Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 09, September-2021

Influence of Technology Adoption on Sustainable Low-Cost Housing in Kajiado County, Kenya

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***Abstract*:- Affordable and low-cost building is the wish of most individuals globally. In the developing countries, sustainable low-cost housing remains a challenge. The purpose of this study is to investigate the influence of technology adoption on sustainable low-cost housing. The researcher used quantitative and qualitative approach; the population was from the user and Building Construction professionals in Kenya and using scientific formulae 63 respondents made the sample size for the study. Primary and secondary data was collected using interview and questionnaire. The data was entered into SPSS so as to generate data array, descriptive statistics data analysis method was applied. The study established that technology adoption had a positive significant effect on cost of housing. The study recommends that all contractors in Kenya should enhance their housing resource usage through value engineering so as to lower the costs of housing. The management of all construction companies to adopt more technologies so as to lower the costs of housing. More advanced value engineering techniques should be adopted by contractors so as to lower the costs of housing**

Key words: Technology adoption, Sustainable Low-Cost Housing

1.1 INTRODUCTION

Sustainable low-cost housing technologies which could provide houses to masses at affordable cost assumes greater significance. The present strains on Kenyan economy and the ever-growing demand for housing, call for adoption of appropriate building technology which could achieve utmost economy and speed in construction (Schilling, 2005).

Kajiado is considered one of the growing counties in Kenya where about 0.7 million inhabitants have moved to the area from other parts of the country. The estimated 3.8% growth rate annually and the average of 5 persons' family size. Shabana (2005), indicates that the geographic and economical siege on Kajiado causes a serious harm to the residents social and economic life. 65% of the people of Kajiado operate below the poverty line. 91.1% of the families need housing units, whereas, 71.1% purely relies on their financial resources because they do not afford the high costs of housing, due to population increase by 3.8% annually. It can be concluded therefore that, new housing units needs to be constructed in order to take care of the swelling population annually (Kabati, 2015).

In the historical context, private sector lead in providing housing in the local markets. The private sector form of involvement in the housing industry ventures in a wise manner. Besides, low incomed families neither benefit from private sector interventions nor construct their houses reliant on their own resources. Social housing programs may be the only way to solve such problem because they help reduce the incurred costs. Social housing programs being implemented in Kajiado by Private estate developers does not successfully provide housing units and repayment does not suits economic capabilities of the beneficiaries.

In nutshell, it is constrained legally for the beneficiary to pay mortgage from monthly income or rent. Consequently, the reimbursement process was constrained and the evolvement of such programs was not in place. According to Gichunge (2001), "one of the main challenges in Kajiado to the estate developers engaged with housing sector is providing low-cost housing for people of limited income and those in need of housing". "Such challenges are due to inability to balance between the needs of the targeted families in terms of spaces and the minimum quality standard in one hand, and the high construction prices and the shortage of financing in the other hand" (Atati, 2014). The moderate and Low-income residents represent the huge majority of the population in Kenya and Kajiado county in particular. Making reasonable and cost effective houses for low-income earners revolves around reducing the cost of housing delivery and the factors that affect producing housing units. This study therefore sought to investigate the influence of technology adoption on sustainable low-cost housing in Kajiado County, Kenya.

2.1 GENERAL OBJECTIVE

The overall objective of this study was to investigate the Influence of Technology Adoption on sustainable Low-Cost Housing in Kajiado County, Kenya.

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3.1 LITERATURE REVIEW

This paper reviewed the related literature concerning the factors predominantly affecting the OSH compliance on construction sites in Kiambu County. The study further reviewed out relevant studies regarding stakeholder engagement and how technology affects the OSH compliance on the construction sites.

3.1.1 Technology adoption and sustainable low-cost housing

Technology adoption in the construction industry plays an instrumental role in realizing that housing which is cost effective is done to ensure that the residents get affordable housing. A study by Jain and Paliwal (2012) on adoption of appropriate and cost-effective technologies in housing established that there is an array of technology options available for various elements of building construction, leading to cost-effectiveness and at the same time not affecting the performance characteristics expected from a decent house. It is desirable to have increased understanding of the various materials and technology options, its structural and functional characteristics and efficiencies and more importantly the methodologies for implementation.

