Stephen Nyakala

Dr Kgashane Stephen Nyakala, Lecturer, Department of Operations Management, Tshwane University of Technology, South Africa. Phone: +27 84 435 8730, email: <nyakalaks@tut.ac.za>, ORCID: https://orcid.org/0000-0002-5160-3747

Dolly Ramoroka

Ms Sekou Dolly Ramoroka, Lecturer, Department of Operations Management, Tshwane University of Technology, South Africa. Phone: +27 72 250 3811, email: <s.dramoroka@webmail.co.za>, ORCID: https://orcid.org/0000-0003-1598-7429

Kemlall Ramdass

Prof. Kemlall Ramdass, Department of Mechanical and Industrial Engineering, University of South Africa, South Africa. Phone: +27 11 471 2117, email: <ramdakr@unisa.ac.za>, ORCID: https://orcid.org/0000-0001-5480-3368

FACTORS INFLUENCING THE QUALITY OF LOW-INCOME HOUSING IN POLOKWANE MUNICIPALITY SOUTH AFRICA

RESEARCH ARTICLE[1]

ABSTRACT

Recent South African and international evidence highlights the broad and lasting impacts of households, particularly those on low income, when unable to afford higher income counterparts to live in apartments, maintained public housing, and other high-quality houses. A broad range of low-income houses recently built in South African local municipalities are reportedly defective, due to poor building and construction quality. This study aims to assess and determine the factors influencing high-quality housing positively impacting on the lives of a significant proportion of low-income housing projects. Reasons for and obstacles to quality design, construction quality and the development of low-income housing projects were identified. To assess the research questions, a quantitative survey (n=103) was carried out, simple random and purposive sampling techniques were used to select contractors who were active in low-income housing projects within the Polokwane Municipality. The quantitative data gathered were analysed using Statistical Package for the Social Sciences (SPSS) to determine a combination of descriptive and non-parametric statistics of the data computing the frequencies, mean scores and standard deviations.

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Selected results show that poor-quality and low-income housing projects are perceived to be related to the contractors, builders and construction practitioners not complying with the standards, variously because of insufficient training or accountability to public authorities and end users of low-income houses, *i.e.*, the beneficiaries. The respondents were of the view that house builders and local government authorities could use five factors, namely quality standards, management, involvement of people, process design and process, planning and scheduling to assess non-conformance to quality requirements in low-income housing projects in South Africa. The finding of this study provides a platform for improving the quality of housing design, construction projects, sustainability and an opportunity for local and international design and construction professionals to rethink design in the context of low-income housing projects.

ABSTRAK

Onlangse Suid-Afrikaanse en internasionale bewyse beklemtoon die breë en blywende impak van huishoudings, veral dié op lae inkomste, wanneer hulle nie in staat is om hoër-inkomste ewekniëë te kan bekostig, in woonstelle te woon, openbare behuising te onderhou of in ander hoë-gehalte huise te kan woon nie. 'n Wye reeks lae-inkomstehuise wat onlangs in Suid-Afrikaanse plaaslike munisipaliteite gebou is, is glo gebrekkig, wat verband hou met swak bou- en konstruksiegehalte. Die doel van hierdie studie is om die faktore wat hoë kwaliteit behuising beïnvloed wat 'n positiewe impak het op die lewens van 'n beduidende deel van lae-inkomstebehuisingsprojekte te bepaal. Redes en struikelblokke vir kwaliteitontwerp, konstruksiekwaliteit en die ontwikkeling van lae-inkomstebehuisingsprojekte is geïdentifiseer. Om die navorsingsvrae te assesseer, is 'n kwantitatiewe opname (n=103) uitgevoer, eenvoudige ewekansige en doelgerigte steekproeftegnieke is gebruik om kontrakteurs te kies wat aktief is in lae-inkomstebehuisingsprojekte binne Polokwane Munisipaliteit. Die kwantitatiewe data wat ingesamel is, is ontleed deur gebruik te maak van Statistiese Pakket vir die Sosiale Wetenskappe (SPSS) om 'n kombinasie van beskrywende en nie-parametriese statistieke van die data te bepaal wat die frekwensies, gemiddelde tellings en standaardafwykings bereken. Resultate het getoon dat behuising en lae-inkomstebehuisingsprojekte van swak gehalte beskou word as verwant aan die kontrakteurs, bouers en konstruksiepraktisyns wat nie aan die standaarde voldoen nie, en hulle verskil vanweë onvoldoende opleiding of aanspreeklikheid teenoor openbare owerhede en eindgebruikers van lae-inkomstehuise, dit wil sê die begunstigdes. Die respondente was van mening dat huisbouers en plaaslike regeringsowerhede vyf faktore, naamlik gehaltestandaarde, bestuur, betrokkenheid van mense, prosesontwerp en proses, beplanning en skedulering kan gebruik om die nie-nakoming aan gehaltevereistes in lae-inkomstebehuisingsprojekte in Suid-Afrika te meet. Die bevinding van hierdie studie bied 'n platform vir die verbetering van kwaliteit van behuisingsontwerp, konstruksieprojekte, volhoubaarheid en 'n geleentheid vir plaaslike en internasionale ontwerp- en konstruksiekundiges om ontwerp in die konteks van lae-inkomstebehuisingsprojekte te heroorweeg.

Sleutelwoorde: Boukonstruksie, kontrakteurs, kwaliteit ontwerp, lae-inkomstebehuising, swak gehalte behuising

1. INTRODUCTION

Section 7(1) of the South African Housing Act of 1997 mandates that the government will do everything in its power to promote and facilitate the provision of adequate housing to the local communities it serves (Statistics South Africa, 2015: 2). The White Paper on Housing (1994) provides an

overall description of the housing condition when the African National Congress (ANC) government took power in 1994 (Statistics South Africa, 2015: 2). The White Paper prioritised the needs of the poor, encouraged community participation and the involvement of the private sector, providing funding assistance to disadvantaged individuals (Department of Human Settlements, 2017: 2). These policies serve to facilitate and coordinate the provision of quality, integrated and sustainable human settlements, in order to offer a better living environment to the communities. One of the Department of Human Settlements' areas of obligation in the delivery of human settlements relates to the bottom end of the market, where it affords housing grants (subsidies) to the poor (South Africa, DHS, 2017: 1). Cloete and Massey (2017: 151) remarked that the gap in the housing market ("missing middle") includes people who characteristically earn over R3,500 but less than R22,000 per month, which is too little to participate in the private property market, yet too much to qualify for government assistance (Reconstruction and Development Programme [RDP] house). Low-income housing (RDP houses) can be described as government-built housing, which provides medium-density, affordable, housing through government subsidy to households earning less than R3,500 per month (Statistics South Africa, 2015: 2).

