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PROJECT QUALITY MANAGEMENT AND PERFORMANCE OF RESIDENTIAL ESTATES IN NORTH CENTRAL NIGERIA- AN EMPIRICAL STUDY

¹Mohammed, B. and ²Adindu, C. C.

^{1,2} Department of Project Management Technology, Federal University of Technology, Minna,
Niger State, Nigeria.

Corresponding author's email: usqrccv@gmail.com

ABSTRACT

Project quality management factors is key to the satisfaction of building occupants and the performance of buildings while in use. This study examines project quality management factors that influence resident's satisfaction of selected residential estates, and also determines quality cost attributes that contribute to performance of selected residential estates in North Central Nigeria. The study involved mixed research methodology with structured questionnaire as research instrument for the quantitative component. The questionnaire was administered to a sample size of 153 respondents scientifically obtained from a study population of 230 multidisciplinary personnel using Taro Yamane's formula. Structural Equation Modeling (SEM) was used to test study hypothesis and analyze empirical data obtained for the study. The result of the study showed existence of strong significant relationship between Air Quality factors as a major influencing factor for resident's satisfaction, and internal cost as the strongest quality cost factor that influence performance of residential estates in North Central Nigeria. The study recommends periodic conduct of quality conformity analysis, air quality evaluation at preliminary project appraisal and pre-design stages, and the setting-up of miscellaneous cost system for proper cost management and control of residential estates.

Key words: Project Quality Management, Performance, Residential Estates, North Central Nigeria.

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1.0 Introduction

Buildings are required to provide shelter, comfort, and safety for its occupants. Hence, to attain these purposes buildings are designed, planned, constructed and managed according to certain codes and regulations, governed by experts and government bodies (Amasuomo, Atanda, & Baird, 2017). The success of any building project could be measured in terms of performance, aesthetics,

stability, cost and duration (Ogundipe, Olaniran, Ajao, & Ogunbayo, 2018). The quest for project delivery can be best achieved with adequate design and quality of supervision exercised at planning and production stage (Ogundipe, et. al 2018). These can be linked to the quality appearance and usefulness of what has been built, the duration observed to build it and the cost of the project. Arditi & Gunaydin (1997), stated that acceptable levels of quality in the construction industry has long been a problem. The last thirty years have also observed groundbreaking studies on improving quality performance of construction projects (CII, 2015). A great expense of time, money and resources, both human and material, are wasted each year because of inefficient quality management procedures. Lee & Arditi (2006) emphasized that the management of quality is an important issue in the delivery of construction projects. Delgado-Hernandez & Aspinwall (2008), reported that the construction industry in the UK has begun to take up the challenge of quality issues; as a result, companies have won repeated businesses, increased their market shares and improved their customer satisfaction levels. In the case of Nigeria construction industry, poor quality was traced to the period of oil boom, which according to Wahab (1977) heralded a period when too many jobs were chasing a few competent contractors.

The era of oil boom and reconstruction after the civil war, created a construction boom where demand far exceeded supply. This led to the emergence of contractors with very limited ability to manage construction projects. Aside from the boom, the climate of corruption in the country gave rise to poor-quality construction, scarcity of materials and made most contractors employ any kind of materials just to finish the project on time. This has led to poor quality output which is evidenced most times by late delivery of projects to clients, cost overrun of project, poor workmanship. Oke et al. (2009) revealed that the quality of materials and workmanship in Nigeria building industry is not satisfactory and that the problem lies in the use of inappropriate materials supplied to site and inefficient supervision of workmen. This study aims at assessing the impact of project quality management on the performance of residential estates in North Central Nigeria.

Objectives of Study

- i. To identify quality factors that influences resident's satisfaction at selected residential estates in North Central Nigeria.
- ii. To determine specific quality cost attributes that contribute to performance of residential estates in North Central Nigeria.