Tam (2011) looked at cost effectiveness of using low-cost housing technologies in construction. Adequate shelter for all people is one of the pressing challenges faced by the developing countries. It is found that cost-effective and alternative construction technologies, which apart from reducing construction cost by the reduction of quantity of building materials through improved and innovative techniques, can play a great role in providing better housing methods and protecting the environment. It was found that about 26.11% and 22.68% of the construction cost, including material and labour cost, can be saved by using the low-cost housing technologies in comparison with the traditional construction methods for walling and roofing respectively. This proves the benefits and the trends for implementing low cost housing technologies in the industry.

Akinboade (2012) sought to understand factors influencing the adoption of housing technology by home builders in South Africa. The adoption of new technologies can provide substantial benefits to the housing industry. These include increased housing affordability, increased profitability, enhanced product quality and durability and reduced environmental footprint. The most influential sources of new technology advice are sub-contractor advice, home buyers and National Home Builders Registration Council seminars.

3.2 Theoretical framework

This research is theoretically grounded on the World Bank Approach. This model is ideal since they support the influence of the independent variables on the dependent variable under study.

3.2.1 World Bank Approach

This approach is holistically articulated on the precinct of economic determinism and was bestowed on replicability and affordable cost recovery. This approach was principally anchored on the absolute cost recovery or close to total recovery with barely any subsidies. However, it is a suitable method in the absence of essential local resources, it had to be supported by other programmes especially if the interests of low-income category of individuals had to encounter.

Such concession, World Bank gave loans to the developing countries in order to enable them invest in the housing scheme for the low-income earners; converted residents to borrowers of loaning institutions thus settling finances for housing venture by the government and delivered these units to housing dwellers. This aimed at strengthening the market mechanism and diminish the delivery of housing project.

The criticism on World Bank model "showed an over focus on market mechanisms, putting miniature consideration to the matters of infrastructure and land tenure". "Structural Adjustment Programmes (SAPs) which were introduced by World Bank in the 1990s were very unpopular, this also made the Kenyan government scale down its expenditure in housing and as a result more informal settlements in the city cropped up".

The newly introduced "Kenya Informal Settlement Improvement Programme (KISIP)" by World Bank and other development partners was geared towards strengthening institutions and program management, promoting security tenure, infrastructural development, planning for urban growth and service delivery.

3.3 Conceptual Framework

Independent variable **Moderating Variable** **Dependent variable**

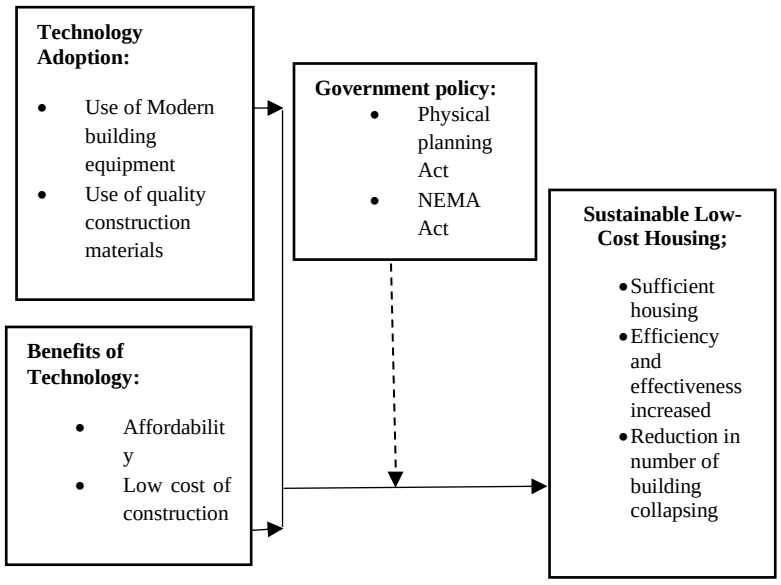

Figure 1 : Conceptual framework showing the inter-relationship between the variables

4.1 RESEARCH METHODOLOGY

The study adopted descriptive research design, as it determines and reports elements in their natural setting and the way they are (Yin, 2013). Descriptive research design is used when data is collected to describe persons, organizations settings or phenomena. Descriptive research design was useful in this study to assess the impact of value

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engineering application to sustainable low-cost housing in Kenya.

