions. This was a qualitative study and unit of analysis was limited to 7 consultants; as a result, the relative importance and significance of the variables identified was not tested statistically.

Tunji-Olayeni *et al.* (2020) examined drivers, practices and policies that influence adoption of sustainability among construction industry practitioners in Nigeria. The study focused on

determining fundamental issues that would encourage growth of sustainable construction practice. Based on qualitative design, 15 professionals were orally interviewed, and data analysed through descriptive statistics in addition to thematic analysis. The study reported demand from clients, pressure from the international groups, the need to give back to society through corporate social responsibility, competition among firms, and cost-effectiveness to sustain business as key drivers. While the study identified key drivers mostly stakeholder-related, it failed to validate the identified drivers since it was more exploratory in nature. Descriptive statistics as well as thematic analyses are limited and do not validate association between variables.

Knowledge Dynamics and Sustainability

Azeem *et al.* (2017) examined impediments and promotional measures for acceptance of green building practices in Pakistan. The variables were identified after extensive literature review listed 30 barriers and 12 measures that formed part of the survey questionnaire. The study findings ranked lack of awareness as the top barrier whereas the most significant measure was identified as conception of public awareness. Moreover, factor analysis was carried out and a 5-factor component that accounted for high percentage of the total variance was recorded. For some reason awareness was not listed in any of the factor clusters although it ranked high in the mean score ranking. The promotional measures were not subjected to any further analysis. The outcome of this study required further investigations to determine why awareness missed out in the factor extraction process yet was highly rated in mean score. Olawumi and Chan (2020) evaluated major drivers for implementation of smart and sustainable construction practices amongst 220 participants from 21 different countries. The study identified 30 drivers from literature review and incorporated them in the survey questionnaire. Descriptive statistics was carried out and mean score ranking reported from which 5 key drivers including training and awareness were listed. Furthermore, analysis of variance (ANOVA) was performed and the findings failed to indicate any divergence in the opinions of the different professionals. Finally, the study conducted factor analysis which generated 5 principal components accounting for 68.36 percent of all the variances with factor loadings ranging between 0.459 and 0.797. The highest factor component was knowledge and industry-related drivers which accounted for 50.79 percent of the total variance. Knowledge was identified as a key dynamic for implementation of sustainability of building projects internationally. Nonetheless, the study failed to investigate direct association between knowledge dynamics and sustainability of building projects. The current study tested correlation between these variables through multiple regression analysis hence determining association between knowledge dynamics and sustainability of building projects. Investigation carried out by Addy, Adinyira, Danku, and Dadzoe (2020) on impediments to the market growth for sustainable building projects in Ghana determined that lack of awareness, lack of education, and lack of incentives were statistically significant key obstacles. The most critical barrier was lack of awareness. However, the study data collected did not meet the normality test thus only non-parametric tests which are not robust were carried out. Additionally, the study failed to determine correlation between variables.

Conceptual Framework

Following literature review, a conceptual framework was developed that graphically illustrated the relationship between key study variables. From the illustration in figure 1,

stakeholder and knowledge variables were hypothesised to influence sustainability of commercial building projects.

