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Original Research Article

Maintenance Culture and Building Sustainability in Public Housing Estates in South-Eastern Nigeria

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Abstract

Maintenance management is fundamental to sustaining the physical condition, functional performance, and environmental efficiency of residential buildings. In Nigeria, public housing estates are frequently characterised by accelerated physical deterioration, service failures, and declining environmental quality—conditions largely attributable to deficient maintenance culture. This study examines the influence of maintenance culture on building sustainability in public housing estates across South-Eastern Nigeria, focusing on Abia, Anambra, Enugu, and Imo States. A descriptive survey design was employed, with structured questionnaires administered to 180 respondents comprising housing occupants (n = 150) and estate maintenance personnel (n = 30) from six purposively selected public housing estates. Data were analysed using descriptive statistics and simple linear regression. Findings indicate that maintenance practices are predominantly reactive rather than preventive, with emergency repairs recording the highest mean (M = 4.12) while preventive maintenance scored lowest (M = 2.41). Key constraints include inadequate funding (M = 4.41), weak institutional frameworks (M = 4.18), and limited resident participation. Regression analysis revealed a statistically significant positive relationship between maintenance culture and building sustainability ($R2 = 0.58$, $F(1,178) = 247.52$, $p < 0.001$). The study concludes that effective maintenance culture is essential for achieving sustainable public housing outcomes and recommends institutional reforms, dedicated maintenance funding mechanisms, lifecycle-based maintenance planning, and enhanced professional involvement of Estate Surveyors and Valuers in housing estate management.

Keywords: Maintenance culture; Building sustainability; Public housing; Estate management; Facilities management; Nigeria

INTRODUCTION

Public housing provision remains a cornerstone policy instrument for addressing housing deficits and improving living standards in developing countries. In Nigeria, successive governments have invested substantially in public housing programmes, yet the sustainability of these housing estates is increasingly compromised by deficient maintenance practices. Buildings that are inadequately maintained experience accelerated depreciation, elevated operational costs, diminished occupant satisfaction, and premature functional obsolescence—outcomes that undermine the long-term objectives of public housing investments (Olanrewaju & Abdul-Aziz,

2015; Ibem & Amole, 2013).

Maintenance culture encompasses the collective attitudes, behaviours, institutional arrangements, and resource allocation patterns that govern the care, upkeep, and preservation of buildings and infrastructure. In public housing contexts, maintenance culture manifests through routine inspections, preventive maintenance programmes, timely corrective repairs, adequate funding mechanisms, and occupant compliance with maintenance regulations (Chanter & Swallow, 2007). A weak maintenance culture not only accelerates physical deterioration but also compromises energy efficiency, safety standards, and broader environmental sustainability objectives.

Building sustainability extends beyond initial construction quality to encompass the capacity of structures to remain functional, safe, and environmentally efficient throughout their operational lifecycles. Sustainable buildings exhibit durability, energy efficiency, adaptability to changing user requirements, and minimal adverse environmental impact (Kohler & Yang, 2007). Maintenance plays a critical mediating role in sustaining these attributes by preserving building fabric integrity, service system functionality, and overall performance standards.

Estate Surveyors and Valuers occupy a central position in housing asset management, particularly in public estates where efficient maintenance planning is essential for value preservation and lifecycle optimisation. Despite professional competencies in property management and maintenance advisory services, public housing estates across South-Eastern Nigeria continue to exhibit conspicuous signs of neglect—peeling facades, malfunctioning services, degraded common areas, and deteriorating infrastructure. This observable disconnect between maintenance policy frameworks and actual practice warrants systematic empirical investigation.

This study therefore examines the relationship between maintenance culture and building sustainability in public housing estates in South-Eastern Nigeria. Specifically, the study: (1) assesses existing maintenance practices in selected public housing estates; (2) evaluates building sustainability indicators across the estates; (3) identifies constraints to effective maintenance culture; and (4) examines the effect of maintenance culture on building sustainability outcomes.

2. Literature Review

2.1 Concept of Maintenance Culture

Maintenance culture refers to the established norms, practices, attitudes, and institutional arrangements that govern how buildings and infrastructure are cared for throughout their operational lives. It reflects both organisational commitment and individual user behaviour toward regular upkeep, timely repairs, and proactive asset stewardship (Olanrewaju & Abdul-Aziz, 2015). Maintenance culture is fundamentally shaped by funding adequacy, organisational capacity, technical expertise, regulatory frameworks, and occupant participation patterns.