2.0 Theoretical Review

The Concept of Project Quality Management

Project quality management according to Ray (2018) encompasses the processes and activities employed to achieve the quality of the deliverables of a project. Quality management generally is a method that ensures that an organization is involved in producing high quality outcomes in everything they do. A major role of project managers is to oversee the implementation of a project's quality management plan, with an objective of delivering a product or service that meets the specifications of a consumer, customer, or stakeholder (Ray, 2018). Willar, (2012) stated that early researches into quality for construction did not give a clear-cut definition of the subject matter. American Society of Civil Engineering (2005) refers quality as meeting the legal, aesthetic and functional requirements of a project. These requirements may be simple or complex or they may be stated in terms of the result required or as a detailed description of what is to be done. For construction projects, quality management means making sure things are done according to the plans, specifications, and permit requirements. The days of embarking on projects which usually involve huge funds without due diligence and proper regulation seem to be over, making it imperative that communities get the most out of their infrastructure projects (Arditi, 2004). Gunaydin (1997) opined that one of the best ways to assure good construction projects is to use an inspector. The first step an inspector should take is to become familiar with the plans, specification, and permit requirements. Also, it is equally important to ensure quality control during all construction phases which is needed to be better and the utility system needs to know what is being installed while the work is being done. On most construction jobs, the inspection is one of the last things to be done if it gets done at all.

The Practice of Project Quality Management

Rever (2007) observed that project quality management despite constituting a major part of any project, is most times unfortunately misunderstood and as such, misapplied. The Project Management Body of Knowledge (PMBOK) (2008), states that project quality management is

subdivided into three main processes, namely-quality planning, quality assurance, and quality control; with each process having a list of inputs, tools, techniques, and outputs.

The American Society for Quality Control characterizes quality as "the aggregate components and attributes of an item or administration made or performed to fulfill clients' needs at the period of buying and during utilization". Quality management on the other hand, can be defined as a managerial approach geared towards in cooperating inherent managerial tendencies of planning, control and improvement. Manufacturing-based definition positions quality management as design activities and manufacturing practices aimed at enhancing product quality. The ISO 9000 defines quality management as the set coordinated activities directing and controlling an organization's quality projections. The activities encapsulate quality planning, quality control, quality improvement and quality assurance. Tsai, Lin & Cheng (2021) posits that in a highly market, service quality gap, competitor performance, and objective assessment of service quality are key considerations for identifying the critical deficiencies of service quality.

Value is defined as identifying the client's wants and their fulfillment. Numerous associations have concentrated on quality and diminished their expenses to increase consumer loyalty e.g. Toyota in Japan, Samsung in South Korea. As indicated by Foster (2001) accomplishing consumer loyalty relies on upon not just how well and how closely quality activities in the few areas of the association work exclusively but also on how well they cooperate. As indicated by Willar, (2012), quality alludes to the diverse workmanship of different exercises. Thus, every business or movement has a varied meaning of value, for instance in sales the term quality is more centered around the client, while in manufacturing, the term quality is more centered around the production procedure, and in development, quality alludes to both services provided and outputs.

Application of Quality Management Systems in the Construction Industry

Studies by Gambi, Boer, Jorgensen, Gerolamo & Carpinetti (2021) states that quality management techniques are best supported through Control oriented human resource management. Some of the recognized quality management standards include; The ISO9000 series, Total Quality Management, Quality Control, Quality Assurance, Malcolm Baldrige (MB) standard and BS 5750 of the British Standard Institute (BSI), European Construction Institute (ECI) which produced the (ECI) Matrix in 1993 (Kado, 2011). According to the ASCE manual, (2012) the primary purpose of codes and standards is to protect the public's health and safety. Without early identification of the appropriate codes and standards, reworking plans and specifications can result

in considerable cost and delay. Wen, Sun & Yan (2020) describes how research on quality management has evolved from emphasis on defect reduction to value enhancement, from product life cycle to service life cycle, and from separated to integrated approach to quality management. The design professional must be knowledgeable about the provisions of codes and standards before starting the design process because the building codes directly control the minimum standards of many components of a building project, and are responsible for much of the finished product quality. Kubal, (1994) claims that regulations controlling the construction processes are much more restrictive than in most manufacturing and service industries. Stasiowski and Burstein (1994) state that quality design begins with sound engineering and scientific principles which must satisfy the criteria of applicable codes and standards but also the owner's project requirements. Glogovac, Ruso & Maricic (2020), declared that 'the context of an organization positively impacts the identity of an organization and its leadership'.