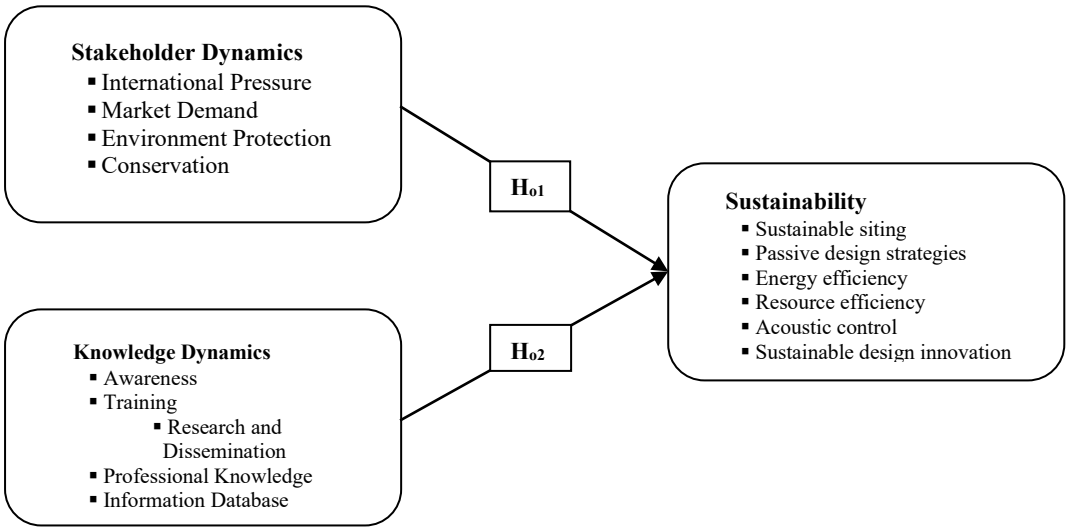

Figure 1: The Conceptual Framework
Source: Literature Review (2023)

Methodology

The study was constructed along descriptive and explanatory design. The former provided information on population characteristics leading to hypothesis testing (Schindler, 2022), while the later assisted in determining cause and effect between the study variables. Additionally, to achieve the desired results, the study was anchored on positivism philosophy which advocates for what is posited and emphasises on scientific observation process (Saunders et al., 2019). The objective of this observation process thus leading to generation of pure data and facts.

Study Model

Multiple linear regression model was employed to analyse data and aided in determination of strength and direction of relationship between the study variables (Uyanik and Guler, 2013). From this relationship, future occurrences in similar relationships could be predicted. The general regression model was presented as follows:

$$Y = b_0 + b_1X_1 + \ldots\ldots + b_nX_n + \varepsilon.$$

Therefore, the study model was presented as follows:

$$SB = b_0 + b_1Sd + b_2Kd + \varepsilon.$$

In which *SB* represents sustainability, b_0 represents intercept constant, *Sd* represents stakeholder dynamics, *Kd* represents knowledge dynamics while ε represents error terms.

The study population was 40 high-rise commercial building projects completed in Nairobi City County between the years 2016 and 2020. Census technique was adopted since the universe was small and manageable (Singh & Masuku, 2014). From the 40 projects, 240 respondents were identified comprising key project team leaders, that is project managers, architects, quantity surveyors, engineers, contractors, property managers and developers. The unit of observation was therefore 6 project team leaders from each of the 40 projects which formed the unit of analysis.

Before commencement of fieldwork, a pilot study was carried out in which 18 respondents participated from projects of similar nature neighbouring the study area. The data from this study assisted in refining and improving on reliability and validity of the research instrument as recommended by Kinchin and Edwards (2017). Data was then collected through self-administered semi structured questionnaires which were dropped and picked later as the respondents were well versed in their areas of speciality. Ethical issues were strictly observed throughout especially during the data collection period.

Reliability of the research instrument was tested using Cronbach's Alpha and the internal consistency of the instrument determined to be acceptable since all the alpha coefficient values were greater than 0.7 as recommended by Bryman (2012). Validity was tested through expert opinion and principal component analysis. The items that were cross loading were deleted and not considered for further analysis while items loading above 0.40 were retained thus confirming factor loadings in correlated constructs (Taherdoost, 2016). Furthermore, content validity was determined by expert opinion (Oluwatayo, 2012).

The study carried out quantitative data analysis utilising SPSS Statistics version 26. Descriptive statistics including frequencies, means, percentages and standard deviations were determined to aid in defining general characteristics and distribution of variables. Additionally, inferential statistical analysis including multiple linear regression analysis were conducted to determine association between the variables and test for hypothesis. The study also conducted diagnostic tests including normality, linearity, heteroscedasticity and multicollinearity tests to detect any violations of linear regression assumptions (Gujarati & Porter, 2009).

The test for normality was done using Shapiro-Wilk test as recommended by Garson (2012) for small samples up to n = 2000. Conversely, Pearson Correlation analysis was used to test for linearity (Field, 2018). Moreover, Breusch-Pagan test recommended by Garson (2012) was utilised to test for heteroscedasticity, while variance inflation factor (VIF) and tolerance statistics were computed to detect the presence of multicollinearity between the predictor variables.

Results and Discussions

From the 240 questionnaires issued to respondents, 183 were well completed and returned, therefore achieving 76.25 percent response rate which was adequate for analysis. Pilot study was carried out to aid in refining the research instrument and improving validity. Furthermore, the pilot study results were used to test reliability using Cronbach's alpha and the outcome is displayed in table 1. All variables recorded alpha values greater than .7 confirming internal consistency of the instrument (Bonett & Weight, 2015).