The South African government has built almost 3 million low-income homes since 1994 and a further 3 million are targeted by 2025 (South Africa, DHS, 2017: 1). Housing beneficiaries have needs such as security, shelter, status, and fulfilment of ambitions; hence, quality of the dwelling is of concern (South Africa, DHS, 2017: 1). The high quality of low-income housing projects not only contributes to improve the socio-economic conditions of communities, but also supports conformance to quality to the original set standard (Ramoroka, 2021: 61). The quality of low-income housing in South Africa is challenging, as there are many multidimensional tasks and operational measures to adhere to (Zunguzane, Smallwood & Emuze, 2012: 19; Aigbavboa, Oke, Akinradewo, Aghimien & Okgonne, 2019: 2). The low-income housing sector within the Polokwane Municipality is confronted with various uncertainties and complications such as deliberate non-compliance to specifications by the contractor, defects of materials used, accidents, competitive building processes, wrong equipment being used, and poor communication during the construction stage (George, 2016). Minas (2016: 20) pronounced that there is a need for a new quality improvement strategy to resolve the common problems in the provision of low-cost housing.

This study seeks to address the following research question: What factors contribute to poor quality of low-income housing within Polokwane Municipality? In order to address this, this study identifies factors that influence quality on low-income houses and measures the key quality

performance indicators of low-income housing projects. The study uses these as benchmark to propose possible measures to improve the quality of low-income housing.

2.   LITERATURE REVIEW

2.1   Poor quality of low-income housing

Housing quality has been broadly used to define the physical condition of a dwelling unit, the characteristics and quality of the physical environment, and end user satisfaction (Mahachi, 2021: 98). For this study, in the context of low-income housing, poor housing quality refers to poor physical condition, poorer ventilation and mental health concerns, which can lead to increased spread of communicable diseases such as influenza and sleep disruption. This view is also supported by Easthope, Troy and Crommelin (2017) who state that poor quality housing can also have a negative impact on households' social lives, neighbourhoods and buildings, for instance, if noise is poor. According to Agrawal, Tausif, Khan and Kesharwani (2017: 19), building defects are mostly based on the performance of the physical product or service delivered to the client, that is, the expression and identification of non-conformance. Studies have revealed that poor-quality houses are instigated by non-conformance with the provided building codes and existing regulations and rules (Zewdu & Aregaw, 2015; George, 2016; Keinan, 2018). Building design errors that include faulty design, specification not being properly followed, and the inability to interpret construction drawings (Rumane, 2011: 65) contribute to the poor quality of low-income housing; it may lead to the incorrect use or incorrect installation of materials, foundation failure, and structural imperfections (Kumar & Sriram, 2017: 329).

Visible building defects of poor-quality low-income houses may include structural cracking, defective plaster, faulty ventilation, roof leakage, as well as timber rot fungus and mould (Ramoroka, 2020 Jogdand & Deshmukh, 2017; Kutta & Nyaanga, 2014: 610). Hong (2012: 114) remarks that roof leakage could result in the water penetrating inside the house, causing mould and weakening the integrity of the house structure. Corrosion of reinforced steel defects are caused by the combination of inadequate concrete cover and insufficient waterproofing (Kumar & Sriram, 2017: 329).

Hong (2012: 109) and Mac-Barango (2017: 7) identified that the use of cheap materials, damaged materials and deliveries that are not safely covered, or exposed to the sun or rain contribute to the poor quality of low-income housing projects. The substandard materials, mixing of inadequate concrete cover, poor waterproofing and crumbling of concrete causes the

defects (Kumar & Sriram, 2017: 328) that compromise the safety of the building (Zunguzane *et al*., 2012; Kutta & Nyaanga, 2014: 609).

Skills shortage, limited quality contractors and inappropriate construction project management techniques (Statistics South Africa, 2015: 2) affect quality, construction project performance and service to customers. Khalid, Marosszeky and Davis (2006: 28) argue that high levels of construction cost, time overruns, and abandonment are related to employees with limited knowledge, and poor workforce, manpower allocation as well as lack of supervision and poor management and control of building contractors affect the quality of construction projects (Romeo, Andrew, Sarich & Michael, 2014: 74; Riaz, Din & Aftab, 2015: 286).

According to Kobina (2012:13), the low-income housing challenges in Ghana are excessive bureaucratic locations, a weak material supply base, financial uncertainties, unregulated labour market and poor management practices, leading to poor quality. Malaysia sits with the challenge of abandoned projects caused by poor management, unreliable government policies, and unstable economic conditions (Aini, Mohd & Nor Azmi, 2015: 69). Minas (2016: 87) found that delays, raw material wastage, poor quality designs, workmanship and lack of resource result in the poor quality in the construction industry.

In South Africa, the root causes for poor-quality low-income houses are listed by Mahachi (2021: 96) as inadequate structural design caused by improper soil classification, non-compliance with design specifications, poor-quality building materials, poor workmanship, inadequate or non-existent service infrastructure such as storm-water systems, ineffective monitoring of homebuilders during construction, as well as complete ignorance and/or lack of experience of homebuilders.

