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Quantity Surveyors' Readiness in Implementation of Sustainable Building Construction in Kenya: A Case Study of Nairobi City County

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Abstract: ***The study sought to assess quantity surveyors' readiness in implementation of sustainable building construction in Kenya with reference to Nairobi County. The study adopted both the descriptive and cross-sectional research designs, targeting the 485 quantity surveyors in Nairobi County, as registered by the board of registration of architects and quantity surveyors in Kenya. A sample of 219 quantity surveyors was obtained, and selected by simple random sampling. Primary data was collected by use a structured questionnaire and analyzed by both descriptive and inferential statistics. Results indicate that quantity surveyors' awareness of their role in sustainable building construction does not have a significant effect on its implementation in Kenya, while challenges faced in adoption of sustainable building construction significantly affect its implementation in Kenya.***

Keywords: Sustainable Building, Construction Practices, Quantity Surveyors, Skills & Competencies, Demand

1. Introduction

Over 111 million people are employed globally in the building and construction industry, which makes up about 10% of the world's Gross Domestic Product (GDP) [1]. The housing and building sector is highlighted in Kenya's Vision 2030 because to its labor-intensive character, which offers a high potential for job creation and takes advantage of Kenya's comparative advantage in labor availability [2]. Strong ties exist between the construction industry and other economic sectors. Because the housing industry has a local component of more than 90%, investments in housing and development planning can have a direct positive impact on national GDP through fostering links between the supply and demand of building materials, transportation, infrastructure development and marketing [3].

However, actual studies show that the construction industry accounts for between 30 and 40% of all deposited trash, all energy used in our society, and all material flows internationally [1, 4]. The constructed environment has a significant impact on the social and natural environment, resource usage, the quality of the indoor environment, the related public health, and land usage [5]. Typical building constructions give little consideration to various health-related difficulties, like sick building syndrome, illnesses associated to buildings, and various chemical sensitivities [6]. Construction and building operations have also been linked to trash production, heavy energy use, habitat fragmentation, nose pollution that causes loss of biodiversity, and the deterioration of natural landscape beauty [7].

Sustainable building practices have been adopted more widely around the world as people have become more aware of the enormous impact that the construction industry has on the surroundings in terms of resource usage, indoor air quality, related human health, and land use [8]. A sustainable or green building is defined as "the process of creating constructions and using procedures that are ecologically sound and resource-efficient throughout a life cycle of a building, from siting to layout, building, functionality, preservation, remodeling, and dismantling [9]. A green building is one that, uses a careful integrative and holistic strategy that reduces energy utilization, enhances daylight, has a high level of thermal and indoor air comfort, preserves water, reuses components and intercepts with recycled material, lessens site interruptions, and typically offers a high extent of occupant comfort [7].

The benefits of green construction technology include lower operating costs; lower utility prices, higher productivity linked to cleaner air and quality of life elements, and increased status [8]. The building industry has the greatest potential to reduce greenhouse gas emissions globally [1]. Green building practices expand upon and complement the traditional building design considerations of economics, usability, longevity, and pleasure [9]. Furthermore, the financial advantages of green buildings outweigh their premium starting price by a factor of 10 [10]. Additionally sustainable buildings can save money while reducing greenhouse gas emissions by a significant 1.8 billion tonnes of carbon dioxide [1].

Sustainable building methods are still not widely used in Kenya, despite their continued global adoption in the construction sector [11]. This is despite the fact that the nation appears to be interested in green building techniques, as evidenced, among other things, by the proceedings of the "Conference on boosting green building rating in Africa" held at UN-Habitat in Nairobi on May 4-6, 2010. Participants in the meeting included non-governmental companies and business, academics, attorneys, and architects, constructors, and strategists. Specialists, professionals, and decision-makers from twenty African

nations, including Kenya, were educated on the necessity of fostering green construction practices in Africa during this conference [12].