Building Construction professionals in Kenya are the target population as they are likely to be knowledgeable about Influence of Technology Adoption on Sustainable Low-Cost Housing in Kajiado County, Kenya. The study will concentrate on construction project professionals and the end-users of low-cost housing units. The population of interest to the researchers covered the four key categories of construction professionals; such that the population was 60 Architects registered by Architectural Association of Kenya (AAK); 47 Construction Managers registered with CPM chapter of the AAK; 54 Civil Engineers registered with Engineers Board of Kenya (EBK) and 41 Quantity Surveyors from Board of Registration of Architects and Quantity Surveyors (BORAQ) and for the users in Kajiado County who have already benefited from the low-cost housing units, as per the records in the county office, there are 440 families that were of interest to the researcher. The reason for the researcher to choose Kajiado County due to an increase in the population of 3.8% annually, the need of 91.1% of the families for housing units and the family size, it can be concluded that a large number of new housing units are needed annually.

The research employed stratified random sampling in selecting registered respondents. The population was segregated into several mutually exclusive subpopulations or strata herein referred to as membership categories. Stratification was applied based on the stratum's share of the total population to come up with the sample in each stratum.

The study then selected 10% from each strata to determine the sample size. According to Mugenda and Mugenda (2003), a sample proposition of between 10 to 30 % is adequate to determine the sample size of a population. Therefore, for the professionals the sample size came to 19 cutting across the different groups and for users it totals to 44. The total number of respondents was 63 who were included in the study. The actual members were arrived at by using simple random procedures to draw the sample from each stratum based on KCA (2009).

4.2 Data Collection method

Data was collected by use of a self-administered structure questionnaire. The study contained open ended, closed ended questions and Likert scales. Open ended questions allowed the respondent to answer the questions in any way they chose while closed ended questions asked the respondents to make choices among a set of alternatives given by the researcher (Kothari, 2006; cited in Abaya & Ondieki, 2021).

Closed ended questionnaires were sent online to the selected participants. The 7 open ended questionnaires for qualitative data were issued via mail to the respondents referred to. Should an interview be necessitated where a respondent is wary on responding to ethical issue via internet in collecting qualitative data, the open-ended data Instrument will not be altered for the purpose of consistency but questions may be asked in a different sequence. The researcher would then fill in responses as the interviewer responds to each query.

Computerization was preferred as it is convenient and has advantages of being impersonal; so social desirability is reduced as well as enhancing consistency. The computerized administration ensured questions are neither asked in the wrong order nor were they skipped. The program prompted respondents on invalid responses and prompt them to check implausible answers. More important; the computer could control sequencing and branching. Internet surveys were available 24 hours making response rate higher while reducing postage and photocopy charges (McBurney and White, 2007).

The greatest advantage of the computer survey is the access of AAK, EBK and BORAQS members spread out in various regions in the country. The questionnaires were programmed in a manner that the researcher was able to automatically remind the participants to fill in the questionnaire. This was followed by a reminder notice in fortnight.

5.1 RESULT

5.1.1 Background of the Respondents

The study issued out 63 research tools to professionals and users during data collection in the field. From these items, 50 of them were completely filed and returned to the researcher. This was equal to a response rate of 79.4% as illustrated in Table 4.1.

Table 4.1: Response Rate

	Frequency	**Percentage**
Response	50	79.4
Non Response	13	20.6
Total	**63**	**100.0**

The response rate in figure 2 was consistent with Babbie (2010) who noted that response rate of over 70% is considered to be sufficient for presentation of the results.