2.2 Quality planning for low–income housing construction

According to Rumane (2013: 99), quality planning can be viewed as a systematic process that interprets quality policy into measurable objectives and requirements. In addition, Kutta and Nyaaga (2014: 610) highlight that quality plans are useful in assuring conformance to customer expectations, facilitating quality traceability, and classifying gaps that can be occupied by the quality team. For housing construction, quality plans should clearly define the objectives to be accomplished. It is critical for housing contractors and project managers to provide specific documented standards and operating procedures to be followed by all employees during the construction process and to create authority, responsibility and resources in different phases of the process (Jumah, Faithy, Rami & Jamal,

2015: 58). This view is also supported by Jogdand and Deshmukh (2017) who stated that suitable testing, inspection, audit programmes as well as examination should take place at appropriate stages in the construction project. In setting housing projects, quality planning remains important, because it stipulates policies and procedures, internal guidelines and good practices, quality standards, practices, structure and resources of activities relevant to a specific job being performed (Yalengama, Chileshe & Ma, 2016; Zhang, 2000).

2.3   Improving the quality of low-income housing

Existing literature shows that housing quality is the key source of competitive strategy in low-income housing (Hong, 2012: 109; Statistics South Africa, 2015: 2; Narsal, Taylor, Jinabhai & Stevens, 2013: 370; Mane & Patil, 2015: 127). According to the 1996 Housing Consumer Protection Measures Act, house builders in South Africa are required to register with the National Home Builders Registration Council (NHBRC) and ensure that all houses built are enrolled for the warranty provided by Standard Builders; the warranty is also extended to government housing schemes (Aigbavboa *et al*., 2019: 3). The warranty was put in place by NHBRC to regulate and maintain house delivery quality by homebuilders.

Aigbavboa *et al*. (2019: 3) and Zunguzane *et al*. (2012: 37) list different initiatives that could be taken to minimise non-conformance to quality of low-income housing in South Africa. These initiatives include contractors' knowledge of the National Building Regulations should be evaluated before contract award, monitoring, and sufficient inspection of work in progress by project stakeholders such as municipal inspectors and NHBRC officials, training and education related to low-income housing building standards should be provided, proper planning and risk assessment, upper management commitment, use of skilled labour, strict supervision, effective communication among project parties, use of appropriate construction management technique, formal training in the selection of appropriate construction material and methods, fixing corruption, use of appropriate design, effective organisational culture, clear goal-setting, and focus on quality and less on production.

To improve the quality of low-income housing, Kutta and Nyaanga (2014: 609) explain rework of building defects as the redundant process or activity that was erroneously implemented the first time. Before rework, experienced engineers or designers are required to identify the defects in a building, in order to determine the causes of the defects (Aigbavhoa & Thwala, 2014). Another initiative to minimise poor quality in low-income housing is to inspect samples (starting with the testing of the building

materials) at various stages of the housing project (Fernandez-Aguera, Dominguez-Amarillo & Alonso, 2019: 103).

For effective quality management, it is important for the South African local government to implement and facilitate the quality measurement of low-income housing projects as well as the performance of building contractors (Chohan, Che-Ani, Shar & Awad, 2015: 118). Limited information is available on frameworks and tools that measure housing construction quality (Tunji-Olayeni, Mosaku, Fagbenle, Omuh & Joshua, 2016: 6). Mahachi (2021) examined the development of a tool that can be used to measure and quantify the construction quality of low-income houses in South Africa. External monitors and authorities should be appointed to evaluate and account on the construction process carried out by contractors towards achieving the quality of low-income housing projects. Contractors and housing sector authorities should analyse their organisational values and attitudes towards the implementation process for quality assurance (Nyakala, Pretorius & Vermeulen, 2019).

Together with the housing project team, the unit responsible for quality control could determine whether the beneficiaries (customers of low-income housing) are satisfied with the inclusive targets of the housing project performance (Emuze & Mhlwa, 2015). Daily construction processes are other important considerations to be assessed by the low-income housing beneficiaries' representative and community project leader (Dwijendra, 2013: 72). Housing project managers should create weekly plans and schedule daily or monthly meetings with community leaders (Zunguzane *et al*., 2012: 20; Aigbavhoa *et al.,* 2019). Research by George (2016: 23) reveals that emerging contractors in developing countries use the critical incident technique to elicit financial challenges.

3.   METHODOLOGY

In this study, quantitative research with a descriptive and exploratory design was used to determine the key factors contributing to poor quality of low-income housing within the Polokwane Municipality, South Africa. The quantitative approach relies comprehensively on statistics and numbers in the analysis and interpretation of findings that are generalised from the sample to the population (Creswell, 2014: 11; Bless, Higson-Smith & Sithole, 2018: 16). The quantitative research approach allows for using structured questionnaire surveys to measure objectives by counting and the use of several scales (Bless *et al*., 2018: 16). According to Brown (2011: 11), quantitative research also allows for the use of descriptive and inferential statistics to analyse data. Several data analysis strategies are available, but for this study the mean scores of interval data were used to calculate the central tendency and to determine the ranking of the items in

the Likert-type scale constructs (Nahm, 2016: 9). Exploratory factor analysis (EFA) was used to reduce the measured items (variables) to smaller factors contributing to poor quality (Yong & Pearce, 2013: 80).

3.1   Sampling method and response rate

In 2020, according to the Construction Industry Development Board (CIDB), 260 individuals were working in construction-related occupations registered within the Polokwane Municipality, South Africa. Purposive sampling (Creswell, 2014: 50) was used to select 160 individuals from this population as participants in this study. The sample size for research done among construction-related populations was calculated in accordance with the table recommended by Krejcie and Morgan (1970: 608). From the table, the recommended sample size for a population of 260 is 155. This resulted in a sample size of 61%. This recommendation validates the sample size of 160 as efficient for the population of 260. From the sample of 160, 103 participants completed and returned the survey responses, resulting in a response rate of 64%. According to Moyo and Crafford (2010: 68), contemporary built-environment survey response rates range between 7% and 40%, in general.

