

DESIGN CHANGES AND QUALITY OF GOVERNMENT FUNDED BUILDING PROJECTS IN ISIOLO COUNTY, KENYA.

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ABSTRACT

Successful management of the crucial and complex interface between design and pre-construction activities of government funded building projects is becoming increasingly important. This is particularly so in the realization of quality public buildings. This study investigated the influence of design changes on the quality of government funded building projects in Isiolo County. The study is pivoted on one theory; Axiomatic design theory. The study is further supported by the object-oriented information model. Descriptive survey research design is employed. Target population was composed of 137 project clients, 92 contractors and 16 consultants. A sample size of 149 participants was used and respondents selected using Stratified and Simple random sampling. Three questionnaires were used to collect primary data. Quantitative data was analyzed using descriptive statistics while qualitative data was reported in form of narratives guided by themes under study. The study established that schedule overruns, building functionality, reduced project costs and cost overruns all emanated from design changes. The study therefore concluded that design changes immensely influenced the quality of government funded building projects in Isiolo County. The study recommends that project clients should both be concise and unambiguous on design objectives. Additionally to ensure buildings quality only competent registered contractors and consultants should engaged in government funded projects.

Key terms: Design Changes, Government Funded, Quality of Building Projects, Schedule Overruns, Cost Overruns

1.0 Background Information

According to Newton, (2008) effective design management does mitigate the negative influence and enhance positive influence of design factors on the quality of building projects. Best, (2010) also did observe that the quality of most buildings is negatively influenced by design factors; design defects, design changes and ineffective communication on design between architect, client and contractor. Sinclair, (2011) did support this view by proposing architects should play a key leadership role in design management as a solution to the negative influence brought about by design factors on the quality of buildings.

Scholars in Europe report that design factors play an important role in influencing the quality of government funded building projects. For instance, in the U.K the performance of the contractor in delivering quality government funding buildings was determined by the specifications and

architectural design given to him (Butcher & Sheehan,2010). However, the Royal Institute of British Architects (RIBA) emphasized that it was the role of architects to ensure that buildings were delivered at clients' design requirements for both public and private (Royal Institute of British Architects, 2013). In Italy, Gersup, (2010) did report that design errors were responsible for 33% of poor quality government funded buildings projects. In Germany, Tiedemann, (2012) did also point that adherence to specifications and minimal design changes and defects did positively influences the quality of government funded buildings projects implemented in most parts of the country.

1.1.1 Design Changes

This is where drawings become different from the ones issued at the time of contract signing. Change in construction projects become almost unavoidable. Changes cause disruption of performance of construction project especially on time and cost. They occur by clients changing on the requirement, design consultants omissions, unforeseen site conditions and advancement in technology (Gray & Hughes, 2001). In South America, Pasquire and Garido (2011) did report that lean design approach was adopted to mitigate the negative effects on the quality of buildings meant for social housing in Chile brought about by constant changes in design. On the other hand in Mexico, González, González, Molenaar and Orozco (2013), did report that design changes did result in delays in 63% of government funded buildings projects adversely influencing the quality of these buildings.

In a study in Korea, Ahadzie (2011) did post that design changes were major factors in the performance of contractors working in the Korean Metrological Administrations (KMA) government funded buildings and overall quality of these buildings. In China also, Yung and Yip, (2010) did report that design changes were major bottleneck in ensuring the successful completion of quality buildings by the Chinese Government. In India, Hementa, Ani, Iyer, and Sameer (2012), did observe that 47% of government funded projects were delivered below expected quality specifications emanating from different design factors mostly design changes.

In Jordan, Sweis, Sweis, Abu and Shboul (2008), did point out that the occurrence of numerous design changes were leading to delay in 69% of government funded buildings which also

resulted to design defects contributed by lack of effective coordination about the variations in design which adversely influenced the quality of these projects. However, the united Arab emirates (UAE) Faridi and El Sayegh (2006) did point out frequent design variations were responsible to delays which adversely influenced the quality of 18% of government funded buildings. Similarly in Saudi Arabia Al-Kharashi and Skitmore (2009), did report that 14% of constant design variations were initiated by government architects and contractors.

