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Project Life Cycle Costing and Sustainability of Public Housing Upgrading Construction Project in Kibera Soweto Slum in Nairobi City County, Kenya

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Abstract:
Plenty of public housing construction projects exist at different implementation stages in Nairobi City County, Kenya, and most of them have failed to balance sustainability during the project lifecycle. The Public construction projects have failed to incorporate economic, environmental, and social factors leading to the growing gap between demand and supply of houses which has, in turn, contributed to the continued failure of housing in the country. The research mainly focused on determining the relationship between project life cycles costing on the sustainability of public housing construction projects in Nairobi City County, Kenya. The research incorporated both descriptive and explanatory research designs. A target population of 90 respondents comprised professionals from the six organizations involved in the project. The findings established that initial costs affected the sustainability of public housing construction projects. From the findings, it was evident that both maintenance costs and end-life costs affected the sustainability of the Kibera public housing project. Finally, research established that operation cost was used to explain public housing construction projects in Nairobi County.

Keywords: *Project life cycle costing, Sustainability, public housing*

1. Introduction

Most countries and international bodies have tried to incorporate proper housing into their policies to ensure every citizen has access. The majority of the set standards stipulate that every citizen should easily access adequate housing that meets a reasonable sanitation standard. However, according to UN-Habitat (2016) research, 1.6 billion people worldwide are reported to be inadequately housed. Sustainable house construction projects remain a problem, not only in Kenya but also in some developing countries in the world. This problem has escalated due to the increase in urban population, high construction, and finance cost, and the ever-increasing prices of urban land cost (Kieti, Rukwaro, & Olima, 2020).

Most countries have attributed the unsustainability of public housing construction projects to the lack of an effective housing finance system. Additionally, most public housing construction projects in developing countries have been designed according to low standards and do not meet residents' needs. Furthermore, the projects are located in areas with poor infrastructure and lack social amenities (Musa, Yusof, Samsudin, & Halil, 2016). Public housing construction projects have been found to fail since they did not consider the environmental, social, and economic factors. For example, in South Africa, public housing construction projects are unsustainable due to the poor mortgage and housing finance systems. This has contributed to the illegal sale of houses, continued construction of shacks, and a huge population on the house waiting list (Ganiyu, 2015). Internationally different countries have taken it upon themselves to join different bodies promoting sustainability.

In Kenya, the government has worked towards attaining sustainable public construction projects by incorporating standard building design and mass production of housing units, using locally available materials to cut construction costs, and adopting innovative building technologies and materials. However, achieving sustainability still proves a problem due to the high capital-intensive venture and funds, shortage of land for development, high construction cost, and the fact that Kenyans have not adapted to alternative building materials and technologies. Finally, the county does not have a standard policy framework that defines the standards of sustainable housing projects (Kieti, Rukwaro, & Olima, 2020).

1.1. Statement of Problem

The government has put a lot of effort into supplying decent accommodations to slum dwellers. For example, the government initiated Kibera-Soweto slum upgrading project to ensure sustainable housing. However, underlying factors bar these efforts (Cronin & Guthirie, 2012). Kamaruddin (2020) identified the inability to implement social aspects in housing construction projects as a contributor to the failure of the projects. Nzau (2020) observed that projects under

environmental constraints find it hard to achieve sustainability. This can be due to the unsuitable topography of the project leading to inhabitable living conditions.

Additionally, economic aspects have hampered the sustainability of this project. Schneidorova (2019) argued that public housing construction projects function under a strict institutional framework and restricted access to financial resources. Moreover, Cytonn (2019) identified the main factors hindering the sustainability of public housing in Nairobi: the inflated land costs, the high construction and infrastructure cost, and inadequate access to financing.