3.2   Data collection

Using the drop-and-collect and email methods, 160 questionnaires were distributed to the prospective respondents who worked on low-income housing projects in the Polokwane Municipality of Limpopo province, South Africa, from September 2019 to October 2020 (Ramoroka, 2020). Topics on the quality of low-income housing used in the questionnaire were extracted from reviews from the literature (Rumane, 2011). The questionnaire was divided into four parts. Part one, on the respondent's profile, obtained personal information on education qualification, occupation, and years of work experience. Part two set 20 Likert-scale items on the construct causes of poor quality of low-income housing (see Table 2). Respondents were required to indicate their level of agreement, in order to determine what items/factors cause poor quality of low-income housing. Part three is a set of 15 Likert-scale items on the construct implications of poor quality of low-income housing (see Table 2). Respondents were required to indicate their level of agreement, in order to examine what the implications of poor quality of low-income housing are for the construction industry. The data from the measurements in Parts 2 and 3 forms the variables used in the Exploratory Factor Analysis (EFA), which tested the validity and reliability of the factors. Part four set 18 Likert-scale items on the construct measures to improve the quality of low-income housing projects (see Table 7). The data from these measurements forms the Likert-scale items used in the descriptive analysis

of different initiatives that could be taken to minimise non-conformance to the quality of low-income housing. To reduce the respondent's bias, closed-ended questions were preferred for Parts 2 to 4 (Akintoye & Main, 2007: 601). The questionnaire was administered to the study sample, along with a covering letter stating the purpose of the research, and the guarantee that the information given by the respondents would be treated as confidential and that no names would be mentioned in the research. The questions were compiled in Sepedi and English to accommodate people who can only speak one of these languages.

3.3 Analysis and interpretation of the data

The data analysis used the Microsoft Excel 2016 and Statistical Package for the Social Sciences (SPSS) version 27 to produce a combination of descriptive and non-parametric statistics of the data computing the frequencies, mean scores and standard deviations (Pallant, 2007; Field, 2013). SPSS was further used to determine the feasibility of conducting a factor analysis of the quality of housing projects survey results relating to low-income housing project delivery. An item with a higher mean item score is ranked as the highest, since it represents its dominance among other items ranked. Moreover, standard deviation was also used to report the variability (how concentrated the data are around the mean) in ranking those items that have the same mean score (Neuman, 2000).

For the purpose of analysis, the ranges relative to the MS are defined as follows: >1.00 to ≤ 1.80 (strongly disagree/not important); >1.80 to ≤2.60 (disagree/fairly important); >2.60 to ≤ 3.40 (neutral); >3.40 to ≤4.20 (strongly agree/extremely important). The mean of responses was generated, in order to analyse the factors (1) causing and (2) improving poor quality of low-income housing projects. Only the mean of the items was used to show the central tendency and to rank the factors in order of having the most affect/implication to having the least affect/implication.

For the analysis of the internal reliability of the factors in the questions on quality of low-income housing projects, Cronbach's *alpha* values were tested (Taber, 2018). Field (2013) suggests that the acceptable values of Cronbach's *alpha* would range from 0.70 to 0.95. In this study, a cut-off value of 0.70 was adopted. In addition to this, the optimal inter-item correlations mean (factor loadings) should range from 0.2 to 0.4, in order for the factor to be reliable (Pallant, 2007: 134). Conversely, in the current study, a value of 0.4 and above was adopted. To confirm whether the data from the measurements was sufficient for testing the validity (factor analysis), the Kaiser-Meyer-Olkin (KMO) test (Kaiser, 1994) and the Bartlett's Sphericity Test (Hair, Black, Babin & Andersen, 2014: 110) were performed. In the KMO test, as the values of the test differ from 0 to 1,

values above 0.7 are recommended as being desirable for Exploratory Factor Analysis (EFA) (Hair *et al*., 2014), and a statistically significant Bartlett test (p<0.05) indicates that sufficient correlations exist between the variables to continue with the analysis (Pallant, 2007: 190). For factor extraction, Principal Components Analysis (PCA) with Varimax rotation was used to summarise most of the information into a minimum number of factors, by concentrating the explanatory power on the first factor (Rossoni, Engelbert & Bellegard, 2016: 102). According to Johnson and Wichern (2007), in the context of PCA, when the number of measures (variables) is between 20 and 50, it is more reliable to use Eigenvalues to extract factors, as it makes interpretation simpler. Thus, the highest Eigenvalues in the data are the principal components in the data, which are retained to form a set of new variables (less than the original variables started with in the analysis) (Rossini *et al.,* 2016).

3.4   Limitation(s) of the study

Using a non-probability purposive sample within one local municipality restricted the representatives of the study over the entire population of contractors involved in low-income housing projects. Future studies could expand the sample to involve more local municipalities from other provinces and other countries. In addition, future research should accommodate other housing stakeholders and generational partners, such as the Department of Human Settlements officials and homeowners' beneficiaries. Future studies should consider probability sampling methods towards strengthening the generalisability of the findings.

4.   RESULTS AND DISCUSSION

4.1   Respondents' profile

Table 1 shows that most of the participants (61%) had either a first degree/ diploma (45.6%) or an Honours degree/B-Tech (14.5%), and 71.7% had over 10 years' experience in low-income housebuilding projects. Respondents were almost equally distributed in their occupations, with architects (24.2%), quantity surveyors (23.3%), engineers (19.4%), construction/project managers (18.4%), and clients/managers (14.5%). This implies that most of the respondents have adequate tertiary qualifications and experience in building low-income houses to provide information that could help in making useful deductions on the factors that affect the quality of low-income houses.

Table 1:   Respondents' profile

Characteristic	Category	Frequency (N = 103)	%
Educational level	Grade 11 or lower	10	9.7
	Grade 12/(N3)	26	25.2
	First degree/Diploma	47	45.6
	Honours/B-Tech	15	14.5
	Masters/M-Tech	5	4.8
Occupation	Architect	25	24.2
	Quantity surveyor	24	23.3
	Engineer	20	19.4
	Construction/project manager	19	18.4
	Client/manager	15	14.5
Experience	Less than 5 years	8	7.7
	5-10 years	21	20.3
	11-15 years	62	60.1
	16 years and above	12	11.6

4.2   Factors affecting quality of low-income housing projects

Table 2 shows the ranking of the factors affecting the building of poor-quality low-income housing projects in the study area, using mean score ratings. An average MS of 3.80 indicates that respondents agreed that all factors affect the quality of low-income housing. The Cronbach's *alpha* was greater than 0.70 at .784, indicating acceptable internal reliability, as recommended by Taber (2018: 1279).