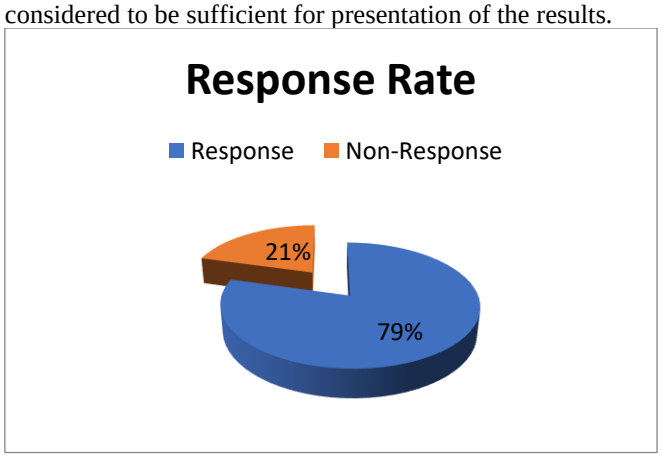

Figure 2: Response return rate

General Information on Professionals

The first general information of the professionals sought to determine their gender and the results are shown in Table 4.2.

Table 4.2: Gender of the Professionals

	Frequency	**Per cent**
Male	10	66.7
Female	5	33.3
Total	15	100.0

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From Table 4.2, majority of the professionals (66.7%) were male and 33.3% were female. This means that there was gender diversity in the study as both male and female respondents were covered. The second general information sought to determine the positions held by respondents. The results are indicated in Table 4.3.

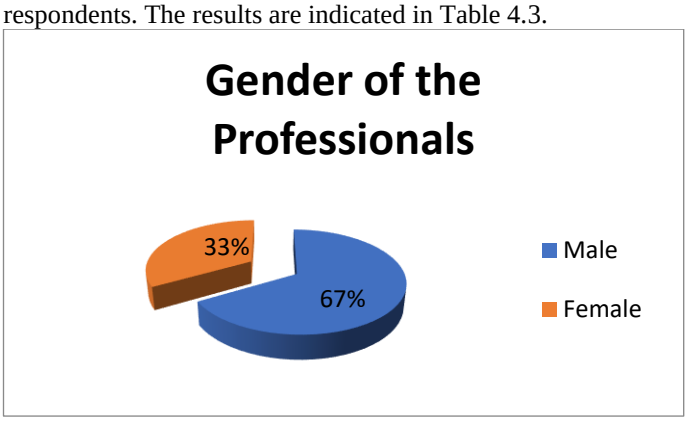

Figure 3: Gender of the professionals

Table 4.3: Positions of the Professionals

	Frequency	Per cent
Architect	5	33.3
Construction Manager	3	20.0
Civil Engineers	4	26.7
Quantity Surveyors	3	20.0
Total	**15**	**100.0**

Table 4.3 indicate that majority of the professionals 33.3% were architects, 26.7% were civil engineers and 20.0% were construction managers and quantity surveyors respectively. This implies that respondents of the study were from diverse fields and areas of specialization which were relevant to the present study. The results on the number of years that respondents had served in these positions are indicated in Table 4.4.

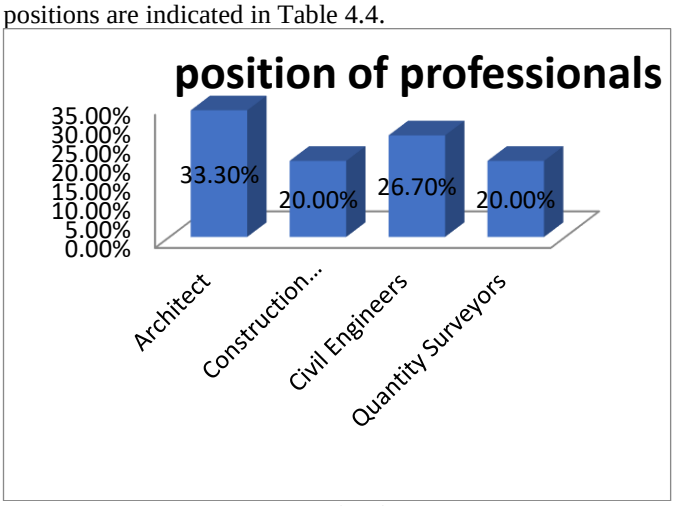

Figure 4: Position of Professionals

Table 4.4: Length of Service in the Position

	Frequency	Per cent
0 – 5 years	3	20.0
5-10 years	3	20.0
10 – 15 years	4	26.7
15 -20 years	3	20.0
Above 20 years	2	13.3
Total	**15**	**100.0**

The results in Table 4.4 indicate that majority of the respondents (26.7%) had worked in their respective positions for a period of 10-15 years, 20% for a period of 0-5 years, 5-10 years and 15-20 years respectively while 13.3% for over 20 years. This means that respondents of the study had generally worked in their respective positions for a long period of time and thus they were knowledgeable as sought by the study. The study sought to determine the classification of the studied organizations and results are illustrated in Table 4.5.