In public housing contexts, maintenance culture is frequently compromised by unclear responsibility frameworks, bureaucratic inefficiencies, funding discontinuities, and weak accountability mechanisms. Zubairu (1999) observed that maintenance culture in Nigerian public buildings is characterised by reactive rather than proactive approaches, with interventions typically triggered by visible failure rather than systematic prevention. This crisis-driven orientation accelerates building deterioration and substantially increases long-term lifecycle costs.

The distinction between preventive and corrective maintenance is central to understanding maintenance culture quality. Preventive maintenance involves scheduled inspections and interventions designed to forestall failure, while corrective maintenance addresses failures after occurrence (Wordsworth, 2001). Research consistently demonstrates that preventive maintenance strategies yield superior lifecycle cost outcomes and enhanced building performance compared to reactive approaches (El-Haram & Horner, 2002).

2.2 Building Sustainability in Residential Estates

Building sustainability refers to the capacity of structures to remain functional, safe, efficient, and environmentally responsible throughout their operational lifecycles. The concept integrates physical durability, energy performance, resource

efficiency, occupant well-being, and environmental impact considerations (Kohler & Yang, 2007). Sustainable buildings minimise resource consumption, reduce environmental burdens, and maintain performance standards over extended time horizons.

In residential estates, sustainability extends beyond individual building performance to encompass estate-level environmental quality, infrastructure functionality, common area maintenance, and overall livability. The Royal Institution of Chartered Surveyors (RICS, 2009) emphasises that building sustainability is contingent upon systematic maintenance throughout the building lifecycle, as even well-designed structures deteriorate without appropriate care.

Maintenance directly influences multiple sustainability dimensions: physical condition preservation extends building lifespan; service system maintenance sustains energy efficiency; fabric repairs prevent moisture ingress and structural degradation; and grounds maintenance preserves estate environmental quality. Inadequate maintenance thus systematically undermines sustainability objectives and accelerates the transition toward obsolescence (Wordsworth, 2001).

2.3 Maintenance and Public Housing Performance

Empirical research consistently associates poor maintenance practices with declining performance of public housing estates. Ibem and Amole (2013) examined maintenance management practices in Nigerian public housing and found that inadequate maintenance significantly reduces housing quality and user satisfaction. Their study identified funding inadequacy, weak institutional frameworks, and limited professional involvement as primary constraints.

Oladapo (2006) observed that reactive maintenance strategies dominate public building management in Nigeria, with preventive maintenance programmes rarely implemented systematically. This reactive orientation results in higher lifecycle costs, more frequent service disruptions, and accelerated building deterioration. Similarly, Adenuga (2012) found that maintenance backlogs in Lagos public housing estates stemmed from funding discontinuities, poor record-keeping, and absence of dedicated maintenance management structures.

Internationally, evidence from developed country contexts demonstrates that professional maintenance management substantially enhances public housing sustainability. Straub (2009) found that Dutch social housing organisations achieved significant performance improvements through systematic condition-based maintenance planning. The transition from reactive to preventive maintenance orientations requires institutional capacity building, stable funding mechanisms, and professional management involvement.

2.4 Theoretical Framework

This study integrates three complementary theoretical perspectives to explain the maintenance culture-sustainability relationship:

Life-Cycle Theory provides the foundational premise that buildings must be systematically maintained throughout their useful lives to optimise performance and minimise total ownership costs (Chanter & Swallow, 2007). The theory posits that construction represents only a fraction of total lifecycle costs, with operation and maintenance constituting the majority of expenditure over typical building lifespans. Effective maintenance thus represents not merely an expense but an investment in asset value preservation and lifecycle cost optimisation.

Institutional Theory (DiMaggio & Powell, 1983) explains maintenance outcomes as products of regulatory frameworks, organisational structures, professional norms, and governance arrangements. In public housing contexts, institutional factors—including funding mechanisms, responsibility allocation, accountability structures, and regulatory enforcement—shape maintenance practices independently of technical considerations. Institutional voids, such as unclear responsibility frameworks and funding discontinuities, systematically constrain maintenance effectiveness regardless of available technical knowledge.

