FACTORS AFFECTING MAINTAINABILITY OF MASS HOUSING UNITS IN LAGOS STATE

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ABSTRACT

Purpose: *Mass housing units are susceptible to defects and varied degrees of deterioration; hence, this study examined factors affecting the maintainability of mass housing units in Lagos State.*

Methodology: *The study employed a quantitative research approach. Primary data were collected through a cross-sectional survey of facility managers and owners/users of mass housing units in the study area. A structured questionnaire was administered to respondents, and the data collected were analyzed using descriptive and inferential statistical tools.*

Findings: *The results indicated that the predominant factors affecting the maintainability of mass housing units include accessibility to building systems and utilities, availability of maintenance records and resources, and availability of spare parts. The study also revealed that there was no significant difference in the way facilities managers and users perceive the factors affecting maintainability of mass housing units, except in considering the complexities of building designs as one of such factors.*

Practical Implications: *The study established the factors affecting maintainability of mass housing units that could serve as value-adding information to stakeholders within the mass housing delivery value chain. The findings also provide operational considerations such as the digitalization of project documents and maintenance records for the production of more resilient and sustainable mass housing projects.*

Originality/Value: *The study particularly focused on the maintainability of various categories of mass-produced housing estates, which is a paradigm shift from most previous studies that lumped up buildings irrespective of their ownership characteristics.*

KEYWORDS: *Building types, Maintainability, Maintenance, Maintenance practices, Mass housing*

INTRODUCTION

In recent times, maintenance issues have become more pressing than ever before. This has led to researchers' increased interest in raising awareness of the importance of maintenance (Safran & Noor 2022). This heightened focus is driven by high demand for housing, and recognition of how maintenance significantly impacts the condition of existing facilities (Olagunju, 2012).

Building maintenance has often been overlooked in the construction industry, as it receives little consideration from both industry professionals and building owners (Ofide, Jimoh,

& Achuenu, 2015). This has led to a widespread lack of understanding of the importance of maintenance in all aspects of building design, procurement, construction, and management. According to Okandu, Akani and Brisibe (2021), the physical deterioration of buildings can be attributed to various factors, including wear and tear resulting from use, the passage of time, neglect, lack of maintenance, acts of vandalism, and exposure to weather conditions. Building components and all constituent elements are bound to deteriorate over time due to inherent defects in design and construction as well as environmental factors (Masengesho, Umubyeyi, Bigirimana, Kundwa, Hakuzweyezu, Niyirora, Ntakiyimana, Ineza, & Nura 2021). As Gambo, Usman, and Chen (2012) point out, no building can endure its entire lifespan without some form of maintenance. Every building has a projected lifespan, and even the ancient structures eventually succumb to the forces of time and nature (Waziri, 2016).

Mass-produced houses, often constructed to meet urgent housing demands, tend to be vulnerable to defects due to standardized design processes that may overlook specific contextual needs (Talamo & Bonanomi, 2015). The rapid construction techniques employed can sometimes compromise the quality of materials and workmanship, leading to an increased incidence of defects over time (Talib, Ahmad, Zakaria, & Sulieman, 2014). As noted by Ogunbayo, Aigbavboa, Thwala, Akinradewom, Ikuabe, and Adekunle (2022), the need for maintenance work on buildings becomes evident as buildings and their materials decline in condition or lose aesthetics, strength and functionality over time. Anuar, Nasrun, and Nawi (2014) opine that effective building maintenance ensures that a building continues to serve its intended purpose, and maintains an appealing appearance.

According to Loman (2014), Mensah and Castro (2004), and the United Nations (2007), the potential benefit of maintainable construction practices is reducing the need for frequent repairs and replacements. However, with proper maintainable practices, building owners can reduce repairs cost, thereby save money on maintenance and repair costs over time. Furthermore, Nwokoro and Onukwube (2011) opine that the practice of maintainability in buildings also improves safety and security.