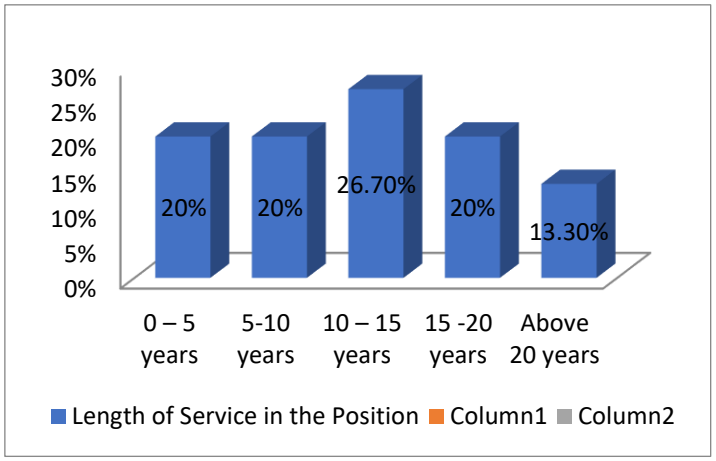

Figure 5: Length of service

Table 4.5: Organizational Classification

	Frequency	Per cent
Contractor	3	20.0
Construction	5	33.3
Client manager	5	33.3
Supplier	2	13.3
Total	**15**	**100.0**

The results in Table 4.5 indicate that 33.3% of the organizations were in the construction or they were client managers, 20% were contractors and 13.3% were suppliers. This means that representative information was gathered from the organizations as they belonged in different categories of business.

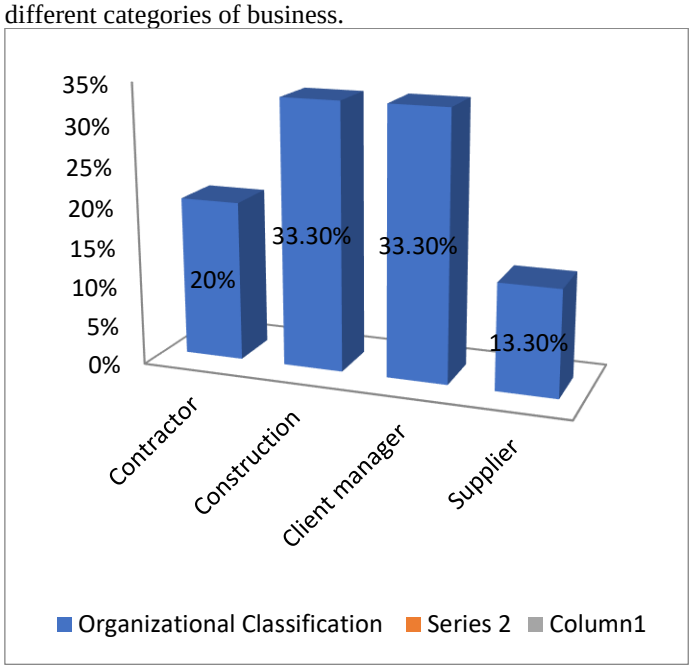

Figure 6: Organization classification

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5.1.2 General Information on Users

The study further gathered the general information of the users of the houses. The first general information under this category was the gender distribution of the users and the results are as tabulated in Table 4.6.

Table 4.6: Gender Distribution

	Frequency	Per cent
Male	26	74.3
Female	9	25.7
Total	**35**	**100**

From the results in Table 4.6, majority of the respondents (74.3%) were male and 25.7% were female. This means that representative findings were gathered from the users as both male and female respondents were covered by the study. The study sought further to determine the highest level of education of the users and the results are as provided in Table 4.7.