Different studies have been conducted on the sustainability of public housing projects. However, a few of them create a balance between the three pillars of sustainability and the project life cycle cost. Mungai (2012) looked at housing development and sustainability challenges in the low-income housing market. The study concluded that the process of acquiring land, costly transaction costs, archaic methods of planning, codes, and regulations guiding the building industry, and the lack of stakeholder involvement act as barriers to achieving economic sustainability for public housing construction projects. Alabi (2017) investigated on effect of building material costs on housing delivery towards sustainability. Alabi (2017) postulated that variation in the construction and maintenance costs tend to increase the cost of building materials for house sustainability. Reddy (2016) researched the analysis of the cost of sustainable construction projects and found that green buildings relate to lower operation costs, lower energy, waste, and water cost, and lower maintenance costs. However, the study was limited to environmental aspects of sustainability.

1.2. Research Objectives

- To investigate the relationship between initial cost and sustainability of public housing upgrading construction project in Kibera Soweto Slum.
- To determine the relationship between operation cost and sustainability of public housing upgrading construction project in Kibera Soweto Slum.
- To examine the relationship between maintenance cost and sustainability of the public housing upgrading construction in Kibera Soweto Slum.
- To establish the relationship between end-life cost and sustainability of the public housing upgrading construction project in Kibera Soweto Slum.

1.3. Research Questions

The following research questions guided the research:

- How does knowledge of the initial cost of projects relate to the sustainability of the public housing upgrading construction project in Kibera Soweto Slum?
- How does awareness of the operation cost of projects appertain to the sustainability of the public housing upgrading construction project in Kibera Soweto Slum?
- How does an appraisal of the maintenance cost of projects pertain to the sustainability of the public housing upgrading construction project in Kibera Soweto Slum?
- How does awareness of the end-life cost of projects apply to the sustainability of the public housing upgrading construction project in Kibera Soweto Slum?

2. Literature Review

2.1. Initial Cost and Sustainable Public Housing Construction Projects

Braganca (2014) studied early-stage design decisions and how to achieve sustainable buildings at lower costs in Portugal. A systematic literature review was conducted on all research published and unpublished to identify existing gaps. The systematic literature review targeted project design phases and sustainable indicators of construction projects done by Building Physics and Construction Technology of the University of Minho since 2004. Braganca (2014) found that a sustainable design requires a coherent design process: input from the entire design team and the design phases.

Kandil (2012) conducted a study on the validity of feasibility study for infrastructure construction projects in the United States of America. The study carried out a case study on Tafileh-Ghor Fifa Road and later compared previous estimates in a feasibility study and the actual data. Kandil (2012) found that there existed discrepancies between the estimated and the actual cost data. The research concluded that there is reason to improve the feasibility studies for infrastructure projects to ensure that public funds are allocated through transparent means. It will also promote public/private partnerships, promoting economic sustainability.

Tam (2011) researched the cost-effectiveness of using low-cost housing technologies in construction in India. The study carried out a case study in which observations were made on foundation, walling, roofing, flooring, plastering, doors, and windows based on conventional and low-cost housing technologies. The study found that approximately 22.68% of roofing costs can be lowered by adapting to low-cost housing technologies compared to conventional construction methods. More so, 26.11% of construction costs on walling can be reduced once low-cost conventional construction methods are adapted.

2.2. Operation Costs and Sustainable Public Housing Construction Projects

Pratesyo (2018) conducted a study on using the green building concept to reduce operating costs. The study applied a qualitative explanatory approach to conduct the study by analyzing the operation cost of Grha Prodia. In addition, the operation costs of Grha Prodia were compared to those of Prodia, a similar building built using conventional

methods. The analysis done indicated that the green building technique cuts down the operation cost of Grha Prodia due to the reduction of water and electricity consumption. Compared to Prodia Tower, Grha Prodia had less water and electricity consumption. Building technologies, such as the use of light detectors and variable refrigerant air conditioning systems, have contributed significantly to this difference.

Marenjak (2017) investigated operation cost models for university buildings in Croatia. Questionnaires were administered to various constituents of the universities. The questionnaires were sent to the associates of the universities to collect data, while data on operation costs were obtained using a predetermined cost structure. The research established that there is a possibility of determining the operation cost for public buildings using statistical methods.