In Nigeria, Oyedele, Jaiyeibo and Fadeyi (2012), did report that design changes were 78.93% responsible in influencing quality of government funded building projects. It was reported client design variations were responsible for drastic modifications in the standard of building materials consequently the overall buildings' quality in Ghana (Asamaoh & Offei-Nyako, 2013).

Scholars in East Africa have also highlighted the influence of design factors on the quality of government funded buildings. For instance in Tanzania, Kikwasi, (2012) did report that despite the existence of a regulatory body; the National Construction Council 64% of government funded buildings were delivered in poor quality emanating from numerous design variations which also caused delays in construction process. In Uganda, Basheka and Tumutegyereize, (2012) reported that 81% of government funded building were delivered at poor quality standards due to the frequent design changes, design errors and unreliable communication on design about these changes.

2.0 Statement of the Problem

Quality is an important aspect and a key performance indicator for all projects. However, along with the aspiration of government world over, most government funded building projects not only fail to be delivered on time but they fall below set quality standards (Chan, Scot and Chan, 2004). The quality of building projects has been compromised due to issues such as deficiencies in scheduling which cause project delays emanating from; design changes, design defects, poor specifications and unreliable and inconsistency communication on design. This has also resulted to issues such as; cost overrun and time delays which adversely influenced the quality of public buildings.

The situation is worse in Isiolo County where a considerable percentage of government funded buildings construction projects are falling below set quality standards as most of these buildings have unpleasant aesthetics, most have poor and unsafe accessibility, undergo numerous re-works and exhibit poor functionality of most building parts like windows and doors. This is evidenced by a report done by the ministry of public works (2015) on fourteen (14) government funded buildings that had to be stopped due to quality issues (Ministry of Public works-Isiolo).

It is for this reason this study sought to investigate the design factors that influence the quality of government funded building projects in Isiolo County. Specifically the study looked at the influence of; communication on design, design changes, design defects and design specifications.

3.0 Hypothesis

H₀: Design changes do not have a relationship with the quality of government funded buildings projects.

H₁: Design changes have a relationship with the quality of government funded buildings projects.

4.0 Quality of Government Funded Building Projects

The quality of buildings that are government funded projects entails various features that include; building safe access, reliable design in terms of cost, attractive finishing or pleasant aesthetics in the floor, walls and ceilings (Cardellino, Leiringer & Clements-Croome, 2009; Suratkon, Chan & Jusoh 2016). Quality of government funded public buildings is also defined in terms of; building reliable security, value for public financial investment and the delivery of the building project within schedule (Cardellino, et al., 2009; Suratkon, et al., 2016).

In their study, McAuley, Hore and West, (2012) observed the need to adopt Building Information Modeling (BIM) to enhance quality of government funded buildings projects in Ireland. They note this involved the use of BIM for the enhancement of; value for money and reliable design in relation to cost (McAuley, et al., 2012). In a study, Wanigarathna (2014) found evidence on the quality of government funded hospitals in England and Wales. He notes the hospitals buildings' quality was defined in terms of; reliable security they offered to patients, their accessibility by patients, reliable design in relation to cost and the delivery of the projects

within schedule (Wanigarathna, 2014). In a study, Castro, Mateus and Bragança, (2012) also established the quality of government funded hospital buildings projects in Portugal was determined by design indicators. Further, they observe the quality of these government funded buildings projects was determined in terms of; building durability as a result of initial design and reliable design in relation to cost (Castro, et al., 2012).