To date however, the number buildings incorporating green features into buildings in the country are countable. Notable among these include the Green House along Ngong Road [13]; the UN Complex at Gigiri – [14]; Fedha Plaza in Westlands [15]; Strathmore University's School of Business Studies in Nairobi [16]; and the One-Africa Place Building along Waiyaki Way in Nairobi [17]. Others include Lamu's Manda Airport, Leven House, Mombasa, Red Pepper House in Lamu, Uaso Nyiro Primary School, Oleleshwa Primary School, Coca Cola Central and East Africa Business Unit in Nairobi, Ewaso Ng'iro, and Catholic University of Eastern Africa's Learning Resource Centre [14].

Whereas all stakeholders involved in building construction projects have the responsibility to promote sustainable practices, quantity surveyors play a critical primary role at the conception stage, beyond quantification [18]. This could involve minimizing waste, planning with as little waste as possible, utilizing pre-assembly whenever practical as well as minimizing over-specification; making use of the natural environment, preservation of biodiversity; as well as reducing the amount of energy used during building, especially by avoiding the use of materials such as cement and aluminum that require a lot of energy. The following roles of quantity surveying were highlighted by Ma and Luu [19] in order to ensure a environmentally friendly built environment: developing sustainability strategies, evaluating life cycle costs, offering advice on engineering solutions and services, determining the sustainability value of a property, and choosing the most cost-effective alternative for a sustainable construction. Similar to this, Seah [20] described how quantity surveying contributes to an environmentally friendly built environment. construction rating evaluation, life cycle costing asset performance measurement, and building information modeling.

The study thus set out to assess quantity surveyors' readiness in implementation of sustainable building construction in Kenya with reference to Nairobi County. More specifically, the study sought to establish awareness among quantity surveyors of their role in sustainable building construction practices; examine the challenges faced by quantity surveyors in the implementation of sustainable building construction practices; to determine the effect of quantity surveyors' awareness of their role in sustainable building construction on its implementation in Kenya; and to assess the effect of the challenges faced in adoption of sustainable building construction on its implementation in Kenya.

2. Materials and Methods

In a desk study, Bolade-Oladepo, Oladipo, and Fasuyi [21] looked at how quantity surveyors can ensure sustainability in the built environment. According to the study, quantity surveyors' primary responsibilities in sustainability include developing sustainability strategies, estimating life cycle costs, offering advice on engineering solutions and services, visiting construction sites, conducting assessments, and making projections for future projects. The study also discovered that some of the difficulties faced by quantity surveyors in ensuring an environmentally friendly building design include a lack of social responsibility and sustainable construction awareness, a lack of persuasive power that could make current costly sustainable techniques more financially feasible in the future, a dearth of cost data for building services / goods, and an absence of ability and understanding in life-cycle costing and life-cycle assessment.

In their analysis, Wong [22] takes into account the growing role of quantity surveyors in Singapore's sustainable construction. The research methodology used involves case studies and a review of the literature. The results demonstrate that the role of a quantity surveyor will include, but not be limited to, life-cycle costing, which entails calculating the environmental impacts of an item (or a larger system, such as a building), value engineering, which entails providing estimated costs for environmentally acceptable construction advanced technologies and construction, cost compared to various construction items, and the cost of obtaining a green rating. A professional quantity surveyor must comprehend what constitutes sustainable infrastructure and the green mark requirements (a rating tool) in addition to comprehending green layouts and integrations, according to Wong (2020).

In their 2019 study, Lim, Liu, and Oo [18] looked into consultant QS's knowledge of achieving sustainability, techniques, and anticipated impediments to its adoption. The data was analyzed using the relative occurrence indexes, one-sample and associated Wilcoxon indicated tests, and the Spearman correlation test after an online survey questionnaire of 40 consultant QS was conducted. Overall, the findings indicate that respondents to the consultant QS had a fair awareness of sustainable building practices and that they frequently associated the term with "environment," "materials," "resources," and "efficiency." Additionally, although displaying a fair level of knowledge of the five sustainable buildings principles, they did not put them into effect at work. The findings also show that the mindsets of clients, the mentality of the construction sector, and high initial capital costs are the three biggest obstacles to the adoption of environmentally friendly construction in the sector.