Taisch (2015) investigated the conceptualization of sustainability in operation management. The research aimed to provide a theoretical foundation of environmental sustainability in operation management. The research conducted systematic research to identify hidden patterns and best practices. The results indicated that sustainability of the manufacturing sector could be achieved by coming up with operation strategies that deal with cost. Furthermore, the research found that sustainability is an operation strategy wholly dependent on the type of the environment and can be used by managers while planning activities for manufacturing projects.

Miller (2010) examined the operations and management of green buildings in the United States. Additionally, the study concentrated on the utility expenditure, cleaning practices, and use of energy-saving elements in offices. The research targeted 154 buildings possessing the energy star label and 105 without the green label. Online questionnaires were administered to the buildings' managers regarding operation and sustainability. A comparative analysis was conducted between green and non-green buildings to analyze the collected data. The research found that the operating cost for green buildings is higher than for non-green buildings in the country. Additionally, operation cost is correlated with the energy star score rather than the energy star label.

2.3. Maintenance Costs and Sustainable Public Construction Projects

Attar (2016) conducted a study on engineering economics and maintenance cost analysis in Mumbai. Rates were collected from the district schedule rates of Mumbai and the suburban area. Some of the included elements in the study were internal plastering, external plastering, internal oil painting, cistern fittings, dedo tiling, and flooring. The research developed forecasts with the help of a tread line characterized by a particular curve equation, thereby producing the projected rates. Based on the projections, the study found that maintenance and repair costs for the elements increase as time passes. Furthermore, the study concluded that maintenance and repair costs would increase linearly while others increase exponentially.

In a study on the preliminary investigation of the factors that influence the maintenance cost of apartments in Malaysia, Talib (2016) aimed to investigate aspects that contribute to the escalation of the maintenance cost of apartments. The study conducted a descriptive survey and distributed questionnaires to personnel managing the buildings. Outcomes of the study indicated that the five components that impact the cost of maintenance include the tenants' preferences, age of the building, construction materials, neglect to carry out preventive maintenance, and budget constraints. The study concluded that considering these factors will reduce the maintenance costs of high-rise buildings.

Shah (2016) conducted a literature review on the critical review of maintenance costs for stratified buildings. The research aimed to identify factors that affect the maintenance cost of stratified buildings in Malaysia. The research systematically categorized all the published literature and reviewed it methodically. The study focused on factors affecting maintenance costs. The results indicated that building age and user's expectations are factors that determine the maintenance cost of buildings. The empirical data indicated that building characteristics could be controlled, whereas the tenant's expectation may be difficult to control because of the human factor. The research recommended that for public buildings to be sustainable, the maintenance cost should be controlled by preserving the building from an early stage, educating clients on community welfare awareness, and opting for corrective maintenance.

Zakaria (2014) researched on assessment of factors affecting building maintenance and defects of public buildings in Penang, Malaysia. The research aimed to identify factors that affect the maintenance of public buildings in Malaysia since most of the public buildings in Malaysia have reduced lifespans and hence can no longer function as intended. The research administered twenty-five structured questionnaires to collect data from the occupants of the public buildings. In addition, the research used descriptive analysis to analyze data that was presented using tables and pie charts. According to the research, maintenance cost was ranked the highest factor affecting the sustainability of buildings in Malaysia. Furthermore, results indicated that overlooked site conditions, defective material, and material conditions influence the sustainability of buildings.

2.4. End Life Costs and Sustainable Public Housing Construction Projects

Banshai (2016) studied re-cycling and reusing construction and demolition waste as a sustainable approach in India. A case study was done in the Municipal Corporation of Delhi, where laboratory experiments were conducted on the material aggregates. The study implied that waste materials after the end of life of a construction project could be economically unviable compared to the natural aggregates depending on the demolition technique. Furthermore, the study found that C&D waste is regulated in green buildings requiring certification. The energy associated with the building was calculated for each management strategy to identify which was best. The results showed that re-cycling had the highest energy-saving strategy and hence the most viable approach. Reusing was found to be the most viable for building elements with high aluminum content.