Additionally, buildings that are designed with maintainability in mind have fewer functionality issues and safety concerns such as leaks, electrical problems or structural issues than buildings that are not. In other words, buildings designed with such mindset can greatly decrease the risk of accidents and injuries, and enhance the overall safety and security of the building. Moreover, good maintainability of such buildings plays a crucial role in determining their long-term condition. Therefore, the influence of maintainability on building conditions cannot be overstated. It is a key factor in preventing a premature decline of mass-produced housing units (Ofide et al., 2015). By addressing maintainability from the outset, it is possible to mitigate the impact of defects, and extend the lifespan of building elements. It is important that stakeholders have an appreciable understanding of the consequences of their individual actions on building maintenance (Plessis, 2012).

In spite of the awareness of the importance of maintainability of buildings, research on integrating maintainability into mass housing projects across different estate types remains limited; hence, the need for this study, to assess the factors affecting the maintainability of mass housing units across different estate types.

Research Objective
The objective of the study was to assess the factors affecting maintainability of mass housing units in Lagos State.

Research Hypothesis
H_o: There is no significant difference in the perception of the facility manager and users on the factors affecting the maintainability of mass housing units.

LITERATURE STUDY

The nature of building maintenance encompasses a wide range of activities and processes aimed to preserve, sustain and optimize the condition, functionality, safety and aesthetics of a building or structure over time (Ofide et al. 2015). Building maintenance aims to safeguard the investment's value by ensuring that the building remains in a condition where it consistently fulfills its function while presenting an appealing appearance (Zulkarnain, Zawani, Rahman & Mustafa, 2011). In essence, maintenance encompasses all essential tasks performed to safeguard a building, including its finishes and fittings, to ensure it continues to provide the same, or nearly the same, facilities, amenities and functionality as when it was initially constructed. The Authors emphasize that the primary objective of maintenance is to preserve a building in its original state to the greatest extent feasible so as to enable it serve its intended purpose effectively.

Maintenance management entails a systematic and organized approach to planning, coordinating, overseeing, and assessing maintenance activities and their associated costs (Technical Information Document [TID], 2000). When complemented by a proficient and knowledgeable maintenance team, an effective maintenance management system can serve several essential purposes, including preventing health and safety hazards and environmental harm. A good Maintenance management system can also prolong the lifespan of assets, reduce breakdowns, lower operational expenses, and enhance the quality of life of occupants and users (Technical Information Document [TID], 2000). Maintenance necessitates precise defect diagnosis, appropriate remedial actions, adequate understanding of materials and their use, resource management, and development and execution of comprehensive plans and policies to ensure sustainability. Though maintenance-free buildings are desirable, they are often impractical. Nonetheless, considerable efforts can be made during the design and construction phases to minimize the need for subsequent maintenance work (Zulkarnain, Zawani, Rahman & Mustafa, 2011).

The quality of a building's design and construction in mass housing plays a pivotal role in its long-term performance, and in its required level of maintenance during its operation. Inadequacies in design and construction can directly impact on the maintenance needs of a building (Ogunbayo, Aigbavboa, Thwala, Akinradewo, Ikuabe, & Adekunle, 2022). Zubairu (2001) highlights various factors contributing to maintenance issues in governmental office buildings in Nigeria, with percentages indicating their relative significance: inadequate architectural design (6%), inadequate structural design (7%), inadequate electrical design (9%), inadequate mechanical design (11%), poor construction quality (12%), use of inferior components and materials (14%), natural deterioration due to age and environmental factors (18%), misuse by occupants (18%), and other factors (5%). Ogunbayo, Aigbavboa, Thwala, Akinradewo, Ikuabe and Adekunle (2022) note that

maintenance work on buildings becomes necessary as all structures, along with the materials and elements they are composed of, undergo deterioration over time. It is crucial to acknowledge that building maintenance is an expensive endeavor, which requires huge finances , including operational costs, real estate management, administrative tasks, debtor management, and legal services (Forster & Kayan, 2009). Furthermore, environmental considerations such as climate change, greenhouse gas emissions, and energy efficiency measures play a significant role. As a result, businesses are increasingly focused on minimizing building-related expenses and enhancing the sustainability and efficiency of their properties.