3.0 Methodology

The study covered four states of North Central Nigeria, namely; Niger state, Kogi state, the Federal Capital Territory, and Nasarawa state. It examined the impact of project quality management on the performance of residential buildings in the aforementioned states. The study involved mixed research methodologies namely- qualitative and quantitative research. The population for the study comprised the occupants of the selected residential estates, and stakeholders registered with Real Estate Developers Association of Nigeria (REDAN) such as Council for Registered Engineers, Architect Registration Council of Nigeria, Estate Surveyors and Valuers Board of Nigeria, Quantity Surveyors Registration Board of Nigeria, Council of Registered Builders of Nigeria, and the Estate Developing Companies handling the estate projects under the umbrella of REDAN. The research instrument comprised questionnaires administered to a study population of 230 respondents with 153 as sample size, obtained using Taro Yamane formula. Structural Equation Modeling (SEM) was used to test study hypothesis and analyze empirical data obtained for the study.

4.0 Results and Discussion of Findings

Table 4.1: Questionnaire administered and retrieved for the Study

| Questionnaires Distributed | Questionnaires Retrieved | Number withheld | Percentage Retrieved (%) | Percentage Withheld (%) |
|----------------------------|--------------------------|-----------------|--------------------------|-------------------------|
| 153 | 146 | 7 | 95% | 5% |

Source: Field Survey (2020)

Table 4.1 shows that 146 copies were retrieved out of the 153 copies administered, implying 95% success rate.

Table 4.2: Demographic Statistics of Respondents

| Demographics | Categories | Frequency | Percent |
|--------------------------|-------------------|-----------|---------|
| Gender | Male | 112 | 77% |
| | Female | 34 | 23% |
| Education Level | PhD/M.Sc./M.Tech. | 19 | 13% |
| | B.Sc./B.Tech | 37 | 25% |
| | HND/OND | 73 | 50% |
| | Others | 17 | 12% |
| Age bracket in Years | Below 30 | 29 | 20% |
| | 31 to 44 | 69 | 47% |
| | 45 to 54 | 34 | 23% |
| | 55 Above | 14 | 10% |
| Designation/Job position | Project Manager | 10 | 7% |
| | Architect | 20 | 14% |
| | Quantity Surveyor | 54 | 37% |
| | Civil Engineer | 15 | 10% |
| | Services Engineer | 19 | 13% |
| | Others | 28 | 19% |

Source: Field Survey (2020)

A total of 101 valid responses obtained from individuals of which majority of the gender population were males (112) 77% and (34) 23% were females. Most of the respondents had HND/OND and B.sc/B.Tech level of education at (73) 50% and (37) 25% respectively; a good number had PhD/M.Sc/M.Tech level of education at (19) 13% whereas; some proportion of (17) 12% respondents had SSCE level of education. (29) 20% of respondents are below 30 years, (69)

47% of respondents were between 31 to 44 years, (34) 23% of respondents are within 45 to 54 years and (14) 10% of respondents are 55 years and Above.

For respondents Job position; 10 (7%) of respondents are Project managers, 20 (14%) of respondents are Architects, 54 (37%) of respondents are quantity surveyors, 15 (10%) of respondents are civil engineers, 19 (13%) of respondents are services engineer and 28 (19%) of respondents belong to other job positions.

Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is a series of multiple regression equations, that examines the structure of inter relationships between the constructs that are expressed in a series of equations. These equations show the entire relationships between the independent and dependent variables involved in analysis.