Sodagar (2013) researched the sustainability of housing refurbishments in the United States. The study targeted two research projects whose funds were sourced externally and completed in January 2013. Questionnaires were

administered to analyze the environmental impact savings, improved health, well-being, and satisfaction of users of the refurbished homes. In addition, the study emphasized how refurbishment increases savings by reducing construction waste and time compared to building new houses. The study found that tenants in the refurbished buildings enjoyed a tremendous amount of appreciation for the different elements of the building. Additionally, the study found that the building should have a longer life span to keep environmental impact at a minimum.

2.5. Sustainability of Public Housing Construction Projects

Parkolwa (2016) conducted research in Laikipia East sub-county on the factors affecting project sustainability of community-managed water supplies. The target population comprised 12,162 house water consumers, key informants, and executive committee members. A sample size of 419 respondents was developed using probability and non-probability techniques. Additionally, questionnaires, household surveys, and purposive identification of the key informants were used to collect data from the relevant government bodies. The research established that involvement and skills of the community, project sustainability, management team skills, and government policies affect the sustainability of water supplies in Laikipia East Sub-county.

Ibem (2015) researched the sustainability of public housing projects in Ogun State, Nigeria, with a post-occupancy evaluation approach. The study explained the concept of sustainable public housing construction projects and how it can be achieved by considering the affordability of house units and climatic conditions. The study found that public housing projects in Ogun State achieved sustainability criteria since they considered the affordability of house units, climatic conditions, and buildings responding to site conditions. However, Ibem (2015) found that the projects were unsustainable since they used asbestos-based materials during construction, lacked adequate domestic space, and had poor infrastructural facilities. The study concluded that public construction projects in Nigeria needed to adapt to the user's requirements while designing, constructing, and managing the structures to attain sustainability.

Mutisya (2015) conducted a study on urban housing affordability in Kenya, a case study of the mortgage housing sector in Nairobi. The survey method was applied while data was collected by administering questionnaires to a sample size of 390 households with mortgage loans from Housing Finance Institutions and Banks. The study found that housing affordability, loan interest, dependents, construction cost, and household size are immensely related. Mutisya (2015) concluded that the affordability of houses is controlled by factors related to the households' social-economic characteristics. The study recommended that policy measures that improve affordability will reduce or stabilize mortgage interest rates, reduce housing prices, and improve households' income.

Wiesel (2012) conducted a study on developing sustainable, affordable housing, a project-level analysis. The study targeted eight affordable housing projects with diverse social, financial, and environmental features. The projects were selected from a list of affordable housing projects that non-profit organizations had developed. Data were collected through interviews, site visits, design checklists, focus groups with residents, and document analysis. The study conducted a thematic analysis to identify issues that emerged across the projects. The study allowed the current study to explain how to attain the three pillars when planning for sustainable public housing construction projects.

3. Research Methodology

3.1. Research Design

The research embraced both descriptive and explanatory research design. The research adopted a descriptive research design because it is neutral, objective, and positive. The researcher has no control over the variables (Walliman, 2010). The research used an explanatory research design to explain the forces that cause a specific phenomenon (Cooper & Schindler, 2014).

In contrast to descriptive research, explanatory asks questions. It is carried out to discover some relationships among different variables under study. While using an explanatory research design, the researcher will quickly understand how and why things happen.

3.2. Target Population

The target population is defined as a collection of entities with the desired set of information that determines whether or not a sample should be selected (Cooper & Schindler, 2014). The project comprises 600 housing units involving 17 blocks of three-roomed houses, i.e., two bedrooms, a sitting room, a kitchen, and a washing area. Therefore, the target respondents of the research were the professional members involved in the project. The professional members included 40 members from the State Department of Housing and Urban Development, 5 members from United Nations Human Settlements Programme (UN-HABITAT), 17 members from Settlement Executive Committee, 14 members from Muungano wa Wanavijiji, 16 members from Pamoja Trust, and 19 members from Soweto High-rise Housing Co-operative Society Limited. These organizations deal directly with KENSUP Programme (UN-Habitat, 2016).