Table 2:   Ranking of factors causing the poor quality of low-income housing projects

V	Statement (N=103)	MS	Std. Dev	Cronbach's alpha	Rank
A1	Low quality of materials and equipment	4.48	1.92	.843	1
A2	Unskilled/incompetent site workers	4.41	1.62	.781	2
A3	Inappropriate mode of financing project	4.36	1.93	.777	3
A4	Poor contract administration	4.28	1.53	.741	4
A5	Project control problems	4.26	1.93	.735	5

V	Statement (N=103)	MS	Std. Dev	Cronbach's alpha	Rank
A6	Involvement of a large number of participants of project	4.13	1.80	.851	6
A7	Problem of communication and coordination	4.00	1.57	.948	7
A8	Shortage of site workers	3.97	1.29	.763	8
A9	Poor relationship between project team members	3.85	1.72	.737	9
A10	Poor safety management	3.79	1.38	.854	10
A11	Delay in interim payment	3.61	1.29	.765	11
A12	Inappropriate risk allocation among project team	3.60	1.27	.751	12
A13	Inappropriate pricing/incentives of services rendered by contractors or consultants	3.56	1.32	.763	13
A14	Inappropriate project planning and scheduling	2.94	2.69	.755	14
A15	Unexpected bad economic conditions	2.92	2.67	.793	15
A16	Unfavourable government policy	2.75	2.75	.721	16
A17	Adverse weather	2.42	2.79	.761	17
A18	Ambiguities or mistakes in scope of work, specifications, or drawings	2.40	1.40	.819	18
A19	Difficulty of design and construction	2.38	2.10	.769	19
A20	Lack of motivation of site workers	2.30	1.80	.764	20
	Composite score (Average)	3.80		.784	

Respondents strongly agreed that low quality of materials and equipment (MS 4.48; SD 1.92) and unskilled/incompetent site workers (MS 4.41, SD 1.62), inappropriate mode of financing project (MS 4.36, SD 1.93), poor contract administration (MS 4.28, SD 1.53), and project control problems (MS 4.26, SD 1.93) are the top five factors affecting the quality of low-income housing projects. Involvement of a large number of participants of project (MS 4.13, SD 1.80), problem of communication and coordination (MS 4.00, SD 1.57), and shortage of site workers (MS 3.97, SD 1.29), are ranked six to eight, respectively.

This study's results are in line with Hong (2012: 114), who ranked quality of materials and equipment first, while Jogdand and Deskmukh (2017: 1024) ranked it third, when investigating the factors influencing housing satisfaction in medium- and high-cost housing. Zewdu and Aregaw (2015: 190) ranked skilled/competent site workers second, while Kumar and

Sriman (2017: 329) ranked process design fourth. This factor concurs with Ola-awo, Alayande, Basher and Oyewobi's (2021: 8) conclusion that, for any project to be successfully completed, there must be a proper project design and process, which is an essential requirement for effective quality of housing. Furthermore, Aigbavhoa *et al.* (2019: 8) ranked identifying the customer requirements and evaluating the current status of low-income housing third, by indicating that, the project manager/leader should have effective communication skills and be able to engage with all stakeholders affected by the project activities.

4.3   Implications of poor-quality housing projects

Table 3 ranks the mean scores to show the implication of poor-quality low-income housing projects.

Table 3:   Ranking the implications of poor-quality low-income housing projects

V	Implication (N=103)	MS	SD	Cronbachs' alpha	Rank
B1	Poor quality control	4.50	1.81	.822	1
B2	Lack of cooperation from local authorities	4.43	1.78	.802	2
B3	Difficulty of design and construction	4.32	1.86	.732	3
B4	Unclear lines of responsibility and authority	4.32	1.23	.753	4
B5	High accident rates	4.26	1.09	.922	5
B6	Faulty buildings	4.14	1.15	.923	6
B7	Cost overruns	3.99	1.33	.720	7
B8	Time overruns	3.96	1.62	.806	8
B9	Faulty tender processes	3.91	1.49	.757	9
B10	Lack of trust from the community members	3.64	1.66	.702	10
B11	Litigation	3.61	1.79	.753	11
B12	Court cases	3.45	1.74	.733	12
B13	Impact on project performance	3.16	1.89	.805	13
B14	Lack of motivation of site workers	3.11	1.29	.750	14
B15	Loss of income to contractors	3.00	1.09	.790	15
	Composite score (Average)	3.59		.785	

An average MS of 3.59 indicates that respondents agreed that all factors in Table 3 are implications of poor-quality low-income housing. The Cronbach's *alpha* was greater than 0.70 at .785, indicating acceptable

internal reliability, as recommended by Taber (2018: 1279). Respondents strongly agreed that poor quality control (MS 4.50, SD 1.81), lack of cooperation from local authorities (MS 4.43, SD 1.78), difficulty of design and construction (MS 4.32, SD 1.86), unclear lines of responsibility and authority (MS 4.32, SD 1.23), and high accident rates (MS 4.26, SD 1.15) are the top five implications of poor-quality low-income housing projects. Others are faulty buildings (MS 4.14, SD 1.15), cost (MS 3.99, SD 1.33), time overruns (MS 3.96, SD 1.62), faulty tender processes (MS 3.91, SD 1.49), lack of trust from the community members (MS 3.64, SD 1.66), litigation (MS 3.14, SD 1.79), and court cases (MS 3.45, SD 1.74).

When investigating factors contributing to waiting for a house or building in South Africa, Landman & Napier (2010) ranked cooperation from local authorities and motivation of site workers first and fourth, respectively. These results demonstrate that quality-control activities indicate the lines of responsibility among employees in low-income housing projects. This study's results are in line with Liu, Easthope and Martin (2019: 13), who ranked regulation of standards and improving housing quality methods second, whilst Goebel (2007) ranked it third, when evaluating challenges faced by low-cost housing in South Africa. Nyakala *et al.* (2019: 38) ranked quality control fourth, while Yalengama *et al*. (2016: 657) ranked impact of project performance second. Furthermore, George (2016: 32) ranked appropriate pricing/incentives of services rendered by contractors third. These results are consistent with the findings of a study conducted by Zunguzane *et al.* (2012), who recommended that effective project managers should consult their subordinates, in order to integrate the key project control processes. These findings suggest that the site workers should be more informed about and trained in quality procedures as well as the planning techniques available in the construction industry. The study supports previous findings by Alink (2003), who found that appropriate training and building skills are the dominant factors influencing the construction process.