The model enabled this study to examine the factors that influence resident's satisfaction and determine quality constructs that contributes to performance of residential estates in North Central Nigeria. The performance of the model is evaluated using the R square, the significance of the path coefficient of the endogenous latent variables. This was obtained by running the PLS algorithm and by performing the bootstrapping procedure using a two-tailed test at 10 percent significance level ($p < 0.1$). This study followed the path of similar studies conducted by Arumugam , Kannabiran & Vinodh (2020), in which SEM was employed on a study involving a sample of 132 auto-manufacturing small and medium enterprises(SMEs) in India. Vinodh, et.al (2020) study specifically investigated the impact of technical and social lean practices on SMEs performance.

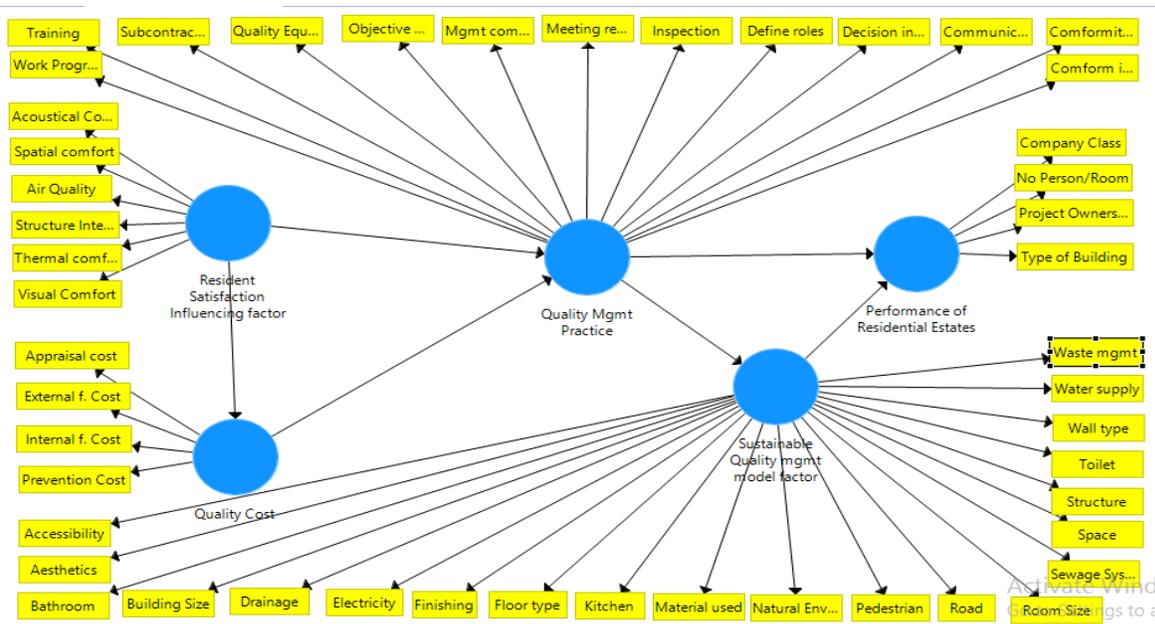


Figure 4.1: Structural Path Model for Research Constructs

Source: Field Survey (2020)

Path models are diagrams which are used to visually display the variable relationships and the hypothesis that are examined in SEM.

Figure 4.2: shows coefficient of determination (R Square) between dependent and independent variables

R Square

| Matrix | R Square | R Square Adjusted |
|---------------------------------------|----------|-------------------|
| | R Square | R Square Adjusted |
| Performance of Residential Estates | 0.944 | 0.943 |
| Quality Cost | 0.931 | 0.930 |
| Quality Mgmt Practice | 0.982 | 0.982 |
| Sustainable Quality mgmt model factor | 0.846 | 0.845 |

Source: Field Survey (2020)

The coefficient of determination (R Square) in Figure 4.2 shows 0.944, 0.93, 0.982 and 0.846 for sustainable performance, quality cost, quality management practice and sustainable quality management model latent variables respectively for residential estates in North Central Nigeria.

This means that sustainable performance of residential estates in North Central Nigeria moderately explain 94.4% effect on all variables. Quality cost management together explains 93.12%; Quality management practices explain 93.1%; while Sustainable quality management model explains 84.6% effect on all variables.