3.3. Sampling Design

Sample design involves developing a plan to obtain a sample from the sampling frame. The research applied stratified random sampling, which is applied in cases where there is a heterogeneous population and contains several different groups. At the same time, it ensures the representation of all groups in the population (Creswell, 2014). The research applied stratified random sampling because it allowed a larger population's involvement and professionals from different organizations to be involved. The stratification was done based on the different organizations involved in the organization.

3.4. Data Collection Instruments

Primary data sources depict all original work done or raw data that has not been altered. Furthermore, primary data can be pronouncements representing official opinions or positions (Cooper & Schindler, 2014). While collecting data, structured questionnaires made up of close-ended questions were employed to collect the primary data in line with the study's objectives (Mathu & Milkah, 2016).

The research employed descriptive statistics to describe data collected in particular percentages, means, and standard information. Data collected were entered into SPSS to carry out an analysis. Multiple regression analysis links two or more independent variables and one dependent variable and determines the strength of association (Kothari, 2015). The researcher used inferential statistics to assess the quantitative data collected. Lastly, a multiple regression model was applied to determine the correlation between initial cost, maintenance cost, operation cost, end life cost, and sustainability of the public housing upgrading construction project. The regression used was as follows:

$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+€$

Where:

Y=Sustainable the Public Housing upgrading Construction Project

B0=Constant term

$\beta1, \beta2, \beta3,$ and $\beta4$ = Beta coefficients;

X1=Initial Cost

X2=Maintenance Cost

X3=Operation Cost

X4=End life Cost

€=Error term

3.5. Inferential Statistics

According to Kothari (2014), where two or more independent variables exist, an analysis investigating the relationship between the variables is known as multiple correlations.

	Unstandardized B	Coefficients Std Error	Standardized Coefficients Beta	t	Sig
Constant	1.688	0.301		5.601	0.104
Initial Cost	0.182	0.069	0.301	2.621	0.011
Operation Cost	0.108	0.079	0.169	1.368	0.032
Maintenance Cost	0.122	0.072	0.198	1.682	0.048
End Life Cost	0.157	0.060	0.271	2.622	0.011

Table 1: Regression Coefficients
Source: Survey Data, 2021

According to the SPSS generated output, the equation ($Y=\beta0+\beta1x1+\beta2x2+\beta3x3+\beta4x4+€$ becomes:

Y Sustainability of Public Housing Construction Projects =1.688+0.182X1 Initial Cost +0.108X2 Operation Cost +0.122X3 Maintenance Cost +0.157X End of-life cost

3.5.1. Relationship between the Initial Cost of Projects and the Sustainability of Public Housing Construction Projects

The results were a co-efficient of 0.1882 and a p-value of 0.011. The results suggest that the initial cost of projects positively correlates with the sustainability of public housing construction projects in Nairobi City County, Kenya. Furthermore, the results corroborate Alnsour's (2019) findings where research indicated that the initial cost of sustainable construction projects is 10% more than traditional construction projects.

According to Muchoki (2016), the initial cost of projects positively correlates with sustainable construction housing projects through land acquisition. Similarly, Salihu (2019) argued that low land acquisition in the initial cost of projects by the government, with low mass housing development and the rampant population growth in Niger estate, make achieving public houses more of a mirage. Furthermore, Noppen (2013) commented that the initial cost is exceptionally expensive in Kenya, making public housing unsustainable. Finally, Ngige (2016) found that incorporating alternative construction technologies in the initial cost of projects reduces the cost of housing and promotes competitive advantage. Furthermore, alternative construction technologies have improved the functional performances of public houses and have made them affordable to people.

3.5.2. Relationship between the Operation Cost and Sustainability of Public Housing Construction Projects in Nairobi City County, Kenya

With a coefficient of 0.108 and a p-value of 0.032, the results imply a significant positive relationship between operation cost and sustainability of the public housing upgrading construction project in Kibera Soweto. Additionally, the findings show that if operation cost increases within one unit, the sustainability of public housing construction projects will increase by 0.032.