Table 1
Cronbach's Alpha Reliability Coefficients

Variables	Cronbach's Alpha	Number of Items	Remarks
Sustainability	.832	21	Reliable
Stakeholder dynamics	.907	5	Reliable
Knowledge dynamics	.786	5	Reliable

Source: Survey data (2024)

Demographic Information of Respondents

The results displayed in table 2 indicate percentage distribution of gender, highest level of education and profession of respondents. The male gender was dominant (81.4%) while the female gender recorded 18.6 per cent. The result mirrors KNBS (2019) which reported that the construction industry is male dominated.

Table 2
Demographic Information of Respondents

Category	Classification	Percentage Distribution (%)
Gender	Male	81.4
	Female	18.6
	Total	**100.0**
Highest Education Level	Diploma	02.2
	Bachelors	68.3
	Masters	24.0
	Doctorate	05.5
	Total	**100.0**
Profession	Engineers	24.0
	Architects	23.0
	Quantity Surveyors	21.3
	Project Managers	14.2
	Town Planners	04.9
	Property Managers	04.4
	Accountants	04.9
	Developers	02.2
	Others	01.1
	Total	**100.0**

Source: Survey data (2024)

Regarding the highest level of education, most respondents had first degrees (68.3%), while 24 per cent had masters' degree and 5.5 per cent had doctorate degree in their respective professions. Only 2.2 percent were diploma holders. The respondents were therefore well educated and able to plan, execute and manage the various projects and capable of providing credible data.

Lastly, on participants' profession, engineers, architects and quantity surveyors were almost equally distributed at 24, 23 and 21.3 per cent respectively. Project managers followed at 14.2 per cent while town planners, property managers, accountants and developers recorded below 5.0 per cent each.

Table 3 displays the respondents' experience in the construction industry as well as in the management of sustainable building projects. Most respondents had over 10 years' experience in the industry (66.2%) while only 25.8 per cent had similar experience in managing sustainable building projects, implying that sustainable construction practice is a new phenomenon (Liu, Pyplacz, Ermakova & Konev, 2020). Over 43 per cent had less than 5 years' experience managing sustainable building projects. However, the level of experience was adequate for participants to appreciate the transition and provide credible data.

Table 3
Distribution of Respondents Experience

Period	Construction Industry Experience (%)	Sustainable Buildings Experience (%)
Under 5 Years	06.0	43.7
6 – 10 Years	27.9	31.1
11 – 15 Years	29.0	12.6
16 – 20 Years	13.7	06.6
Over 20 Years	23.5	06.6

Source: Survey data (2024)

Descriptive Analysis Results

Sustainability

The descriptive results for sustainability are summarized in table 4, which indicates that all the 6 components were important in contributing to sustainability of building projects. Site planning (*M* = 4.38, *SD* = .812) design strategies (*M* = 4.13, *SD* = .845), energy efficiency (*M* = 4.51, *SD* = .639), resource efficiency (*M* = 4.24, *SD* = .813) and innovations (*M* = 4.50, *SD* = .725) each had high mean score and a low standard deviation indicating their importance in contributing to sustainability. Only noise control had an average mean score of 3.97 and standard deviation of .815. The results resonate with a study by Salah *et al.* (2023) in a similar study that identified indicators for an assessment tool for sustainability of building projects.

Table 4
Descriptive Analysis Results for Sustainability

Indicators	Mean	Standard deviation
Site planning	4.38	.812
Design strategies	4.13	.845
Energy efficiency	4.51	.639
Resource efficiency	4.24	.813
Noise control	3.97	.815
Innovations	4.50	.725

Source: Survey data (2024)

Stakeholder dynamics

The participants were required to respond to a statement on the level of collaboration between stakeholders in the development of sustainable building projects. The result indicated a mean score of 2.85 and a standard deviation of .901 which is within the midpoint range of a 5-point Likert scale as shown on the second row of table 5 indicating that collaboration between stakeholders was moderate. The result differs slightly from a study by Ali and Haapasalo (2023) who found that collaboration between stakeholders was low due to lack of shared vision and other related issues.