Convergent validity

Figure 4.3: Discriminant validity of research constructs

Discriminant Validity

| | Performance of Residential Estates | Quality Cost | Quality Mgmt Practice | Resident Satisfaction Influencing factor | Sustainable Quality mgmt model factor |
|--|------------------------------------|--------------|-----------------------|--|---------------------------------------|
| Performance of Residential Estates | 0.926 | | | | |
| Quality Cost | 0.950 | 0.958 | | | |
| Quality Mgmt Practice | 0.968 | 0.980 | 0.922 | | |
| Resident Satisfaction Influencing factor | 0.975 | 0.965 | 0.984 | 0.978 | |
| Sustainable Quality mgmt model factor | -0.922 | -0.869 | -0.920 | -0.933 | 0.898 |

Source: Field Survey (2020)

To ensure that individual constructs are truly distinct from each other, discriminant validity assessment was conducted. Also, to check convergent validity, each latent variable's Average Variance Extracted (AVE) was evaluated. From figure 4.3, it was found that all the AVE values were greater than the acceptable threshold of 0.5; therefore, convergent validity is confirmed.

Test of Research Hypothesis

Objective 1: To identify quality factors that influences resident's satisfaction at selected residential estates in North Central Nigeria.

H₁: There are no quality factors that influence resident's satisfaction at selected residential estates in North Central Nigeria.

Inner model path coefficient sizes and significance

According to figure 4.4 the inner model path coefficient sizes suggests that quality cost has the strongest effect on resident's satisfaction influencing factors in selected estates in north central Nigeria with (96.0%). Also, performance factor of selected residential estate factor has a positive effect on residential satisfaction influencing factors in selected estates in north central Nigeria with (94.2%). Quality management practice has a positive effect on quality cost and performance factor of selected estates in north central Nigeria with (84.6%). The hypothesized path relationship between resident's satisfaction influencing factors and quality cost with performance factor of selected residential estate in North Central Nigeria is statistically significant. Also, the hypothesized path relationship between resident's satisfaction influencing factors and performance factor of selected residential estate with quality cost at selected residential estates in North Central Nigeria is statistically significant. This is because standardized path coefficient (0.601 and 0.393) is greater than 0.100. Thus, we can conclude that quality cost and performance factors moderately predict resident's satisfaction in selected residential estates in North Central Nigeria.