These findings are consistent with Barroso's (2013) research that operation costs in residential buildings are relatively high due to the high water consumption that renders the buildings unsustainable. Additionally, the findings accede with Hwang (2017), who argued that sustainable buildings are leased at a faster rate, reduce operation costs and

create a pool of tenants of better quality. Other studies that agree with the aforementioned statement include Collins & Junghans (2015), among others. Finally, these findings are supported by Ghoul (2016), who stated that operating costs could be extremely expensive and among the factors determining the sustainability of construction projects.

3.5.3. Relationship between Maintenance Cost and Sustainability of the Public Housing Upgrading Construction Project in Kibera Soweto Slum

The results from the analysis indicate a coefficient of 0.108 and a p-value of 0.032, which implies a positive significance. Consequently, maintenance cost positively correlates with the sustainability of public housing construction projects. Therefore, an increase in maintenance costs increases the sustainability of public housing construction projects in Nairobi City County.

These findings are in line with Heralova (2019), who documented that the maintenance cost of public construction projects has not been taken into consideration while making decisions on the sustainability of construction projects which, in turn, led to poor performance of the projects. Additionally, sustainable construction projects have contributed to long-term profits for building owners and occupants by reducing maintenance costs and creating more comfortable internal spaces (Wang, Zainon, & Yusoff, 2014).

Furthermore, Runeson (2016) concluded that a strong relationship exists between the building age and sustainability. In regards to the age of a building, buildings with higher life expectancy are calculated to have a lower maintenance cost and directly affect the economic sustainability of a building (Anderson, 2019). Lastly, Wallhagen (2021) found that using high-quality building materials that incur low maintenance cost is a possible solution to ensure the sustainability of construction projects.

3.5.4. Relationship between End Life Costs and Sustainability of the Public Housing Construction Project in Kibera Soweto Slum

From the results, the coefficient and P-Value were recorded to be 3.168 and 0.01, respectively. Therefore, the results imply that end-life cost significantly affects the sustainability of public housing construction projects in Nairobi City County. This suggests that a unit increase in end-life costs increases the sustainability of public housing construction projects in Nairobi City County by 3.168. The current findings have been supported by Olomomaliye (2012) that the end of life of a building should be considered to control the functional requirements of residential buildings.

Moreover, the probability of a resale value will be improved by the ability to adapt to the new users and subsequently reduce the end-of-life cost of adapting to the new users. Therefore, creating effective end-of-life of a building is one of the strategies to promote sustainability in a building. Gibberd (2015) commented that demolishing buildings after the end of life is unpreventable and should ensure sustainability. One of the ways to achieve this is by reusing materials as much as possible. In a study by Morsi and Radwan (2018), an investigation was conducted to identify how reusing materials can be integrated into sustainability. It was established that re-cycling and reusing materials would save energy consumption and create job opportunities for the public, achieving sustainability. As demonstrated by Pradeep (2017), re-cycling buildings are considered the most effective method to achieve the sustainability of the buildings.

4. Summary

According to the research findings, initial cost positively correlates with the sustainability of public housing upgrading construction projects in Nairobi City County. Also, there is a significant positive correlation between operation cost and sustainability of public housing construction projects. Additionally, maintenance cost positively correlates with the sustainability of public housing construction projects. However, it is a little bit weaker compared to other factors. Finally, the end-life cost was deemed to have the weakest relationship with the dependent variable.

5. Recommendation

The research found that all the dependent variables positively correlate with the independent variable.

The county government of Nairobi should integrate the initial cost of construction projects while considering the sustainability of public housing construction projects. This should be matched with improving building construction technologies to deal with the modern-day sustainability challenges. It also recommends that the county government conduct thorough site surveys to ensure proper relocation of people affected to enhance the sustainability of their projects.

Secondly, the study encourages the county government to consider integrating operation costs into the project costs of public housing construction projects to attain sustainability. Once the operation cost is considered, stakeholders will be given a holistic view of a project's actual cost, subsequently leading to the use of cost-efficient solutions. Furthermore, estimation of operation cost leads to stakeholders coming up with operation strategies that ensure the sustainability of a project. Moreover, the respondents ranked water and sewer connections in operation to have a strong relationship with the sustainability of the public housing construction project. Therefore, the county government should put stringent measures to concentrate on water consumption and sewer connection during operation.