The second set of questions required the respondents to indicate the level of their agreement with 5 statements on a 5-point Likert scale ranging between strongly disagree (1) and strongly agree (5). The results shown on the third to fifth row of table 5 indicated that all the indicators had a mean score ranging between 3.44 and 4.05 with a standard deviation ranging from .834 and .978 imply that respondents generally agreed that each of these items influenced growth of sustainability. The results confirm the outcome of a study carried out by Tunji-Olayemi *et*

al. (2020). In their study, market demand and pressure from international conventions were reported as key indicators of stakeholder dynamics. The results are further corroborated by a study conducted by Oguntona *et al.* (2019), in which they concluded that increased demand for natural resource conservation is a major driver for the implementation of sustainable building projects.

Table 5
Descriptive Results for Stakeholder Dynamics

Indicators	Mean	Standard deviation
Collaboration between stakeholders	2.85	.901
Pressure due to international conventions	3.44	.970
Increased market demand	4.05	.834
Pressure for environmental protection	3.93	.978
Demand for conservation of resources	3.85	.941
Efficiency in energy and water usage	4.04	.969

Source: Survey data (2024)

Knowledge Dynamics

The results shown on the second row of table 6 indicates that a mean score of 3.00 and a standard deviation of .703 was obtained. The mean score corresponds to the midpoint of a 5-point Likert scale which implies a moderate awareness of benefits for sustainable building projects. The results differ slightly from a study by Chebet, Gweyi and Kitur (2024) who reported that most construction practitioners were not aware of the benefits of sustainable building projects. Moreover, Oduho, Vikiru and Mireri (2022) reported low awareness of benefits from occupants of these projects.

Participants were further required to indicate their level of agreement with 5 statements based on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The results shown on the third to fifth row of table 6 indicates mean score ranging between 4.40 and 4.64 with standard deviation ranging between .544 and .680. These results infer that participants strongly agreed that knowledge dynamics influence sustainability of building projects. Besides, the results echo the findings by Olawumi and Chan (2020), in which knowledge dynamics indicators of awareness, information data base, training, information and knowledge dissemination and competency accounted for the highest percentage of total variance in a factor analysis test. Although knowledge dynamics was found to be weighty in influencing sustainability, the status of awareness of the benefits of sustainable construction were found to be moderate.

Table 6
Descriptive Results for Knowledge Dynamics

Indicators	Mean	Standard deviation
Status of benefits awareness	3.00	.703
Response to benefits awareness	4.40	.680
Skill development	4.48	.627
Research and dissemination	4.54	.581
Professional Knowledge	4.60	.555
Availability of a knowledge data bank	4.64	.544

Source: Survey data (2024)

Multiple Linear Regression Analysis

Diagnostic Test Results

Prior to multiple linear regression analysis, diagnostic tests including test of normality, linearity test, test for the presence of heteroscedasticity as well as test to determine presence of multicollinearity were carried out. These tests are critical in ensuring that the assumptions of ordinary least squares (OLS) are not violated to obtain trustworthy regression results (Frost, 2020).

Normality Test Results

Normality Test Results indicated that data was approximately normally distributed since all the p-values for sustainability (p = .363), stakeholder dynamics (p = .387) and knowledge dynamics (p = .133) were greater than the threshold of 0.05 (Garson, 2012) as displayed in table 7.

Table 7
Test of Normality Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistics	**df**	**Sig.**	**Statistics**	**df**	**Sig.**
Sustainability	.052	182	.200*	.992	182	.363
Stakeholder dynamics	.099	182	.200*	.954	182	.387
Knowledge dynamics	.084	182	.200*	.974	182	.133

Source: Survey data (2024)

Linearity Test Results

Linearity test results indicated that both stakeholder (r = .523, p = .000) and knowledge dynamics (r = .541, p = .000) had significant positive linear relationship with sustainability.

Heteroscedasticity test

The presence of heteroscedasticity was tested using Breusch-Pagan test. For this test, the regression model was estimated using the squares of the residual values as the outcome variable against knowledge and stakeholder dynamics as predictor variables. The resulting Anova table had a p-value of .167 which is larger than .05, thus heteroscedasticity was not a problem.

Multicollinearity test

Multicollinearity was not detected since the computed variance inflation factor (VIF) and the tolerance statistics were 1.247 and .802 respectively which is within the acceptable threshold.