4.4 Exploratory factor analysis related to poor-quality low-income housing

The 35 factors (Tables 2 and 3) measuring the quality of low-income housing projects were subjected to factor analysis to study the trend of inter-correlations between variables and to group these variables with similar characteristics into a set of reduced factors according to the hidden components in the collected data. Only the 27 factors extracted with communalities loadings of 0.4 and above were subjected to EFA. The results report the factor extraction, Eigenvalues, correlation, and interpretation. The Kaiser-Meyer-Olkin (KMO) value of 0.815 was obtained, which is

greater than 0.70, and Bartlett's Test of Sphericity has the significant value of ($p<0.05$) at 5% level of significance, as shown in Table 4. Therefore, the obtained results indicate that the data is robust and suitable for conducting factor analysis in line with Pallant (2013).

Table 4:   KMO and Bartlett's Test results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.815
Bartlett's Test of Sphericity	Approximate Chi-square	238.526
	Degree of freedom	36
	Significance P- value	0.00

PCA, with initial Eigenvalue greater than 2 criterions, the orthogonal Varimax rotation and a factor loading of 0.7 were used to determine the number of factors to retain and rotate in line with Hair *et al*. (2014). Table 5 confirms the retaining of 5 components (factors), where component 1 (quality standards) explains 48, 188% of the total variance; component 2 (management), 41,484%; component 3 (involvement of people), 52,962%; component 4 (project design and process), 57,193%, and component 5 (planning and scheduling), 42,494%.

Table 5:   Total variance explained – Extraction method: Principal component analysis

Component	Initial Eigenvalues		
	Total	% of variance	Cumulative %
1	2,409	48,188	48,188
2	2,904	41,484	41,484
3	2,648	52,962	52,962
4	2,288	57,193	57,193
5	2,550	42,494	42,494

Based on PCA, orthogonal Varimax rotation with Kaiser Normalisation rotation method and with a significant factor of .07, the correlation between components and variables after rotation are shown in Table 6. Correlation exists between variables A1, A2, A3, A9 and B9, as they load onto Component 1: Quality standards. Similarly, correlations were identified between variables A7, A6, A12, B1, B4, A16, A1, A4 and A5, which loaded onto Component 2: Management. Variables A11, A8, B14, B2 and A10 show correlation, as they loaded onto Component 3: Involvement of people. Correlation exists between variables B11, A20, B3 and A13, which all loaded onto Component 4: Process design and process. Variables A18,

A15, A17, A14 and A19 show correlation, as they loaded onto Component 5: Planning and Scheduling.

These 27 factor items are validated and reduced to five through factor analysis to measure housing quality when building low-income houses: quality standards, suitable management skills, implementation of quality design and process, involving suitable people and the effective planning and scheduling of projects.

Table 6:   Rotated component matrix for factors influencing poor-quality low-income housing

V	Factor	Component					Commu-nality
		1	2	3	4	5	
	F1: Quality standards						
A1	Low quality of materials and equipment	0.843					.722
A2	Unskilled/incompetent site workers	0.781					.748
A3	Inappropriate mode financing project	0.777					.573
A9	Incompetent contractors or sub-contractors	0.773					.770
B9	Faulty tender process	0.755					.673
	F2: Management						
A7	Problem of communication and coordination		0.948				.480
A6	Involvement of a large number of participants in the project		0.851				.454
A12	Financial difficulties faced by the contractor		0.850				.519
B1	Poor quality control		0.791				.642
B4	Unclear lines of responsibility and authority		0.785				.512
A16	Adverse weather		0.761				.647
A4	Poor contract administration		0.741				.682
A5	Project control problems		0.735				.646
	F3: Involvement of people						
A11	Poor safety management on site			0.854			.729

V	Factor	Component					Commu-nality
		1	2	3	4	5	
A8	Shortage of site workers			0.763			.400
B14	Lack of motivation of site workers			0.764			.417
B2	Lack of cooperation from local authorities			0.748			.559
A10	Poor relationship among project team members			0.737			.544
	F4: Project design and process						
B11	Litigation				0.849		.721
A20	Ambiguities or mistakes in scope of work, specifications or drawings				0.819		.671
B3	Difficulty of design and construction				0.769		.480
A13	Delay in interim payment				0.765		.416
	F5: Planning and scheduling						
A18	Unexpected bad economic conditions					0.793	.592
A15	Inappropriate pricing/ incentives of services rendered by contractors or consultant					0.763	.770
A17	Inappropriate project planning and scheduling					0.755	.465
A14	Inappropriate risk allocation among project team					0.751	.855
A19	Unfavourable government policy					0.721	.558

Factor 1: Quality standards

With five sub-factors, this component accounts for 48.188% of the total variance. Low quality of materials and equipment has the highest loading of 0.843; unskilled/incompetent site workers has a loading of 0.781; inappropriate mode financing project has a loading of 0.777; incompetent contractors or sub-contractors has a loading of 0.773, and faulty tender process has a loading of 0.755.

Zunguzane *et al.* (2012: 19) consider that quality standards in the housing sector are tasks carried out to ensure internal consistency and that they

are systematically applied. This includes procedures and the way in which a process must be carried out. Many factors have a potential impact on poor housing and improper construction design. These include low quality of materials and equipment, unskilled labour, and unfavourable government policies (Leong & Zakuan, 2014: 106). A study by Easthope *et al*. (2017) revealed that a lack of adequate governance structures and responsibilities can result in poor building and cost overruns in housing projects.

Factor 2: Management

This factor accounts for 41.484% of the total variance and comprises seven sub-factors. Poor quality control has the highest factor loading of 0.791; poor contract administration, 0.741; project control problems, 0.635; financial difficulties faced by the contractor, 0.550, and problem of communication and coordination, 0.498.

These results illustrate that poor quality control has a negative impact on low-income housing projects in terms of contractors' reputation, faulty buildings, and loss of income to contractors (Liu *et al*., 2019: 8). Zunguzane *et al*. (2012) suggest that an appropriate quality control system must be in place, in order to facilitate set standards by the project-based organisation's management. Fernandez-Aguera *et al*. (2019) found that poor contract administration leads to a range of quality concerns, including increased late payments to contractors and time overruns.