In a study, Suratkon and Jusoh (2015) found evidence on quality indicators of government buildings projects in Malaysia. They observe these included; safe access to buildings, security of the buildings and the integration of pleasant aesthetics to the buildings (Suratkon & Jusoh, 2015). Similar evidence by Samah, Ibrahim, Othman and Wahab (2012) who observed the quality of a government funded outpatient unit in a public hospital in Malaysia. They note these included; building safe access by patients, pleasant finishes and reliable design in relation to cost (Samah et al., 2015). In a study, Juan, Cheng, Perng and Castro-Lacouture, (2016) also found the government was funding renovations of old buildings to improve on the quality of government funded building projects in Taiwan. They note these included enhancing quality in terms of; reliable design in relation to cost, building accessibility and security. However, they observe most of these building projects were finished behind schedule and the design prejudiced building durability adversely influencing on the overall quality (Juan, et al., 2016).

In a study, Cobbinah (2010) observed factors that define the quality of government funded building projects housing academic institutions in Ghana in relation to design. He notes that these included; pleasant aesthetic, building safe access and durability all of which are determined by initial design influencing the maintenance of these public institutions' buildings (Cobbinah, 2010). Similarly, Agyekum, Ayakrwa and Amoah (2016) found evidence on quality of government funded building projects in Ghana. He contends the indicators of quality in government funded building project were; building accessibility and durability and pleasant aesthetics that most buildings lacked (Agyekum, et al., 2016). In a study, Femi (2014) also observed faulty design issues influencing the quality of government funded building projects in Nigeria. He notes these influenced the quality of these building projects in terms of; pleasant aesthetic, building safe access and durability and value for money (Femi, 2014).

In a study, Gaetsewe, Monyane and Emuze (2015) found evidence on the quality indicators of government funded building projects in South Africa. They note the quality of these projects was defined by the delivery time that was behind schedule (Gaetsewe, et al., 2015). Similarly, De Klerk (2013) observed changes in design to a better model had influenced the quality of government funded public schools buildings projects in South Africa. He established that the quality of these projects was determined by; safe access to these buildings and their durability, reliable design in relation to cost and project delivered on time (De Klerk, 2013).

In a study, Mhando, Mlinga and Alinaitwe (2017) observed quality disparities in government funded building projects in Tanzania. They note different public building projects exhibited variations in quality in terms of; their delivery schedules and design in relation to costs (Mhando, et al., 2017). Similarly in a study, Kakitahi, Alinaitwe, Landin and Mone (2016) found evidence on quality indicators of government funded building projects in Uganda. They note the quality of these building projects was determined by; delivery schedules which was in most case behind time and reliable design in relation to project cost (Kakitahi, et al., 2016). Further, Muguiyi (2012) also found evidence on quality of government funded buildings projects in Kenya. She notes quality was defined in terms of; delivery of building projects in time, building safe access and reliable design in terms of costs (Muguiyi, 2012).

5.0 Design Changes and Quality of Government Funded Building Projects

According to Armstrong, (2008) variations in design have both positive and negative influence on the quality of buildings construction projects. Keane, Sertyesilisik and Ross (2010), also emphasized that variation in design were in some cases reported to have positively influenced the quality of public buildings. They for instance observed that in Scotland, variations in design did positively influence the aesthetics of public buildings such as through repainting of walls and improvement of accessibility through improvement of alleviators and stairways and also the fitting to standard of doors and windows that were previously poorly installed (Keane et al., 2010). Haymaker, Chachere and Senecu (2011), in a study in Sweden demonstrated similar results by pointing out that design changes in the construction of an office in a public university did improve the building's interiors especially the ceiling, the construction of a disabled person's ramp, proper installation of windows and doors and the paint work. Further, in study in Finland

on the life cycle of public buildings, Malmqvist, Gaulmann, Scarpellini, Zabalza, Arnada, Lliela and Diaz (2011), did demonstrate that variations in design in government funded buildings had improved previous construction work with significant improvement been reported in the ventilation rates in these buildings, light quality, duct systems, roof structure and roof insulation. The abrasive nature on the paint work on exterior walls was also reduced through the improved roof structure (Malmqvist et. al., 2011).