Multiple Linear Regression Analysis

Multiple linear regression analysis was conducted to test if stakeholder and knowledge dynamics significantly predicted sustainability of building projects. The outcome of the analysis displayed in table 8 indicated that the two predictors, stakeholder and knowledge dynamics explained 39.2 percent of the variance in sustainability of building projects (R^2 = .392, F (2,180) = 58.11, p = .000). It was further found that both stakeholder dynamics (b = .198, t = 5.419, p = .000) and knowledge dynamics (b = .450, t = 5.933, p = .000) significantly predicted sustainability of building projects. The regression model was fit and was expressed as follows:

$$SB = 1.453 + 0.450Kd + 0.198Sd + \varepsilon$$

Table 8
Summary Results for Multiple Linear Regression Analysis
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.453	.290		5.017	.000
	Knowledge dynamics	.450	.076	.385	5.933	.000
	Stakeholder dynamics	.198	.037	.352	5.419	.000
	R-square	.392				
	Adjusted R-square	.386				
	F-Statistics	58.110 (2, 180), (p = .000)				

a. Dependent Variable: Sustainability
Source: Survey data (2024)

Tests of Hypotheses
The first study objective entailed investigation of knowledge dynamics and their effect on sustainability. The null hypothesis derived from this objective stated that:

H_{o1}: Knowledge dynamics have no significant effect on sustainability of building projects.

The findings from regression analysis indicated that knowledge dynamics had a coefficient of .450 and a *p*-value of .000 which was less than .05, implying that at 5 percent significance level, the null hypothesis was rejected. Therefore, knowledge dynamics have significant positive effect on sustainability. The finding indicates that increased awareness of sustainable construction benefits, improved research and dissemination of findings, development of professional knowledge and increased provision of knowledge data banks contributes to growth of sustainability of building projects. According to findings by Wang and Zhang (2018), knowledge attributes have significant positive impact on sustainability. Additionally, Juffle, Rahman and Asli (2024) found that knowledge and awareness should be promoted for sustainable construction to gain momentum in developing countries.
The second study objective involved examination of stakeholder dynamics and their influence on sustainability of building projects. The resultant null hypothesis statement from the objective was:

H_{o2}: Stakeholder dynamics has no significant influence on sustainability of building projects.

Regression analysis results indicated that stakeholder dynamics had a coefficient of .198 and a *p*-value of .000 which was significant since the value was lower than the threshold of .05. The implication is that at 5 percent significance level, the null hypothesis was reject, therefore, stakeholder dynamics has significant positive influence on sustainability. Consequently, positive variation in stakeholder dynamics should result in growth of sustainability in building projects. Therefore, implementation of international treaties, increased demand for sustainable buildings, positive response to environmental protection, continued focus on conservation of natural resources and means to ensure efficient utilisation of water and energy will contribute to growth of sustainability. The study findings are reminiscent of Bohari *et al.* (2020) who reported that stakeholder values have positive and

significant influence on green orientation of construction procurement. The outcome also echo findings by Micheni, Were and Namusonge, (2023) who reported that stakeholder engagement and sustainability of donor funded projects have a positive and significant association.

Consequently, stakeholder dynamics are important ingredients in the maturity of sustainability in building projects. Stakeholders should increase collaboration amongst themselves to the extent that collective gains are made. Government should ensure realisation of international obligations they are signatory to including Sustainable Development Goals (SDGs) since the industry contributes to the SDGs through sustainable construction principles (Chukwu *et al.*, 2019). Equally, environmental protection regulations as well as natural resource conservation policy should be developed and implemented. Finally, as the cost of utilities increase, efficiency will become a necessity, thus stakeholders' demand for sustainability in building projects.

Summary, Conclusion and Recommendations

The main purpose of this study was the examination of knowledge and stakeholder dynamics and their influence on sustainability of commercial building projects in Nairobi, Kenya. Primary data was collected from construction industry stakeholders and both descriptive and inferential statistical analyses were executed including regression analysis that led to testing of hypotheses.

The first study objective was to examine stakeholder dynamics and their influence on sustainability of commercial building projects in Nairobi City County, Kenya. The study findings indicated that collaboration between key stakeholders was moderate. However, each of the stakeholder dynamics indicators were reported to be very critical in achieving sustainability of building projects as they recorded above average mean score and a small standard deviation. The indicators including implementation of international conventions, market demand, measures for environmental protection, conservation policies and measures to ensure efficiency in utilisation of energy and water were established to be very important in growing sustainability of building projects. Moreover, the regression model indicated that coefficient for stakeholder dynamics was positive and significant implying that stakeholder dynamics have significant positive influence on sustainability of commercial building projects in Nairobi City, Kenya.