Previous studies by Minas (2016) found that lack of project control has a negative impact on construction project performance in Ethiopia. In support of the results of this study, Goebel (2007) and Agrawal *et al*. (2017) observed that financial difficulties, ineffective communication and coordination among project team members are factors leading to non-conformance to quality in low-income housing projects. Similarly, results by Hong (2012) indicated that more focus on construction process and less on quality are the major causes of non-conformance to quality, as pointed out also by findings of this study.

Factor 3: Involvement of people

This factor accounts for 52.962% of the total variance and has five sub-factors. Poor safety management on site has the highest loading of 0.854; lack of motivation of site workers, 0.764; shortage of site workers, 0763; lack of cooperation from local authorities, 0.737, and poor relationship among project team members, 0.737.

This result corresponds with that of Vermeulen, Pretorius and Nyakala (2018: 223) in that the involvement of various stakeholders is a vital ingredient for successful construction projects. An effective relationship

between contract parties assures the possibility of good performance. People involvement in a project leads to the attainment of organisation goals, as all allow for sharing knowledge, exchanging information, disseminating instructions, and providing supporting tasks (Ola-awo *et al*., 2021: 24). Yalengama *et al*. (2016: 656) asserted stakeholder involvement as a driver with a significant impact on projects. They concluded that the project manager must involve, communicate, and organise all people affected by the project activities prior to commencing any task. Easthope *et al*. (2017) observed that unskilled site workers and communication among stakeholders in low-income housing projects could be attributed to a failure in determining the skill development and knowledge impacting on staff motivation and built-environment requirements. Skills development programmes and unselfish observance to low-income housing projects and standards must be established and measured frequently (Aigbavboa *et al*., 2019).

Factor 4: Project design and process

Project design and process accounts for 57.193% of the total variance with four sub-factors: litigation has the highest loading of 0.849; ambiguities or mistakes in scope of work, specifications or drawings, 0.819; difficulty of design and construction, 0.693, and delay in interim payment, 0.645. Famiyeh, Amoatey, Adaku and Agbonohevi (2017: 196) observed that disputes affect project progress and strains relationships among parties to a contract. A study by Muhwezi, Acai and Otim (2014) found that poor technical specification and non-compliance with design codes affect timely completion of construction projects, demonstrating that low-income housing projects suffer from defects resulting in poor maintainability considerations at the design and construction stage. A study conducted by MacCarthy and Jayarathne (2018) found that poor financing, as well as poor planning and scheduling are the most significant causes of project delay in construction projects.

Factor 5: Planning and scheduling

This factor accounts for 42.494% of the total variance with six sub-factors. Inappropriate pricing/incentives of services rendered by contractors or consultant has the highest loading of 0.763; unfavourable government policy, 0.721; unexpected bad economic conditions, 0.693; unclear lines responsibility and authority, 0.578; inappropriate risk allocation among project team, 0.571, and inappropriate planning and scheduling, 0.555. Ezeldin and Ibrahim (2015: 648) stated that appropriate pricing is the decisive parameter in evaluating the competition for the implementation of construction works. A study by MacCarthy and Jayarathne (2018: 703)

suggest that determining the appropriate price for a project ensures that a project's budget is on track and will be completed according to its planned scope. Liu *et al*. (2019) argue that a low-income housing project without a cost control can easily lose money and costs can go above project profit. Adebayo and Omolabi (2017: 804) found that public income housing projects fail to complete within the specified time, due to unfavourable government policies in Nigeria. This means that construction practitioners and policymakers need to understand and mitigate the bottlenecks in low-income housing projects. Omolabi, Alayiwola and Okesoto (2012) found that the vast majority of construction projects go through a financial recession, with the result that project-based organisations are laying off many of their employees. A study by Robinson (2017) found that lack of clear role responsibilities may prevent project owners from effectively fulfilling their roles and organisations from successfully realising benefits from their project investments. Mane and Patil (2015: 129) believed that effective planning and scheduling are a vital ingredient for successful construction projects. Aigbavhoa *et al*. (2019: 8) asserted that it is important to understand project planning and scheduling for successful project delivery.

4.5 Measures to improve the quality of low-income housing projects

Table 7 shows an average MS of 3.98. The respondents ranked as important the factors that could be considered to minimise non-conformance to quality of low-income housing projects. The Cronbach's *alpha* was greater than 0.70 at .778, indicating acceptable internal reliability, as recommended by Taber (2018: 1279).

Table 7:   Measures to improve the quality of low-income housing projects

V	Measures (N=103)	Bartlett's Test of Sphericity value = 0.00		Kaiser-Meyer-Olkin value = 0.770	
		MS	Cronbach's alpha	SD	Rank
C1	Planning and scheduling	4.21	.877	1.61	1
C2	Time-cost trade-offs	4.12	.710	1.40	2
C3	Selecting right suppliers	4.03	.720	1.02	3
C4	Budget control	4.00	.723	1.80	4
C5	Good communications	4.00	.805	1.57	5
C6	Teamwork	3.97	.855	1.77	6
C7	Policies and objectives are defined	3.85	.890	1.72	7

V	Measures (N=103)	Bartlett's Test of Sphericity value = 0.00		Kaiser-Meyer-Olkin value = 0.770	
		MS	Cronbach's alpha	SD	Rank
C8	Reporting corruption	3.85	.817	1.38	8
C9	Workers' participation	3.79	.802	1.24	9
C10	Top-down commitment	3.61	.819	1.42	10
C11	Accurate construction management	3.56	.831	1.81	11
C12	Organisational structure	3.48	.802	1.29	12
C13	Monitoring and controlling	3.36	.657	1.18	13
C14	Architect's designs	3.25	.690	1.90	14
C15	Completion of the project on time	3.20	.715	1.90	15
C16	Employees are properly qualified to do the work	3.18	.690	1.80	16
C17	Accurate and reliable strategic planning	3.18	.805	1.70	17
C18	Local government managers monitor and evaluate	3.15	.830	1.65	18
	Composite score (Average)	3.98	.778		