Systems Theory conceptualises housing estates as integrated socio-technical systems where physical, managerial, and user components interact to determine overall performance (Kast

& Rosenzweig, 1972). Building sustainability emerges from the interaction of physical building systems, maintenance management arrangements, and occupant behaviour patterns. This perspective highlights that sustainability cannot be achieved through addressing physical components alone but requires attention to the management systems and user behaviours that govern building use and care.

3. Methodology

3.1 Research Design

A descriptive cross-sectional survey design was employed to examine the relationship between maintenance culture and building sustainability in public housing estates. This design is appropriate for investigating relationships between variables within a defined population at a specific point in time (Creswell & Creswell, 2018).

3.2 Study Area and Population

The study focused on public housing estates in South-Eastern Nigeria, specifically in Abia, Anambra, Enugu, and Imo States. Six public housing estates were purposively selected based on: (1) government ownership or development; (2) minimum occupancy period of ten years (to allow observable maintenance patterns); and (3) presence of identifiable maintenance arrangements. The selected estates included Federal Housing Authority estates in Owerri and Enugu, State Housing Corporation developments in Umuahia and Awka, and older public housing schemes in Onitsha and Enugu metropolis. The target population comprised housing occupants and estate maintenance personnel.

3.3 Sampling Procedure

A multi-stage sampling procedure was employed. First, six estates were purposively selected across the four states. Second, within each estate, systematic random sampling was used to select 25 housing units, with one adult occupant per unit serving as respondent. Third, all identifiable maintenance personnel (5 per estate) were included through census sampling. This yielded a total sample of 180 respondents comprising 150 housing occupants and 30 maintenance personnel. The sample size satisfies minimum requirements for regression analysis ($n > 50 + 8m$, where m = number of predictors; Tabachnick & Fidell, 2019).

3.4 Research Instrument

Data were collected using structured questionnaires comprising four sections: (A) socio-demographic characteristics; (B) maintenance practices assessment (5 items measuring preventive maintenance, routine inspection, prompt repair, emergency repairs, and maintenance funding adequacy); (C) building sustainability indicators (5 items measuring physical condition, energy efficiency, safety, environmental quality, and occupant satisfaction); and (D) constraints to effective maintenance (5 items). Sections B-D employed a 5-point Likert scale (1 = Very Poor/Strongly Disagree to 5 = Excellent/Strongly Agree). The instrument was validated through expert review by three academics in Estate Management and Facilities Management. Pilot testing with 20 respondents from a non-sampled estate yielded Cronbach's alpha coefficients of 0.78 for maintenance practices, 0.81 for sustainability indicators, and 0.76 for constraints, indicating acceptable internal consistency reliability.

3.5 Data Analysis

Data were analysed using IBM SPSS Statistics (Version 26). Descriptive statistics (frequencies, percentages, means, standard deviations) summarised respondent characteristics and variable distributions. Mean scores were interpreted using the following decision rule: 1.00-2.49 = Low; 2.50-3.49 = Moderate; 3.50-5.00 = High. Simple linear regression examined the relationship between maintenance culture (independent variable, computed as composite mean of maintenance practice items) and building sustainability (dependent variable, computed as composite mean of sustainability indicator items). Statistical significance was set at alpha = 0.05.

4. Results

4.1 Respondent Characteristics

Table 1 presents the socio-demographic profile of respondents. Housing occupants constituted 83.3% of respondents, with maintenance personnel comprising 16.7%. The majority of occupants (76.7%) had resided in the estates for five years or more, indicating adequate

familiarity with maintenance conditions and building performance. Maintenance responsibility was predominantly vested in government agencies (65.6%), with shared arrangements (24.4%) and resident-only responsibility (10.0%) less common. This distribution reflects the institutional arrangements typical of Nigerian public housing estates.

Table 1: Socio-Demographic Characteristics of Respondents (n = 180)

Variable	Category	Frequency	Percentage (%)
Respondent Type	Housing occupants	150	83.3
	Maintenance personnel	30	16.7
Length of Residence	< 5 years	42	23.3
	5-10 years	58	32.2
	> 10 years	80	44.5
Maintenance Responsibility	Government agency	118	65.6
	Shared (government/residents)	44	24.4
	Residents only	18	10.0
Total		180	100.0

4.2 Existing Maintenance Practices

Table 2 presents mean scores for maintenance practices in the surveyed estates. Emergency repairs recorded the highest mean (M = 4.12, SD = 0.68), indicating that maintenance activities are predominantly crisis-driven. Conversely, preventive maintenance (M = 2.41, SD = 0.83) and maintenance funding adequacy (M = 2.35, SD = 0.87) recorded the lowest scores, both falling within the "Low" interpretation range. Routine inspection (M = 2.58, SD = 0.79) and prompt repair (M = 2.76, SD = 0.81) scored moderately. The composite maintenance culture index yielded a mean of 2.84, indicating overall moderate-to-low maintenance culture.