The second study objective was to investigate knowledge dynamics and their effect on sustainability. The study findings indicated that awareness of sustainable construction benefits was moderate amongst key stakeholders. However, the indicators for knowledge dynamics had mean scores ranging between 4.40 and 4.64 indicating that each of the knowledge dynamics indicators influences sustainability of building projects. Therefore, awareness of benefits, relevant skills, research and dissemination of findings, professional knowledge and a knowledge data bank should be enhanced for the growth of sustainable building projects. Furthermore, the coefficient for knowledge dynamics was positive and significant indicating a positive significant association. Therefore, to boost sustainability of building projects, knowledge dynamic indicators must be advanced.

Study Conclusions

The first objective which involved examination of stakeholder dynamics and their influence on sustainability of commercial building projects determined existence of moderate collaboration between key stakeholders. Consequently, collaboration between key stakeholders including professionals, developers and financiers need to be advanced for successful delivery of sustainable building projects. Moreover, the study established that there was a significant positive linear correlation between stakeholder dynamics and sustainability of commercial building projects. Each of the indicators had high mean scores demonstrating their importance in influencing sustainability of the projects. The implementation of international agreements and increased market demand including pressure from stakeholders to protect environment and conserve natural resources not forgetting the need for efficiency in utilisation of energy and water resources will drive the growth of sustainable building projects. The study consequently concludes that stakeholder dynamics is a fundamental element in the drive for sustainability of commercial building projects in Nairobi City, Kenya.

The second objective focused on the investigation of knowledge dynamics and their effect on sustainability of commercial building projects in Nairobi City, Kenya. The outcome revealed that key stakeholders were moderately aware of the benefits of sustainable building projects. Moreover, the study established a significant positive linear correlation between knowledge dynamics and sustainability. Consequently, knowledge dynamics are fundamental components in realisation of sustainability. Awareness of benefits of sustainable construction should be made through seminars, webinars and conferences while professionals should be equipped through continuous professional development programmes to grow sustainability in building projects.

The Study Recommendations

The study focused on examination of stakeholder and knowledge dynamics and their influence on sustainability of commercial building projects in Nairobi City, Kenya. From the outcome of the study, several recommendations have been derived regarding policy development and implementation in the construction industry as well as contribution to knowledge. On stakeholder dynamics, government should develop measures to comply with international commitments on sustainable development and enforce existing regulations to safeguard the environment and conserve natural resources. Moreover, efficient use of utility services needs to be enforced through legislation and relevant codes to develop sustainable building projects.

With respect to knowledge dynamics, the industry stakeholders should be made aware of the benefits of sustainable building projects through seminars, webinars and workshops while relevant institutions should be committed to research, disseminate and collaborate with practitioners for application of the findings.

Theoretical and Contextual Contributions

The current study focused on sustainable building projects and how they are influenced by two key dynamics, that is stakeholder and knowledge. The study built on previous studies that determined the important elements influencing sustainable building projects by analysing and determining correlation between them in the context of a developing economy.

Moreover, the outcome validates stakeholder theory which posits that the product of an enterprise is affected by the participation of diverse interest groups. Additionally, the study has demonstrated the fundamental role played by knowledge dynamics, a channel of diffusion of innovation theory in influencing growth of sustainability in building projects.

Policy Recommendations

Clear policy document in stakeholder collaboration is necessary to ensure awareness of benefits, and the necessary elements are in place especially during the project planning and approval phase. Government should put in place clear guidelines to enable stakeholders implement international treaties for example sustainable development goals especially goal 11 on cities and human settlement, goal 6 on water efficiency and goal 7 on energy efficiency among others to encourage growth of sustainability in building projects. Consequently, construction industry should contribute towards Sustainable Development Goals (SDGs) while projects managers have a duty to adhere to the objectives of achieving sustainability. Additionally, the study brought to light research and dissemination including documentation of best practice as indicators, therefore research and learning institutions should take the lead in collaborating with practitioners.

Areas for Further Studies

The current study focused on commercial building projects; a similar study could be conducted on high rise housing projects. Energy and water usage in housing projects differs substantially from commercial building projects and the occupancy may be influenced by the design of these utilities. Additionally, future studies could include more dynamics to determine the main influencers of sustainable construction.

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