Design changes have been reported to have both positive and adverse effects on the quality of public buildings in Asia. For instance, in a multivariate regression model study on factors influencing the quality of public buildings in China, Bin, Qin, Yignxin, Li, Hongbo and Gaofeng (2011), did observe that, design changes had positively influenced the quality of most public buildings in Shanghai and that citizens were more satisfied with public buildings in Shanghai than those in Beijing. They further argue that changes in design of public buildings in Shanghai did do away with previously poorly constructed stairways, poorly fitted doors and windows and poorly done floor tilling which improved both the accessibility and aesthetics of buildings (Bin et. al., 2011). Dolo, Sawhney, Iyer and Rentala (2012), in their study did report that public buildings in India were delivered both behind schedule and at higher costs a situation that arose from the numerous design changes implemented by government architects and structural engineers. Further, they postulated that this did adversely influence the quality of these buildings leaving most of them with unpleasant aesthetics especially an undesirable paint work, inaccessible and poor functionality of windows, stairs and elevators (Dolo et. al., 2012).

Similarly in their study Pai and Bharath, (2013) did postulate that the numerous design changes effected by government architectures and structural engineers in India did cause delays in the implementation of government funded building infrastructural projects which had adverse effects on the quality of these buildings. Further, they observed that these changes on the design had a negative effect on the understanding of contractors on the final product resulting to buildings that had poorly fitted doors, windows and poorly done floor tilling (Pai & Bharath, 2013). Similar findings were reported in a study in Malaysia by Ibrahim, Roy, Ahmed and Imtiaz (2010), who did point out that design changes did majorly influence the quality of government funded buildings infrastructural projects as they adversely influenced the construction process. This they argue had adversely influenced the installation of interior features of these buildings resulting to

poorly installed ceilings, doors and windows and also had influenced stairway construction which resulted to dangerous accessibility of these buildings (Ibrahim et. al., 2010). Alwi and Hampson, (2003) did also demonstrate that the quality of buildings' interiors in government funded buildings in Indonesia was compromised by the frequent design changes effected by government architects.

Arain and Pheng, (2005) in their study also found that variations in design had adversely influenced the quality of government funded institutions' buildings in Iran. Further, they demonstrate that design variations negatively influenced the installation of buildings interiors such as; doors and windows, influenced paint work and floor tiling (Arain & Pheng, 2005). In a study, Alaryan, Elbeltagi, Elshahat and Dawood (2014) did also demonstrate that frequent variations in design did adversely influence the proper installation of buildings interiors in public housing projects in Kuwait which was evidenced by poorly and loosely fitted doors and windows and hanging ceiling parts. Further, they contend that delays caused by variations in design did affect paintwork as it exposed it to the abrasive effects of climatic conditions and the positioning of ventilations in these buildings (Alaryan, et. al., 2014). However in Kuwait Rashid, Elmikawi and Saleh (2012), in his study did contend that variations in design did positively influence the quality of government funded sports facilities leading to the introduction of disabled people's ramps, improved paintwork and seating areas. The quality of public buildings in Oman was adversely influenced by numerous changes in design which resulted to schedule overruns that led to cracks on walls, beams and pillars (Alnuaimi, Taha, Mohsin & Alharti, 2010).

Design changes have also been found to have negative influence on the quality of government funded buildings in Africa. This is opined in a study in Egypt by El-Razek, Bassioni and Mobarak (2008), through which they pointed out that design changes did cause delays in government funded building construction projects in the country which had adverse effects on the quality of these projects. This they observe was evidenced by the poorly done paint work, ceilings and poorly constructed stairways that made the accessibility of these buildings dangerous (El-Razek et al., 2008). These findings were supported in a study by Marzouk and El-Rasas, (2014) who did postulate that government funded buildings in Egypt were delivered behind schedule as a result of the many design changes that were initiated by government architectures and structural engineers. This they contend did negatively influence the quality of

these buildings evidenced by the undesirable paint work, incomplete stairs that made the accessibility of these buildings dangerous and poorly fitted doors and windows (Marzouk & El-Rasas, 2014). Cracks in beams, poorly fitted doors and windows were as a result of delays in the construction of public buildings in Libya arising from design changes effected by government officials (Tumi, Omran & Pakir, 2009).