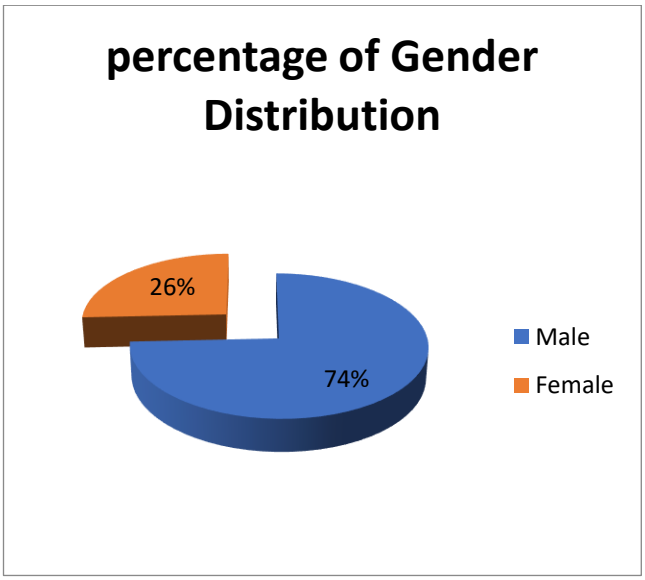

Figure 7 Gender distribution

Table 4.7: Highest Level of Education

	Frequency	Per cent
No formal education	3	8.6
Primary education	4	11.4
Secondary/High School	10	28.6
College Diploma	11	31.4
University Degree	7	20.0
Total	**35**	**100.0**

As indicated in Table 4.8, majority of the respondents (31.4%) had college diplomas, 28.6% had secondary/high school education and 20.0% had university degrees, 11.4% had primary education while 8.6% had no formal; education. This shows that the users who were covered by the study could generally read and writes and thus they were able to read and interpret the research questions.

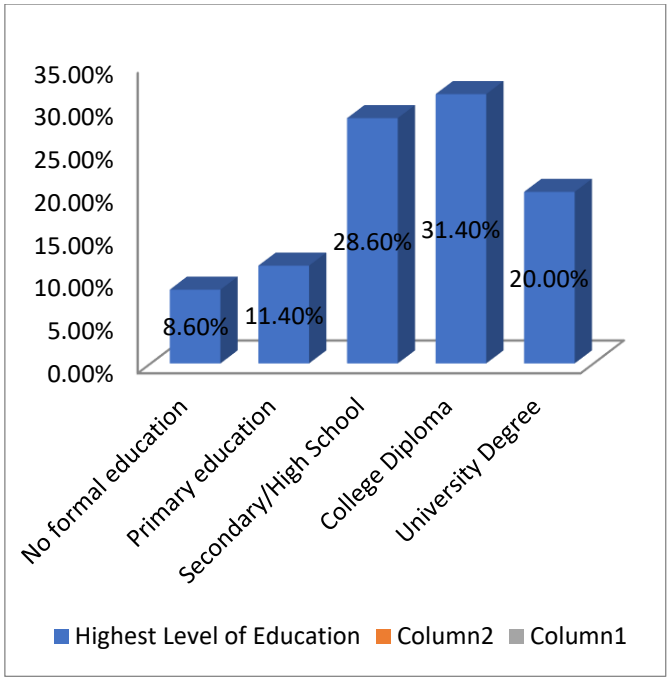

Figure 8 Highest level of education

5.1.3 Descriptive analysis

The research sought to establish the influence of technology adoption on sustainable low-cost housing. The results are presented in subsequent sections.

5.1.3.1 As Shared by Professionals

The responses of the professionals on the influence of technology adoption on sustainable low-cost housing are shown in Table 4.8.