To determine the availability of green construction courses, Onososen [8] looked at the school curricula of higher institutions that offer quantity surveying at the undergraduate level. According to the report, there is hardly any instruction on green building in the syllabi of Nigerian universities. Additionally, deficiencies were found in the competency categories. More importantly, informal learning must be structured for exercising quantity surveyors through retraining and retraining, workshops, and conferences to improve their abilities as well as keep them current with required competencies and knowledge to operate as green building experts. Formal education must be checked by revamping the curricula to satisfy green building competencies.

Ma and Luu [19] aimed to determine whether the current wave of green building development had altered the traditional roles of quantity surveyors. According to questionnaire research and in-depth interviews done in South Australia, the traditional duties of quantity surveyors have evolved to include green structures alongside new ones. The formulation of sustainability strategies, the estimation of life cycle costs, consulting on the green star system, giving advice on engineering service solutions, and assessing the durability of a property are some of the evolving roles in relation to environmentally friendly buildings. Additionally, it was discovered that in order to efficiently provide clients and other business professionals with cost consulting services for green initiatives, Ma and Luu [19] tried to determine whether the conventional responsibilities of quantity surveyors had changed. According to the new wave of green requirements, quantity surveyors must gradually increase their abilities and knowledge. It has been shown that one of the major benefits for quantity surveyors to stay viable in the profession is their knowledge of green materials and goods.

From the results of a study on the implementation of the green building ideas in Kenya that the authors undertook, Were et al. [11] set out to highlight the main problems faced by practitioners in the implementation of green building concepts in Kenya. 38 buildings in Nairobi that were finished in the previous five years were the source of the data used in the study. Participants in the building of the 38 commercial properties answered to questionnaires and some of them were chosen for interviews. The study found that some of the biggest obstacles to practitioners adopting the ideas were an absence of government incentives and implementation of sustainable construction rules. Strictly enforced urban land and planning regulations, increased county government implementation of green principles, and education and training with a sustainability focus are some of the tactics suggested to encourage adoption of the ideas.

Seah [20] conducted a study on the effects of sustainable building on quantity surveyors. It was found that the effect of green building on the quantity surveyor is two-fold. One, new opportunities have been presented to the Quantity Surveyor who has the essential skill set to thrive in the new roles such as green costing and carbon management. Two, the Quantity Surveyor must be quick to respond to the challenges of sustainable construction and cater to the changing requirements of clients in order to safeguard its profession that there is immense potential for green buildings to grow due to the endless list of social, economic and environmental benefits.

The study adopted both the descriptive and cross-sectional research designs, targeting the 485 quantity surveyors in Nairobi County as registered by the board of registration of architects and quantity surveyors in Kenya. To obtain a sample, the study employed the Yamane [23] formula, which is justified for its scientific approach as illustrated below:

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = Required sample
N=Total population=485
e = Margin of error=0.1
=0.01, 0.05, and 0.1 where the margin of error will be taken as (0.05).

$$n = \frac{485}{1+485\,(0.1)^2} = 219.2$$

Sample (n) = 219

The 219 quantity surveyors were selected by simple random sampling from the obtained list of quantity surveyors by the board of registration of architects and quantity surveyors. A systematic questionnaire was used to collect primary data, which was then analyzed using both descriptive and inferential statistics. The following regression model was adopted:

$$Y=\alpha+\beta_1 Awr +\beta_2 Perc + \varepsilon$$

Where: Y = Implementation of Sustainable Building practices; α = Intercept; β = Beta Coefficient; Awr = Awareness; Perc = Perception; ε = Error Term

3. Results and Discussion

The study performed both descriptive and inferential analysis. While descriptive analysis involved the use of means and standard deviations, inferential analysis included simple linear regression analyses which were used to assess the association between the independent and dependent variables.

3.1 Descriptive Analysis

Respondents were first asked to indicate their respective degrees of affirmation to various statements depicting awareness among quantity surveyors of their role in sustainable building construction practices. This was on a 5-point Likert scale. Outcomes are demonstrated on Table 1.