Research recommends that the county government estimate the maintenance cost to cut future losses. In addition, estimating maintenance costs will ensure that the project achieves high quality, cuts down the total cost, and determines the end-users' satisfaction. Finally, the project will achieve environmental and social benefits (Obamwonyi, 2011).

The research recommends that the county government of Nairobi implement policies that govern the end-life costs of public housing upgrading construction projects. This will allow investors to balance the functional and disposal

requirements while planning for the building. In addition, this will enable investors to identify early how to finance the disposal of the buildings and ensure sustainability is achieved.

6. References

i. Amr, K. (2012). Validity of Feasibility Studies for Infrastructure Construction Projects. Jordan Journal of Civil Engineering, 66-77.
ii. Anderson. (2019). Sustainability and the Built Environment: The Role of Durability. Sustainability, 1-19.
iii. AShah, A. (2016). Maintenance Cost for Stratified Buildings: A Critical Review. MATEC Web of Conferences, (pp. 1-12). Kuala Lumpur.
iv. Attar. D. (2016). Engineering Economics and Life Cycle Cost Analysis. International Journal of Research in Engineering Technology, 390-394.
v. Bansal, A. (2016). Recycling and Reuse of Construction and Demolition waste: sustainable approach. (pp. 1-7).
vi. Barroso, M., & Amado, P. (2015). Sustainable Construction; Water Use in Residential Buildings in Portugal. International Journal of Sustainable Construction Engineering & Technology, 14-22.
vii. Bon-Gang, H. (2018). Green Construction Project Financing: Policies, Practices, and Research Efforts. Management Strategies and Innovations, 85-101.
viii. Bragança, L., Vieira, S., & Andrade, B. (2014). Early Stage Design Decisions: The Way to Achieve Sustainable Buildings at Lower Costs. The Scientific World Journal.
ix. Collins, D., & Junghans, A. (2015). Sustainable Facilities Management and Green Leasing: The Company Strategic Approach. 8th Nordic Conference on Construction Economics and Organization (pp. 128-136). Elsevier.
x. Cooper, R., & Schindler, S. (2014). Business Research Methods (12th ed.). McGraw-Hill/Irwin.
xi. Creswell, J. (2014). Research Design: Qualitative, Quantitative, and Mixed Approaches. California: SAGE Publications Ltd.
xii. Cronin, V., & Guthirie, P. (2012). Alternative approaches to slum upgrading in Kibera, Nairobi. Proceeding of the Institute of Civil Engineers-Uran Planning and Design, 173(6), 129-139. doi:10.1680/udap.2011.164.2.129
xiii. Eziyi, I., Egidario, A., & Emmanuel, A. (2015). Assessment of the Sustainability of Public Housing Projects in Ogun State, Nigeria: Mediterranean Journal of Social Sciences, 523-535.
xiv. Fapohunda, Julius, A., & Bimbe. (2021). Effects of Increase in the Cost of Building Materials on the Delivery of Affordable Housing in South Africa. Sustainability, 1-12.
xv. Ganiyu, O. (2015). Sustainable housing financing model to reduce South Africa's housing deficit. International Journal of Housing Markets and Analysis, 411-430.
xvi. Gibberd, J. (2015). Assessing the Sustainable Building in Developing Countries. The World Sustainable Building Conference, (pp. 1605-1612).
xvii. Gora, R. (2016). Relationship between sustainable technology and building age: Evidence from Australia. International High-Performance Built Environment Conference (pp. 1131-1138). Sydney: Elsefvier Ltd.
xviii. Hadeel, A. G., Enshassi, A., & Bernd, K. (2016). Factors Affecting Sustainable Performance of Construction Projects during Project Life Cycle Phases. International Journal of Sustainable Construction Engineering & Technology, 50-68.
xix. Heralova, S. (2017). Life cycle costing is an essential contribution to a feasibility study in construction projects. Science Direct, 565-570.
xx. Kieti, M., Rukwaro, W., & Olima, W. (2020). Affordable Housing in Kenya: Challenges and Opportunities. Africa Habitat Review Journal, 1677-1687.
xxi. Kothari, R. (2015). Research Methodology Methods &Techniques. New Delhi: New Age International (P) Limited, Publishers.
xxii. Marenjak, S. (2017). Operation Costs Model for University Buildings. Croatia.
xxiii. Mathu, & Milkah. (2016). Determinants of Entrepreneurial Activities. Kenyatta University, Department of Gender and Development Studies. Nairobi: Semantic Scholar.
xxiv. Miller. G., Pogue. D., Saville. J & Tu. C. (2010). The Operations and Management of Green Buildings in the United States. 2, 52-64.
xxv. Moawiah, A. (2019). Factors Affecting Sustainability Integration in Public Construction Industry in Jordan. International Journal of Civil Engineering and Technology (IJCIET), 57-68.
xxvi. Morsi, A., & Radwan, A. (2018). Integration of Reusing of Materials as a Tool in Sustainable Design. Helwan University, Faculty of Fine Arts, Egypt.
xxvii. Mungai, E. (2012). The Challenge of Housing Development for Low Income Market. Nairobi.
xxviii. Mutisya, R. (2015). Urban Housing Affordability in Kenya, a Case Study of the Mortgage Housing Sector in Nairobi. Nairobi.
xxix. Noppen, V. (2011). The ABCs of Affordable Housing in Kenya. Acumen Fund.
xxx. Olomolaiye, O., & Chinyio, A. (2012). Design of a Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector. Buildings, 126-152.
xxxi. Opresnik, D., & Marco, T. (2015). The Conceptualization of Sustainability in Operation Management. The 22ND CIRP Conference on Life Cycle Engineering (pp. 532-537). Elsevier.
xxxii. Parkolwa, H. (2016). Factors affecting Project Sustainability of community-managed water supplies in Laikipia East Sub-County, Laikipia East County. Nairobi.