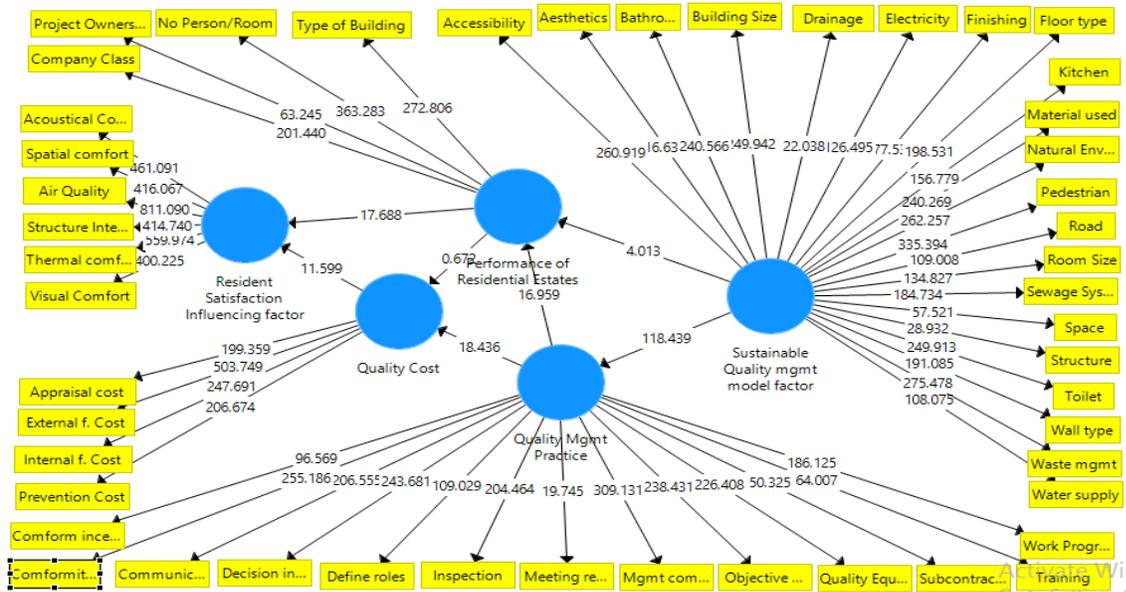


Figure 4.5: Bootstrapping construct measurements of research hypothesis (**H₀₁**)
 Source: Field Survey (2020)

Path models are diagrams which are used to visually display the variable relationships and the hypothesis that are examined in SEM and the research construct as shown in Figure 4.5 above. The factors loading measurements of above 0.50 as suggested by Hulland, (1999) was accepted. Loadings were above 0.50 which signifies that all the loadings are acceptable for the study.

Table 4.3: Loadings of quality factors associated with resident’s satisfaction

| Factors | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (IO/STDEV) | P Values |
|--|---------------------|-----------------|----------------------------|-------------------------|----------|
| Acoustical Comfort <- Resident Satisfaction influencing factor | 0.975 | 0.975 | 0.002 | 461.091 | 0.000 |
| Air Quality <- Resident Satisfaction influencing factor | 0.987 | 0.987 | 0.001 | 811.090 | 0.000 |
| Spatial comfort <- Resident Satisfaction influencing factor | 0.976 | 0.975 | 0.002 | 416.067 | 0.000 |
| Structural Integrity <- Resident Satisfaction influencing factor | 0.977 | 0.977 | 0.002 | 414.740 | 0.000 |
| Thermal Comfort <- Resident Satisfaction influencing factor | 0.983 | 0.983 | 0.002 | 559.974 | 0.000 |
| Visual Comfort <- Resident Satisfaction influencing factor | 0.969 | 0.969 | 0.002 | 400.225 | 0.000 |

Source: Field Survey (2020)

From Table 4.3; Acoustic Comfort - Resident Satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 461.091), Air Quality - Resident Satisfaction influencing factor relationship has STDEV of 0.001 (T-Stat. = 811.090), Spatial comfort - Resident Satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 416.067), Structural Integrity - Resident Satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 414.740), Thermal Comfort - Resident Satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 559.974) and Visual Comfort - Resident Satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 400.225).

The results of the study revealed existence of a significant positive relationship between all factors that influences resident's satisfaction at selected residential estate in north central Nigeria. Also, it was discovered that there exists a very high significant relationship between Air Quality factor as a major influencing factor for resident's satisfaction at selected residential estate in north central Nigeria.

Objective 2: To determine quality cost attributes that contribute to performance of residential estates in North Central Nigeria.

H₂: There are no quality cost attributes that contribute to performance of residential estates in North Central Nigeria.

Table 4.4 Bootstrapped effect on latent variables associated with quality cost for research hypothesis 2

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (O/STDEV) | P Values |
|---|---------------------|-----------------|----------------------------|--------------------------|----------|
| Quality Cost -> Performance of Residential Estates | 0.951 | 0.951 | 0.004 | 236.74 | 0.000 |
| Quality Cost -> Resident Satisfaction Influencing factor | 0.965 | 0.965 | 0.002 | 429.233 | 0.000 |
| Quality Mgmt Practice -> Performance of Residential Estates | 1.104 | 1.11 | 0.042 | 26.466 | 0.000 |
| Quality Mgmt Practice -> Quality Cost | 1.161 | 1.167 | 0.043 | 27.082 | 0.000 |
| Quality Mgmt Practice -> Resident Satisfaction Influencing factor | 1.12 | 1.126 | 0.042 | 26.57 | 0.000 |
| Sustainable Quality mgmt model factor -> Performance of Residential Estates | 0.187 | 0.192 | 0.043 | 4.332 | 0.000 |

| | | | | | |
|---|-------|-------|-------|-------|-------|
| Sustainable Quality mgmt model factor -> Quality Cost | 0.196 | 0.202 | 0.045 | 4.345 | 0.000 |
| Sustainable Quality mgmt model factor -> Resident Satisfaction Influencing factor | 0.189 | 0.195 | 0.044 | 4.333 | 0.000 |