Table 1: Awareness of the Role of Quantity Surveyors

	Mean	Std. Dev
Quantifying the environmental impact of a project	3.6492	.48935
Providing cost estimates for alternative green building technology	4.2670	.52003
Advising on the cost of achieving green rating/green star system	4.2461	.43185
Advising on resource efficiency during material selection and construction	4.2513	.51267
Valuing the sustainability of a property	4.2199	.49611
Designing for minimum waste	4.3844	.48088
Avoiding over-specification	4.0366	.5766
Recommending pre-assembly where possible	4.1937	.49115
Sustainability strategy development	4.2522	.43491
Mean Score	4.167	

As indicated in Table 1, a mean score of 4.167 was established, implying that a majority of respondents highly affirmed to the established quantity surveyors' roles in sustainable building construction practices, as obtained from literature. This is indicative of high levels of awareness among a majority of quantity surveyors in Kenya, on their role in sustainable building construction practices. A majority particularly highly agreed that their role in

sustainable building construction involves designing for minimum waste (4.3844); providing cost estimates for alternative green building technology (4.2670); sustainability strategy development (4.2522); advising on resource efficiency during material selection and construction (4.2513); advising on the cost of achieving green rating/green star system (4.2461); valuing the sustainability of a property (4.2199); and recommending pre-assembly where possible (4.1937).

Respondents were also asked to indicate their respective degrees of affirmation to various statements depicting challenges faced by quantity surveyors in the implementation of sustainable building construction practices. This was also on a 5-point Likert scale, where: 1=strongly disagree, 2=disagree, 3=Neutral, 4=agree and 5=strongly agree. Outcomes are demonstrated on Table 2.

Table 2: Challenges

	Mean	Std. Dev
High initial investment costs	4.2461	.48901
Long pay-back period	4.0628	.83113
Uncertainty in cost savings	3.8168	.76291
Lack of building codes on sustainability	3.8743	.87354
Lack of demand for sustainable products	4.5177	.49966
Low awareness among stakeholders on sustainable building practices	3.9267	.85524
Expensive sustainable building materials	4.1728	.68556
Insufficient cost database for building services and products	3.8901	.89646
Limited skills and competencies on sustainable building practices	4.0995	.39639
Lack of enforcement of sustainable building policies	3.8848	.97728
Lack of incentives from government	3.9843	.89723
Poor urban planning	3.2356	1.21482
Limited research on sustainable building practices	3.3560	1.15574
Lack of stakeholder empowerment	3.5183	1.09949
Mean Score	3.899	

As shown in Table 2, a mean score of 3.899 was established, implying that a majority of respondents highly affirmed to various challenges faced by quantity surveyors in the implementation of sustainable building construction practices. A majority particularly highly affirmed that among the challenges faced include lack of demand for sustainable products (4.5177); high initial investment costs (4.2461); expensive sustainable building materials (4.1728); lack of enforcement of sustainable building policies (4.1728); long pay-back period (4.0628); limited skills and competencies on sustainable building practices (4.0995); low awareness among stakeholders on sustainable building practices (3.9267); insufficient cost database for building services and products (3.8901); and lack of building codes on sustainability (3.8743).

Respondents were further asked to indicate their respective degrees of affirmation to various statements depicting the level of implementation of sustainable building construction in Kenya. This was also on a 5-point Likert scale, where: 1=Not at all, 2=Small extent, 3=Moderate extent, 4=Great extent and 5=Very great extent. Outcomes are demonstrated on Table 3.

Table 3: Implementation of Sustainable Building Practices

	Mean	Std. Dev
In the last five years, I have been involved in lifecycle assessment of a building construction project	3.0874	.76547
In the last five years, I have practiced resource reuse and recycling in a building construction project	3.8377	.84595
In the last five years, I have used renewable resources in preference to non-renewable resources in a building construction project	3.0241	.69830
In the last five years, I have adopted policies and practices that advance sustainability in a building construction project	3.7215	.79413
In the last five years, I have used serviceability and maintainability to promote sustainability	3.7539	.93874
Mean Score	3.485	

Results in Table 3 indicate a mean score of 3.665, implying that in the last five years, a majority of quantity surveyors in the country have, to a moderate extent, implemented sustainable building construction practices. A majority particularly reported that in the last five years, they have to a great extent, adopted policies and practices that advance sustainability in a building construction project (3.7215); practiced resource reuse and recycling in a building construction project (3.8377); and used serviceability and maintainability to promote sustainability (3.7539). A majority however reported that in the last five years, they have only to a moderate extent, used renewable resources in preference to non-renewable resources in a building construction project (3.0241); and have been involved in lifecycle assessment of a building construction project (3.0874).