xxxiii. Pradeep, T., & Gomathi, S. (2017). Application of 3R Principles in Construction Project-A Review. Journal of Industrial Engineering and Advances, 1-3.
xxxiv. Reddy, S. (2017). Sustainable Construction: Analysis of Its Costs and. International Journal of Innovative Research in Engineering & Management (IJIREM), 522-525.
xxxv. Salihu, N., & Udoekanem. N.B. (2019). The Significance of Compulsory Land Acquisition in the Delivery of Public Housing in Niger State. Nigeria: Centre for Human Settlement and Urban Development (CHSUD) the Federal University of Technology.
xxxvi. Shan, M., Hwang, B.-G., & Zhu, L. (2017). A Global Review of Sustainable Construction Project Financing: Policies, Practices, and Research Efforts. Sustainability. doi:10.3390/su9122347
xxxvii. Sodagar. B. (2013). Sustainability Potentials of Housing Refurbishment. Buildings, 278-299. doi:10.3390/buildings 3010278
xxxviii. Talib, Yasmin; Ismail, Kelvin; Yakin, Masoudza; Salleh, Agravan. (2016). Preliminary Investigation on The Factors That Influencing The Maintenance Cost of Apartment. MATEC Web of Conference, (pp. 1-6). Perak.
xxxix. Tam, V. (2011). Cost Effectiveness of using Low-Cost Housing. The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction (pp. 156-160). Elsevier Ltd.
xl. Tenggoro. N & Pratesyo. K. (2018). The usage of green building concept to reduce operating costs (study case of PT. Prodia Widyahusada). Asian Journal of Accounting Research, 72-80.
xli. UN-Habitat. (2016). World Cities Report, Urbanization, and Development: Emerging Futures Nairobi: UN-Habitat. Nairobi.
xlii. Wallhagen, M. (2021). Life Cycle Cost Analysis of a Single-Family House in Sweden. MDPI, 1-20.
xliii. Walliman, N. (2010). Research Methods: The basics. London: Routledge.
xliv. Wang, c., Zainon, N., & Yusoff, M. (2014). Sustainable Construction through Life Cycle Costing. Journal of Building Performance, 84-94.