Danso and Antwi, (2012) also in their study on the Telecom Tower Construction process in Ghana demonstrate the negative influence of design changes on the quality of government funded buildings. Further, they emphasize that changes in design were positively correlated with the installation of the building's interiors such as doors, windows, ceilings and also influenced floor tiling and stairways construction which affected the accessibility of the building (Danso & Antwi, 2012). The negative influence caused by design changes is also pointed out through a study on the quality of public housing projects in Nigeria by Adenuga, (2013) who observes that variations in design exposed exterior paint work to the abrasive effects of climatic condition causing it to lose its allure. He also emphasizes that variations in design were responsible for the difficulty in accessibility of these buildings and numerous cracks in pillars and beams in these buildings which compromised the durability of the buildings (Adenuga, 2013). Mbachu and Nkando, (2007) also demonstrated the negative influence of variations on design on the quality of government funded buildings in South Africa. They further contend that design changes resulted to the presence of beam cracking which compromised both the paint work and durability of building projects in the country (Mbachu & Nkando, 2007). Aigbavboa, Thwala and Mukuka (2014), did contend that numerous variations in design in the construction process of public buildings did lead to both schedule and cost overruns. They also argue that schedule overruns had adversely influenced the quality of these buildings which had been abandoned resulting to cracking walls and pillars (Aigbavboa, et al., 2014).

Fetene, (2008) did contend that numerous design changes effected by government architects and structural engineers had resulted to delays in the construction of government funded public buildings in Ethiopia which had contributed to cost overruns before the commissioning of these projects. They further argue that cost overruns had resulted to most of these buildings being abandoned resulting to decaying door frames, incomplete ceilings, incomplete glasswork, cracking walls and pillars and partly done paint work (Fetene, 2008). In a study in Uganda,

Apolot, Alinaitwe and Tindiwensi (2011), demonstrated a strong link between variations in design and the quality of public buildings in the country. This they argued did cause delays during the construction process which also resulted to cost overruns and poor quality buildings evidenced by unfinished building interiors such as hanging ceiling panels, loosely fitted window panes and door frames and unpleasant aesthetics characterized by poorly partly done paint work and floor tiling (Apolot et. al., 2011). Muhwezi, Acai and Otim (2014), did reiterate these findings by pointing out numerous changes in design implemented by structural engineers did result to delay in the construction process of public buildings which was positively correlated to the numerous quality issues in both the exterior and interior of these buildings.

Studies in Kenya also demonstrate that variations in design in public building projects also led to delays which eventually influence the quality of these buildings. Mbaluka and Bwisa, (2013) in their study for instance posit that numerous changes in design did result to schedule over-runs of Kenya Agriculture Research Institute's (K.A.R.I) building construction projects which had influence the quality of these buildings. Further, they observe that schedule over-runs did contribute to loosely hanging ceiling panels, uncompleted paint work and loosely fitted door frames (Mbaluka & Bwisa, 2013). Mono, (2013) in his study on the successful delivery of housing projects under the ministry of housing contends that numerous design changes effected by ministry design teams and other construction consultants had resulted to delays in the construction process. This he observes did not only lead to costs overruns but also contributed to the abandonment of these buildings for some time resulting to hanging ceiling panels, incomplete ventilation and unpleasant facades (Mono, 2013).

6.0 Theoretical Perspective

This study is pivoted on one theory: Axiomatic design theory. The study is further supported by the object-oriented information model. Suh, (2001) Axiomatic design theory is a systematic method for the design transformation (alterations or changes) between the client, the functional, physical and production domains. According to this theory to enhance quality in building and construction projects, there is need for reliable communication on design requirements and any variations or transformation between the client, the functional, physical and production domains

be done in good time (Jensen, Olofsson & Johnsson, 2012). This can be done through Zigzag decomposition as illustrated in figure 1:

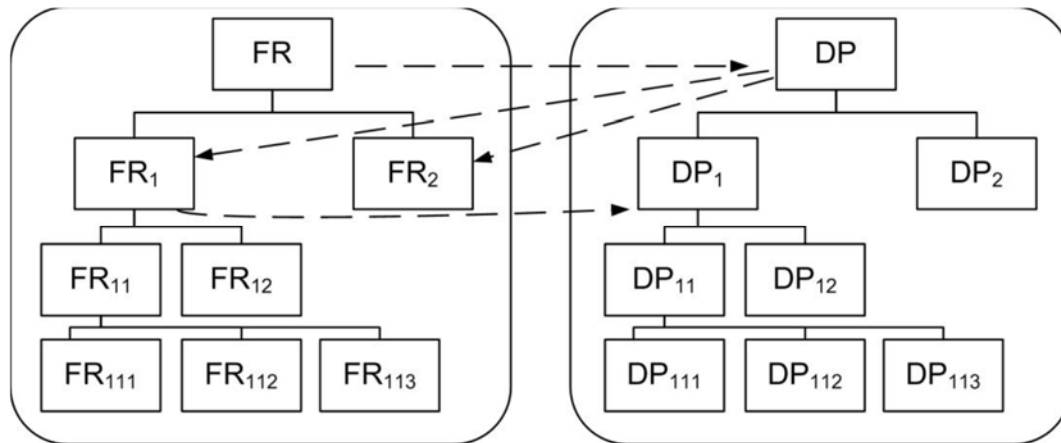


Figure 1: Zigzag decomposition in Axiomatic Design (Suh, 2001)

Zigzagging is one of three basic concepts in axiomatic design where the other two axioms are:

1. The independence axiom: Maintain the independence of the functional requirements (FRs).
2. The information axiom: Minimize the information content of the design. Reduce information for the design solution without affecting the independency of FRs (Suh,2001)

Decisions taken from higher levels stages act as constraints at lower levels (Suh, 2001).

The transformations between the domains are normally carried out by different actors with specific product views. In the context of construction, the *architectural view* describes the transformation from customer attributes (CAs) within the customer domain to functional requirements (FRs) within the functional domain. The *engineering view(s)* describes the transformation from functional requirements (FRs) to design parameters (DPs) in the physical domain and the *production view* describes the transformation work from design parameters (DPs) to production variables (PVs) in the process domain. Constraints (Cs) are limitations of downstream activities that have to be considered in upstream transformations. These constraints can arise as a result of the standardization of components, processes or organizational conditions. Constraints can also describe regulations used at the site or conditions for transportation (Jensen et al., 2012).

The other theoretical framework is an object-oriented information model by (Hegazy, Zanelidin & Grierson, 2001). The model is utilized within the building and construction discipline to facilitate design coordination and management of design changes. This model aids in both the

understanding and managing of ripple effects emanating from design changes. The model however lays great emphasis on the existence of preset communication paths automatically communicating alterations to affected parties (Hegazy, et al., 2001).

7.0 Research Methodology

The study adopted the descriptive survey research design to investigate the influence of design changes on the quality of government funded building projects in Isiolo County. Descriptive survey research design facilitated the gathering of both qualitative and quantitative data on how design changes influence quality of government funded building projects in the county. Through survey design the study was able to establish the link between study variables and study problem. This emanated from the inherent features of survey research design that enabled the researcher to inquire respondents' perceptions, attitudes and values in relation to the research topic. Survey design is also a valuable channel in collection of data from samples representing large populations. A sample size of 149 participants was used for the study constituting of; clients (Public Schools and Public Dispensaries), contractors and consultants. Stratified and simple random sampling techniques were used to pick subjects. Questionnaires were self-administered to clients, contractors and consultants. Primary data collected was sorted, edited to give it meaning and completeness then coded. Quantitative data was analyzed through the application of descriptive statistics employing Statistical Package for Social Sciences (SPSS) version 21.0. Results were presented in frequency and percentage tables to make significant conclusions. Qualitative data were analyzed through content analysis through categorization of data in themes and sub-topics as per the study objectives. Significance of the study variable was

8.0 Findings and Interpretations

The study sought to establish the influence of design changes on quality of government funded building projects. Results are presented in the ensuing sections.