Table 4.8: Technology Adoption by Professionals

Statement	Mean	Std. Dev
Sustainable low-cost housing technologies help in producing housing for the masses	3.56	.833
Adoption of appropriate building technology increases the speed in construction	3.83	.816
There are technology options for various elements of building construction that lead to cost-effectiveness	3.60	.676
Our construction staff have an understating on the various building technology options	3.66	.487
Alternative construction technologies help in providing better housing units	3.63	1.133
Innovative technologies are used to protect our environment	3.53	.516
Low-cost housing technologies reduce construction costs	3.80	.414
The adoption of new technologies provides substantial benefits to the housing industry	3.73	.816
We get new technological advice from contractors in seminars	3.53	.743

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ISSN: 2278-0181
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Increasing our housing unit delivery makes us enjoy economies of scale	3.65	.899
We use locally available technology to ensure low cost of building materials	3.53	1.112

From Table 4.8, majority of the professionals agreed with a mean of 3.83 that adoption of appropriate building technology increases the speed in construction and that low-cost housing technologies reduced construction costs with a mean of 3.80. The professionals were in agreement that adoption of new technologies provides substantial benefits to the housing industry with a mean of 3.73, their construction staff had an understating on the various building technology options with a mean of 3.66 and that increasing their housing unit delivery made them enjoy economies of scale with a mean of 3.65. Alternative construction technologies helped in providing better housing units with a mean of 3.63, there were technology options for various elements of building construction that led to cost-effectiveness with a mean of 3.60 and that sustainable low-cost housing technologies helped in producing housing for the masses with a mean of 3.56. The professionals also shared that they got new technological advice from contractors in seminars and that they used locally available technology to ensure low cost of building materials as shown by means of 3.53 respectively. The statements are supported by low values of standard deviations implying that respondents shared similar views on them.

5.1.3.2 As Shared by Users

The findings on technology adoption as shared by the users are illustrated in Table 4.9.

Table 4.9: Technology Adoption According to Users

Statement	Mean	Std. Dev
Our houses are more advanced	3.54	.505
The houses are affordable for us	3.47	.978
Housing professionals us technology to ensure low cost of building materials so that we can afford the house	3.58	.817

From Table 4.9, majority of the users shared that housing professionals used technology to ensure low cost of building materials so that they could afford the house with a mean of 3.58 and that their houses were more advanced with a mean of 3.54. However, respondents were not certain whether the houses were affordable as shown by a mean of 3.47. The values of standard deviation are all less than 1; showing that respondents shared same views on the statements provided under technology adoption.

5.1.4 Cost of Housing in Kajiado County

The dependent variable of the study was cost of housing and the results are as shown in Table 4.10.

Table 4.3: Cost of Housing in Kajiado County

Statement	Mean	Std. Dev
Our affordable housing units satisfy the demand for low cost housing units	3.63	.816
We use modern technologies to avail low-cost house units to people	3.80	.736
We design conservative houses to aide in provision of low cost units	3.60	.736
Eliminating unnecessary designs lowers the cost of houses	3.70	.736
We use engineering techniques to prevent costs hence provide low cost houses	3.76	.833

From the results in Table 4.10, majority of the professionals agreed with a mean of 3.80 that they used modern technologies to avail low-cost house units to people, they used engineering techniques to prevent costs hence provide low cost houses with a mean of 3.76, eliminating unnecessary designs lowered the cost of houses with a mean of 3.70, their affordable housing units satisfied the demand for affordable housing units with a mean of 3.63 and that they designed conservative houses to aide in provision of low cost units with a mean of 3.60.

5.2 Conclusions

Findings in regard to the study concluded that technology adoption revealed a positive effect on cost of housing. Majority of the professionals said that adoption of appropriate building technology increases the speed in construction and that low-cost housing technologies reduced construction costs. The professionals indicated that adoption of new technologies provided substantial benefits to the housing industry, their construction staff had an understating on the various building technology options and that increasing their housing unit delivery made them enjoy economies of scale. Alternative construction technologies helped in providing better housing units, there were technology options for various elements of building construction that led to cost-effectiveness and that sustainable low-cost housing technologies helped in producing housing for the masses. The professionals also shared that they got new technological advice from contractors in seminars and that they used locally available technology to ensure low cost of building materials. Majority of the users shared that housing professionals used technology to ensure low cost of building materials so that they could afford the house and that their houses were more advanced.

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7.0 Bibliographies

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