3.2 Inferential Analysis

Under inferential analysis, regression analyses were performed with the assumption that: there is a normal distribution among variables; and that there is a linear linkage between the independent and dependent variables for estimation accuracy. The study sought to determine the effect of quantity surveyors' awareness of their role in sustainable building construction on its implementation in Kenya; and to assess the effect of the challenges faced in adoption of sustainable building construction on its implementation in Kenya. To this end, regression analyses produced the model summary, Analysis of Variance (ANOVA) and coefficients of determination. ANOVA was used to determine whether the average difference between the determinant and predictor concepts is significant at the 95% confidence level. Table 4 below presents the results.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.467[a]	.218	.210	1.90859

a. Predictors: (Constant), Challenges, Awareness

As portrayed in Table 4, the study recorded a correlation value (R) of .467, showing a moderately strong linear association between quantity surveyors' awareness of and

challenges faced in adoption of sustainable building construction and its implementation in Kenya. The study also recorded an adjusted R Square of .218, meaning that 21.8% of the variance in the implementation of sustainable building construction is attributed to quantity surveyors' awareness of their role and challenges faced in adoption of sustainable building construction and its implementation in Kenya, while the balance of 78.2% is attributed to factors which this study did not explore in the regression model.

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	191.041	2	95.520	26.222	.000[b]
	Residual	684.834	188	3.643		
	Total	875.874	190			

a. Dependent Variable: Implementation
b. Predictors: (Constant), Challenges, Awareness

As Table 5 depicts, the study further recorded an F value of 26.222 (<0.05) which implies that the regression model which was adopted in this study is statistically significant, and can be relied upon to make further inferences. It was further revealed from the regression coefficients in Table 6 that quantity surveyors' awareness of their role sustainable building construction does not have a significant effect on its implementation in Kenya (β = .050, p = .446>.05); while challenges faced in adoption of sustainable building construction have a significant effect on its implementation in Kenya (β = .460, p = .000<.05).

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.600	1.973		3.853	.000
	Awareness	.032	.042	.050	.764	.446
	Challenges	.175	.025	.460	7.092	.000
a. Dependent Variable: Implementation						

4. Conclusions

Based on the study findings, it is concluded that a majority of quantity surveyors in Kenya are highly aware of their role in sustainable building construction practices. A majority are particularly aware that in the context of sustainable building, their roles involve consultancy on various environmental and economic aspects of sustainability. These include among others, designing for minimum waste giving estimates of the cost of alternative green building technologies; sustainability strategy development; advising on resource efficiency during material selection and construction; advising on the cost of achieving green rating/green star system; valuing the sustainability of a property; and recommending pre-assembly where possible.

The study also concludes that quantity surveyors face a myriad of challenges in the implementation of sustainable building construction practices in Kenya. Key among these challenges include lack of demand for sustainable products; high initial investment costs; expensive sustainable building materials; lack of enforcement of sustainable building policies; long pay-back period; limited skills and competencies on sustainable building practices; low awareness among stakeholders on sustainable building practices; insufficient cost database for building services and products; and lack of building codes on sustainability.

It is further concluded that quantity surveyors in the country do practice sustainable building construction, to a moderate extent. A majority particularly adopt practices and laws that promote sustainability in a building construction project; practice resource reuse and recycling in a building construction project; and use to encourage sustainability, serviceability and maintainability. There is however, limited use of in favor of renewable resources over non-renewable resources in a building construction project and lifecycle assessment of building construction projects.

The study also concludes that quantity surveyors' awareness of their role in sustainable building construction does not have a significant effect on its implementation in Kenya, while challenges faced in adoption of sustainable building construction have a significant effect on its implementation in Kenya. This implies that whereas a majority of quantity surveyors are highly aware of their role in sustainable building construction, its implementation in Kenya is largely hampered by the myriad of challenges faced by quantity surveyors, ranging from high initial investment costs and low demand, to poor government support among others.

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