Table 2: Assessment of Maintenance Practices

Maintenance Practice	Mean	Std. Dev.	Interpretation
Preventive maintenance	2.41	0.83	Low
Routine inspection	2.58	0.79	Moderate
Prompt repair response	2.76	0.81	Moderate
Emergency repairs	4.12	0.68	High
Maintenance funding adequacy	2.35	0.87	Low
Composite Index	2.84	0.62	Moderate

Decision Rule: 1.00-2.49 = Low; 2.50-3.49 = Moderate; 3.50-5.00 = High; Source: Field Survey (2024)

4.3 Building Sustainability Indicators

Table 3 presents sustainability performance across the surveyed estates. All indicators fell within the moderate-to-low range, with energy efficiency recording the lowest mean (M = 2.54, SD = 0.88), followed by environmental quality (M = 2.63, SD = 0.86). Physical condition (M = 2.69, SD = 0.84), occupant satisfaction (M = 2.72, SD = 0.79), and safety (M = 2.91, SD = 0.81) scored marginally higher but remained within the moderate range. The composite sustainability index (M = 2.70) indicates overall moderate-to-low building sustainability performance.

Table 3: Building Sustainability Indicators

Sustainability Indicator	Mean	Std. Dev.	Interpretation
Physical condition	2.69	0.84	Moderate
Energy efficiency	2.54	0.88	Moderate
Safety	2.91	0.81	Moderate
Environmental quality	2.63	0.86	Moderate
Occupant satisfaction	2.72	0.79	Moderate
Composite Index	2.70	0.71	Moderate

Decision Rule: 1.00-2.49 = Low; 2.50-3.49 = Moderate; 3.50-5.00 = High

4.4 Constraints to Effective Maintenance Culture

Table 4 presents the ranked constraints to effective maintenance culture. Inadequate funding emerged as the most critical constraint (M = 4.41, SD = 0.58), followed by weak institutional framework (M = 4.18, SD = 0.64), poor maintenance planning (M = 4.02, SD = 0.71), low occupant cooperation (M = 3.78, SD = 0.76), and lack of professional management (M = 3.69, SD = 0.79). All constraints scored within the "High" range, indicating systemic challenges across multiple dimensions.

Table 4: Constraints to Effective Maintenance Culture

Constraint	Mean	Std. Dev.	Rank
Inadequate funding	4.41	0.58	1st
Weak institutional framework	4.18	0.64	2nd
Poor maintenance planning	4.02	0.71	3rd
Low occupant cooperation	3.78	0.76	4th
Lack of professional management	3.69	0.79	5th

4.5 Regression Analysis

Table 5 presents the regression analysis examining the relationship between maintenance culture and building sustainability. The model was statistically significant ($F(1, 178) = 247.52$, $p < 0.001$), with maintenance culture explaining 58% of the variance in building sustainability ($R2 = 0.582$, Adjusted $R2 = 0.580$). The standardised coefficient (beta = 0.763, $p < 0.001$) indicates a strong positive relationship: each unit increase in maintenance culture index is associated with a 0.87 unit increase in sustainability index. These results confirm that maintenance culture significantly influences building sustainability outcomes.

Table 5: Regression Analysis Results

Model Summary

R	R2	Adjusted R2	Std. Error
0.763	0.582	0.580	0.46

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	52.38	1	52.38	247.52	< 0.001
Residual	37.67	178	0.21		
Total	90.05	179			

Coefficients

Model	B	Std. Error	Beta	t	Sig.
(Constant)	0.23	0.16	-	1.44	0.152
Maintenance Culture	0.87	0.06	0.763	15.73	< 0.001

Dependent Variable: Building Sustainability Index; Source: Field Survey (2024)

5. Discussion

The findings reveal that maintenance practices in South-Eastern Nigerian public housing estates are predominantly reactive, characterised by crisis-driven interventions rather than systematic preventive programmes. The high mean score for emergency repairs (M = 4.12) contrasted with low scores for preventive maintenance (M = 2.41) confirms patterns identified in earlier Nigerian studies (Zubairu, 1999; Oladapo, 2006). This reactive orientation is theoretically problematic from a lifecycle perspective: buildings maintained reactively incur higher cumulative costs and experience accelerated deterioration compared to those under preventive regimes (El-Haram & Horner, 2002).