Source: Field Survey (2020)

Table 4.4 shows total effect of quality cost on associated factors. Quality cost → performance of selected residential estate in North central Nigeria has STDEV of 0.004 (T-Stat. = 236.740), Quality cost → Resident’s satisfaction influencing factor relationship has STDEV of 0.002 (T-Stat. = 429.233), Quality management practice → performance of selected residential estate in north central Nigeria factor relationship has STDEV of 0.042 (T-Stat. = 26.466), Quality management practice → Quality cost factor relationship has STDEV of 0.043 (T-Stat. = 27.082), Quality management practice → Resident’s satisfaction influencing factor relationship has STDEV of 0.042 (T-Stat. = 26.570), Sustainable quality management model factor → performance of selected residential estate in north central Nigeria has STDEV of 0.043 (T-Stat. = 4.332).

Sustainable quality management model factor → Quality Cost factor relationship has STDEV of 0.045 (T-Stat. = 4.345), Sustainable quality management model factor → Resident’s satisfaction influencing factor relationship has STDEV of 0.044 (T-Stat. = 4.333).

The results of the study revealed that Quality cost has a strong significant relationship with Resident’s satisfaction influencing factor (STDEV- 0.002, T-Stat. = 429.233) and on the performance of selected residential estate in north central Nigeria (STDEV- 0.004, T-Stat. = 236.740).

Table 4.5 Loading effect of Quality cost factors on Quality cost

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (O/STDEV) | P Values |
|---------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|
| Appraisal cost <- Quality Cost | 0.902 | 0.903 | 0.008 | 118.378 | 0.000 |
| External Cost <- Quality Cost | 0.97 | 0.97 | 0.003 | 324.165 | 0.000 |
| Internal Cost <- Quality Cost | 0.99 | 0.99 | 0.002 | 601.071 | 0.000 |
| Prevention Cost <- Quality Cost | 0.911 | 0.911 | 0.008 | 110.530 | 0.000 |

Source: Field Survey (2020)

Table 4.5 shows the relationship between quality cost factors and quality cost with; Appraisal cost <- Quality Cost has STDEV of 0.008 (T-Stat. = 118.378), External Cost <- Quality Cost has STDEV of 0.003 (T-Stat. = 324.165), Internal -Cost <- Quality Cost has STDEV of 0.002 (T-Stat. = 601.071), Prevention Cost <- Quality Cost has STDEV of 0.008 (T-Stat. = 110.530).

Thus, Table 4.5 shows that there exists a strong significant relationship between all quality Cost factors and quality cost. Internal Cost (quality cost factor) has the strongest influence among all quality costs that contributes to performance of residential estates in North Central Nigeria.

5.0 Conclusion and Recommendations

The study has critically examined the role of project quality management on the performance of residential buildings in North Central Nigeria. The study concludes that there exists strong significant relationship between Air Quality factors as a major influencing factor for resident's satisfaction at selected residential estate in north central Nigeria. Also, Internal cost is the strongest influencing quality cost factor which influences performance of residential estates in North Central Nigeria.

The study recommends that a miscellaneous cost should be set-up to manage internal costs for proper cost management and control. The study also, recommends that proper quality conformity analysis should be periodically carried out for sustainable performance of residential estates. The study also emphasized the importance of conducting a proper checking 'air quality and direction' at preliminary project appraisal stages before estate developer's go-ahead to establish/ erect structures on a residential estate site. The optimum number of persons per room should also be assessed and put into consideration when designing and planning for residential estates in North Central Nigeria.

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