Schedule Overrun Arising From Design Changes

The respondents were requested to indicate whether they thought that schedule overruns arise from design changes. The findings are as shown in Table 1.

Table 1: Reports of Schedule Overrun Arising From Design Changes

Opinion	Clients		Contractors		Consultants	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	61	88.4	43	86.0	9	100
No	8	11.6	7	14.0	0	00
Total	69	100.0	50	100.0	9	100

From the findings, majority of the clients as shown by 88.4% % indicated that there were reports of schedule overruns of government funded building project arising from variations in project design; the same was also reported by majority of contractors as represented by 86.0%. While 11.6% and 14.0% respectively indicated the non-existence of schedule overruns emanating from design changes in government funded building projects. Further, 100% of consultants indicated the existence of schedule overruns emanating from design variations. From these study findings it was inferred that there were reports on schedule overruns of government funded building project arising from variations in project design.

Design Changes and Improved Building Performance Features

Respondents were further asked whether design changes improved building performance features. The findings are as shown in Table 2.

Table 2: Influence of design changes of building performance features

Opinion	Clients		Contractors		Consultants	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	56	81.2	43	86.0	0	0
No	13	18.8	7	14.0	9	100
Total	69	100.0	50	100.0	9	100

From the findings, 81.2% of the clients and 86.0% of the contractors indicated that design changes interfere with specific estimates provided thereby affecting standardization of materials thus influencing the quality of government funded buildings while 13% and 14.0% respectively indicated it does not. Contractors however admitted that any design changes accompanies with

the right amendments improve the quality of the structure which is very rare. From the consultants’ findings, 100% indicated that design changes had no influence on building performance features. From these findings it was deduced that design changes had mixed influence on buildings performance features.

Statements on Design Changes and Quality of Government Funded Building Projects

The respondents were also asked to indicate the extent to which they agreed with some statements on design changes and quality of government funded building projects. The findings are as shown in Table 3.

Table 3: Influence of design changes on quality of GFBP

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std Deviation
Design changes leading to schedule overruns on government funded building projects influence the quality of these types of projects.	3.9%	6.3%	10.9%	62.5%	16.4%	4.18	0.16
Design changes lead to improvement in the functionality of buildings which influence the quality of government funded building projects.	4.7%	5.5%	12.5%	68.8%	8.6%	4.29	0.11

Design changes leading to reduced projects costs on government funded building projects influence the quality of these types of projects.	1.6%	3.1%	10.2%	46.1%	39.1%	4.33	0.40
Design changes leading to cost overruns on government funded building projects do influence the quality of these types of projects.	3.1%	5.5%	7.8%	65.6%	18.0%	4.35	0.08
Average mean						4.29	0.19

Results obtained on effect of design changes government funded building projects, showed that majority of the respondents agreed that design changes leading to cost overruns on government funded building projects do influence the quality of these types of projects as shown by a mean of 4.35, design changes leading to reduced projects costs on government funded building projects influence the quality of these types of projects as shown by a mean of 4.33, design changes lead to improvement in the functionality of buildings which influence the quality of government funded building projects as shown by a mean of 4.29 and that design changes leading to schedule overruns on government funded building projects influence the quality of these types of projects as shown by a mean of 4.28.

The average mean for sub measure assessing the effect of design changes on quality of government funded building projects was 4.29 and STD deviation 0.19. This translates to agree as per the measurement scale. In other words this mean that design changes had a significant influence on quality of government funded building projects. The findings are in support of the research by Gray and Hughes, (2001) design changes were major factors in the performance of contractors working in the Korean Metrological Administrations (KMA) government funded buildings and overall quality of these buildings

Respondents were required to suggest measures that can be put in place to reduce the influence of design changes implemented by clients that affect the quality of the quality of government funded building projects. From the views gathered, respondents suggested that any changes in project design should reflect in project cost, there is need to embrace technology in project design to enhance accuracy, Proper consultation and pre-survey of all necessities were highly advocated for.