The moderate-to-low sustainability performance across all indicators reflects the cumulative effects of inadequate maintenance investment. The particularly low energy efficiency score (M =

2.54) likely stems from deferred maintenance of building services—mechanical systems, electrical installations, and envelope components that directly influence energy performance. This finding aligns with Kohler and Yang's (2007) observation that building sustainability is contingent upon continuous maintenance investment throughout the operational phase.

The prominence of funding inadequacy and institutional weakness as primary constraints corroborates Institutional Theory predictions. DiMaggio and Powell (1983) argue that organisational behaviour is shaped by regulatory frameworks and governance structures; in the absence of stable funding mechanisms and clear accountability arrangements, maintenance effectiveness deteriorates regardless of technical capacity. The finding that 65.6% of estates vest maintenance responsibility in government agencies—while simultaneously identifying government funding as inadequate—highlights a structural contradiction in Nigerian public housing governance.

The strong positive relationship between maintenance culture and building sustainability ($R^2 = 0.58$) provides empirical validation for the lifecycle maintenance hypothesis. This magnitude of explained variance suggests that maintenance culture is a substantial determinant of sustainability outcomes, though the 42% unexplained variance indicates that other factors—including original construction quality, building age, and occupant behaviour—also contribute. The finding is consistent with Ibem and Amole's (2013) conclusion that maintenance management quality significantly influences public housing performance in Nigeria.

From a professional practice perspective, the findings underscore the need for Estate Surveyors and Valuers to assume more prominent roles in public housing management. Professional involvement in maintenance planning, condition assessment, and lifecycle cost analysis could address the knowledge and capacity gaps identified as constraints. The current marginalisation of professional estate management in Nigerian public housing represents a missed opportunity for applying established facilities management principles to enhance sustainability outcomes.

6. Conclusion and Recommendations

This study examined the influence of maintenance culture on building sustainability in public housing estates in South-Eastern Nigeria. The findings demonstrate that weak maintenance culture—characterised by reactive practices, inadequate funding, and institutional deficiencies—constitutes a fundamental barrier to achieving sustainable housing outcomes. The statistically significant relationship between maintenance culture and building sustainability confirms that effective maintenance is not merely a technical requirement but a strategic imperative for preserving public housing investments.

The study contributes to the limited empirical literature on maintenance management in Nigerian public housing while providing evidence-based recommendations for policy and practice. The theoretical integration of lifecycle, institutional, and systems perspectives offers a multi-dimensional framework for understanding maintenance-sustainability relationships in developing country contexts.

Based on the findings, the following recommendations are advanced: First, housing authorities should transition from reactive to preventive maintenance strategies through systematic condition surveys, planned maintenance programmes, and performance monitoring. Second, sustainable maintenance funding mechanisms—including dedicated maintenance levies, sinking funds, and ring-fenced budget allocations—should be established to ensure funding continuity. Third, institutional frameworks should be strengthened through clear responsibility allocation, accountability mechanisms, and performance standards. Fourth, Estate

Surveyors and Valuers should be positioned as central actors in professional housing estate management, contributing expertise in maintenance planning, condition assessment, and lifecycle cost optimization. Fifth, resident participation should be enhanced through maintenance awareness programmes and shared responsibility arrangements.

6.1 Limitations and Future Research

The study has several limitations. The cross-sectional design precludes causal inference regarding the maintenance-sustainability relationship. The reliance on perceptual measures introduces potential response bias; future research should incorporate objective building condition assessments. The purposive selection of estates limits generalisability beyond the study contexts. Future research should adopt time-series and panel-based research designs to examine how maintenance investments influence sustainability outcomes across different periods, undertake comparative analyses across Nigeria's geopolitical regions, and integrate quantitative survey techniques with systematic technical building condition assessments.

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