With MS ratings above 4, contractors' planning and scheduling (MS 4.21, SD 1.61), time-cost trade-offs (MS 4.12, SD 1.40), selecting right suppliers (MS 4.03, SD 1.02), budget control (MS 4.00, SD 1.80), and good communications (MS 4.00, SD 1.57) are the four most important factors to improve the quality of low-income housing projects. With MS ratings above 3.4, respondents agreed that teamwork (MS 3.97, SD 1.77), defined policies and objectives (MS 3.85, SD 1.72), reporting corruption (MS 3.85, SD 1.38), workers' participation (MS 3.79, SD 1.24), top-down commitment (MS 3.61, SD 1.42), accurate construction management (MS 3.56, SD 1.81), and organisational structure (MS 3.48, SD 1.29) are important measures to improve quality in low-income housing projects. This study's results are in line with Zhang (2000: 135), who ranked quality management methods first, while Kulemeka, Kulunga and Morton (2015: 13) ranked them third, when examining factors influencing the quality of small- and medium-scale contractors in the Malawi construction sector. Kumar and Sriram (2017: 329) ranked strong relationship between project team members second and Kissi and Badu (2016: 470) ranked it first.

According to Rossoni *et al*. (2016: 209), competent site workers, as well as effective communication and coordination play an important part for any project to be successfully completed. There must be a clear contract administration, which is a necessary requirement for an effective project

manager/leader. Chohan *et al*. (2015: 655) and Yalengama *et al*. (2016: 657) ranked appropriate project planning and scheduling first. These factors concur with Claasen and Cumberlege's (2014: 42) conclusion that a model of housing quality determinants for affordable housing are vital ingredients for the successful delivery of projects. Narsal *et al.* (2013: 380) ranked project control fourth, while Addo (2015: 242) ranked appropriate mode of financing a project second. Furthermore, George (2016: 32) ranked appropriate pricing/incentives of services rendered by contractors third.

Studies on quality for affordable housing in the construction industry show similarity to a model of housing quality determinants for affordable housing (Hong, 2012; Aigbavhoa & Thwala, 2014: 1); good communications and better performance (Chohan *et al*., 2015: 117), and enable quality improvement in the construction industry (Nyakala *et al*., 2019). Selecting the right supplier plays a key role in business success and presents great viable opportunities for construction organisations (Kissi & Badu, 2016).

Studies on the quality of low-income housing projects incorporated in the local government show similarity to those studies reporting that corruption is important in quality planning and development (Kulemeka *et al.,* 2015) and for top-down commitment (George, 2016: 30). In support of the results of this study, Zewdu and Aregaw (2015) observed that contractor cost overrun, inexperienced and incompetent workers, and poor construction design are factors leading to non-conformance to quality in construction projects. Correspondingly, Addo's (2015) results indicated that poor planning and scheduling as well as delay in the delivery of construction projects are the major causes of non-conformance to quality, as pointed out by the findings of this study. These factors have an argumentative effect, indicating ineffective budget control and poor construction management. It also leads to dissatisfaction of stakeholders, particularly end users and clients. Rumane (2011) notes that improving organisational performance needs to be supported by strong leadership that binds employees to form multifunctional and self-working groups. Aigbavboa *et al*. (2019) also emphasised improving the quality of low-income housing projects in South Africa. Narsal *et al*. (2013) noted variations in housing satisfaction and health status in four lower socio-economic housing typologies. Progress control and budget planning are the benefit of project managers in organising low-income housing projects. Project managers not only help keep track of project progress internally, but they can also be used as justification in communicating with project stakeholders, for instance, to justify the demand for additional resources. In order to limit, manage and determine the effect of construction process implementation, Keinan (2018) suggested that total quality practices, which include employee empowerment, teamwork, training and education, are possible solutions.

This agrees with the results of this study, where top-down commitment, accurate construction management, appropriate organisational structure as well as good communications are the major quality control measures. This also agrees with the proposals by Kulemeka *et al*. (2015); George (2016); Jogdand and Deskmukh (2017) who affirmed that employee involvement and top management commitment are statistically significantly positively related to the high performance of construction projects.

5.   CONCLUSION AND RECOMMENDATION

The study assessed factors in relation to non-conformance of quality requirements in low-income housing projects from the perspective of house builders in the South African local government context. Prior to this study, quality measurement and monitoring in building low-income houses has not been explored. The study also investigated measures that could be considered to minimise non-conformance to the quality of low-income housing projects.

The results indicate that the low quality of materials and equipment, unskilled/incompetent site workers, inappropriate mode of financing project, poor contract administration, and project control problems are the top five factors affecting the quality of low-income housebuilding projects. In addition, the top five implications as a result of poor-quality low-income housing projects are poor quality control and lack of cooperation from local authorities, difficulty of design and construction, unclear lines of responsibility and authority, and high accident rates. The measures that could improve the quality of low-income housing projects are contractors' effective planning and scheduling, time-cost trade-offs, selecting the right suppliers, budget control, and good communication.

The initial 32 items related to poor quality in low-income housebuilding projects was subjected to factor analysis; 27 factors that met the factor loading criteria were extracted and then rotated, resulting in retaining five factors: quality standards, management, involvement of people, process design and process, as well as planning and scheduling that could be used by house builders and local government authorities to assess non-conformance to quality requirements in low-income housing projects in South Africa.

This study has added to the existing body of knowledge of the low-income housebuilding sector within the South African context to focus on the quality of housebuilding projects. The results would help contractors and housing officials understand the key factors that influence the poor quality of low-income housing in a South African local government.

Since, prior to this study, there are no specific factors assessing non-conformance to quality requirements in low-income housing projects within the South African local government context, the following recommendations are proposed: prioritisation of customer's requirements and successfully transform these requirements into plans and specifications to construct quality low-income houses; develop a set of design elements to match the demanded quality elements provided by the end users; structural soundness; quality building materials; building stability; good workmanship, and project performance.

To improve housebuilding quality, it is recommended that all employees involved in the construction of low-income houses obtain adequate working skills and receive training on the building standards, appropriate building regulations and codes and quality programmes specific to housebuilding, for example the NHRBC.

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