Recently, the issue of building maintenance has gained considerable attention in many developing countries. This is due to the growing demand for housing, realization that maintenance plays a critical role in preserving the condition of existing facilities. It is viewed as an essential strategy for sustaining the current stock of infrastructure (Olagunju, 2012). The scale of maintenance challenges has been increasingly acknowledged by researchers, who emphasize the importance of addressing these issues. This growing concern about the condition of the nation's building stock has brought the severity of the problem to light. Although effective maintenance policies are not yet the standard practice, there is a shift towards more informed resource allocation and critical examination of how a building's overall performance is intricately linked to the condition of its structural components (Ofide et al., 2015).

Adequate housing remains a major challenge in cities of the global south; particularly in Africa, where rapid urbanization has placed immense pressure on governments to provide sufficient housing and infrastructure (Obi & Ubani, 2020). Despite the urgency, governments have struggled to meet the rising demand, leading to a host of administrative, institutional and management issues (Ibem et al., 2011). These challenges include outdated records, restrictive organizational structures, inadequate funding, and a lack of comprehensive rehabilitation for older housing units.

While these issues are significant, the importance of maintainability to buildings is often overlooked. Maintainability refers to the ease with which a building's components can be maintained or repaired over time to ensure its continued functionality and safety (Ikpo, 2009). The significance of maintainability to buildings cannot be understated, as it directly impacts on the longevity and performance of housing units (Bhonde, Zadeh, & Staub, 2022). A building with poor maintainability is likely to suffer frequent defects and shortened lifespan, which in turn exacerbates the housing crisis by reducing the available stock of functional housing (Irfan et al., 2010).

Makinde (2014) highlights several factors that contribute to the housing crisis, as unavailability of land, high infrastructure costs and inadequate finance mechanisms. However, the maintainability of housing units is a critical factor that influences the long-term sustainability of building structures. Poorly maintained buildings deteriorate rapidly, leading to additional costs of repairs and, in some cases, the need for complete reconstruction. This not only places additional financial burdens on homeowners but also strains public resources that could be used for new housing developments.

Several factors influence the maintainability of buildings. These include the quality of materials used in construction, the design of the building, the availability of skilled labor for maintenance, and the presence of a robust maintenance plan. Olugbenga and Adekemi (2013) note that the root of the housing crisis in Lagos lies in issues such as land accessibility and the high cost of building materials. These factors also directly impact the maintainability of buildings, as poor-quality materials and inadequate construction practices can lead to frequent defects and maintenance challenges. Talib et al. (2014) highlight five major factors affecting building maintenance, which are lack of preventive maintenance, financial incapability to maintain buildings, lack of management and maintenance standards, non-availability of spare parts, and lack of participation of users in maintenance.

Moreover, Ukoje and Kanu (2014) observe that housing challenges are complex and interconnected, involving financial resources, public sector capacity and stakeholder collaboration. These factors also influence maintainability of buildings. For instance, limited financial resources can result in the use of substandard materials, which may be more prone to defects and harder to maintain. Additionally, inadequate public sector capacity can lead to insufficient oversight of construction practices, resulting in buildings that are difficult to maintain.

Many studies have identified critical factors affecting the maintainability of buildings. Table 1 provides a summary of these factors as identified by different authors. It highlights how they impact the long-term performance of housing units.