Measures of the quality in government funded building projects

Respondents were requested to highlight on quality indicators of government funded building projects in regards in design. Results are as shown in Table 4

Table 4: Measures of the quality for government funded building projects

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std Deviation
Projects delivered on time	1.6%	4.7%	8.6%	57.8%	27.3%	1.66	0.23
Building Safe Access	2.3%	3.9%	9.4%	50.8%	33.6%	1.65	0.15
Building Reliable Security	1.6%	3.1%	10.2%	46.1%	39.1%	1.79	0.36

Reliable Design in relation to cost	3.1%	5.5%	7.8%	65.6%	18.0%	1.68	0.31
Building Durability	2.3%	7.0%	5.5%	73.4%	11.7%	1.66	0.11
Value for Money	3.9%	6.3%	10.9%	62.5%	16.4%	1.69	0.74
Number of buildings with pleasant Aesthetics	4.7%	5.5%	12.5%	68.8%	8.6%	1.69	0.18

The study sought to establish the extent to which the above measures of the quality were ensured in government funded building projects. From the research findings, majority of the respondents agreed to a great extent the following measures were highly taken in consideration in government funded building projects; building safe access as shown by a mean of mean of 1.65, building durability, projects delivered on time as shown by a mean of 1.66 in each case, reliable design in relation to cost as shown by a mean of 1.68, value for money , number of buildings with pleasant aesthetics as shown by a mean of mean of 1.69 in each case, building reliable security as shown by a mean of mean of 1.79. This means that most building in Isiolo County are of moderate quality. The findings also signify that effective communication on design has a positive impact on successful project execution; the efficiency and effectiveness of the construction process strongly depend on the quality of communication on design in government funded building projects.

In this study, a multiple regression analysis was conducted to test the influence among predictor variables. The research used statistical package for social sciences (SPSS V 21.0) to code, enter and compute the measurements of the multiple regressions. The model summary is presented in the Table 5

Regression Analysis

Table 5: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.864 ^a	.746	.741	1.45642

Adjusted R squared is coefficient of determination which tells us the variation in the dependent variable due to changes in the independent variable. From the findings in the above table the value of adjusted R squared was 0.741 an indication that there was variation of 74.1 percent on quality of government funded building projects due to design changes at 95 percent confidence interval. From these results it was inferred 74.1 percent changes in quality of government funded building projects are as a result of design changes.

The study used the coefficient table to determine the study model. The findings are presented in the Table 6.

Table 6: Coefficients^a

Model	Unstandardized		Standardized	t	Sig.
	Coefficients		Coefficients		
	B	Std. Error	Beta		
1 (Constant)	-4.273	1.266		-3.375	0.023
Design Changes	-0.437	0.144	0.193	3.035	0.000

From the data in the above table the established regression equation was

$$Y = - 4.273+ (-0.437 X)$$

From the above regression equation it was revealed, that unit increase in design changes would lead to decrease in quality of government funded building projects by a factor of -0.437, in other words this means that increase in design changes would negatively influence the quality of government funded building projects. It was also noted that this was at a significance value of 0.000 which is < 0.05 which meant design changes to a great extent influence the quality of government funded buildings projects. Therefore the Null hypothesis that design changes do not influence the quality of government funded buildings projects is rejected and the Alternative hypothesis; design changes influence the quality of government funded buildings projects is accepted.

Conclusion

The study concluded that variations in design significantly influenced the efficiency and effectiveness of the construction process due to insufficient communication of design expectation prior to construction. This consequently influenced the quality of government building projects in Isiolo County.

Recommendations

In order to minimize changes in the project design and the consequent effects in government structural design, clients of government building projects (Public Schools and Public Dispensaries) should provide a design review for consultants working on these projects. This should be done before finally approving the design for construction.

To address design changes public schools and public dispensaries (clients) should clearly state project design expectations and be concise on their objectives. Information on initial buildings projects design should be unambiguous.

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