Table 1: Factors affecting maintainability of buildings

Factors	Authors	Key findings
Quality of building materials	Ogunbayo et.al. (2022), Zubairu (2001)	Poor materials lead to frequent defects, increasing maintenance costs
Design complexities	Zubairu (2001), Talib et.al (2014)	Inadequate design can hinder accessibility for maintenance and cause operational inefficiencies.
User behavior and participation	Talib et al. (2014), Ukoje & Kanu (2014	Lack of user participation in maintenance can lead to neglect and accelerated deterioration.
Management policies	TID (2000), Olagunju (2012)	Poor management leads to uncoordinated maintenance efforts and higher costs.
Environmental factors	Forster and Kayan (2009), Olagunju (2012)	Climate change and environmental stressors can accelerate building deterioration
Financial resources	Makinde (2014), Ukoje & Kanu (2014)	Limited financial capacity affects the quality of materials and maintenance practices

Non-availability of spare parts	Talib et al. (2014)	The absence of readily available spare parts delays repairs and increases the cost of maintenance over time.

The study adopts all the factors enumerated in this section as a guide to assessing the factors affecting maintainability of mass housing units in Lagos State.

While significant research has been conducted on the physical aspects of building maintainability, such as materials and design, there is a noticeable lack of focus on the social and operational dimensions. Studies like those of Ogunbayo et al. (2022) and Zubairu (2001) emphasize the role of design and construction quality but overlook how user behavior and management policies can either exacerbate or mitigate maintenance challenges. Talib et al. (2014) identify user participation as a key factor, but this aspect remains relatively under-researched in comparison to physical factors.

Moreover, while financial constraints are commonly cited as a barrier to effective building maintenance (Makinde, 2014, Ukoje & Kanu, 2014), there is limited discussion on innovative funding mechanisms or public-private partnerships that could help address this issue. Similarly, although environmental factors such as climate change are acknowledged (Forster & Kayan, 2009), their long-term impact on maintainability, particularly in the context of developing countries like Nigeria, remains insufficiently explored.

This study aims to address the aforementioned gaps by focusing on both the physical and operational factors affecting the maintainability of mass housing units in Lagos State. By assessing how factors like user behavior, management policies and financial constraints interact with traditional concerns such as design and materials, this study will provide a more comprehensive understanding of maintainability in this context. Additionally, it will contribute to the growing body of literature on sustainable housing practices by offering insights into how mass housing projects can be better maintained to ensure long-term usability and performance.

RESEARCH METHODS

A cross-sectional survey research design was used for the study because it allows for quick and efficient data collection. The population of the study comprised building managers and users of mass housing units in the Lagos metropolis. The choice of Lagos as the study area was because the state is considered the economic centre of Nigeria with the largest concentration of industries, financial institutions and major seaports (Farinmade, Oluwo, & Avwenagha, 2021).

Cochran's formula for an infinite population was adopted to calculate a representative sample of the population. The minimum sample size calculated for this study was 100 respondents. With the aid of a structured questionnaire, primary data were collected from 215 respondents.

The questionnaire used close-ended questions to elicit information relating to the research objective. Both descriptive and inferential statistics were used to analyze the data, and differences and relationships were obtained from the analyzed data gathered. The data

sourced for this study were collected through the use of Google Forms, and processed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 27.0.

Frequency tables, charts and the Mann-Whitney U test were used as statistical tools for the descriptive and inferential statistical analyses respectively. The level of significance of each of the factors was then calculated by adopting the Relative Importance Index (RII). The calculated RSI values were interpreted using the scale RII ≥ 0.76 means most significant, 0.67 RII 0.75 means significant, 0.45 RII 0.66 means less significant, and RII 0.44 means not significant (Waziri & Vanduhe, 2013, Magutu & Kamweru, 2015). This relative significance index was adopted to rank the factors affecting the maintainability of mass housing units according to the Relative Significance Index (RSI) value. The RSI value ranges from 0 to 1. The resultant value of each factor suggests the level of significance for that particular factor.

In ensuring the integrity of the test, both face and content validity were used. Content validity focuses on how well the instrument covers the entire structure, whereas face validity focuses on the overall superficial appearance of the instrument. These were reviewed by two senior lecturers from the Department of Building, University of Lagos. All the corrections and constructive criticisms made by the reviewers were the basis for the final version of the questionnaire. This was done to ensure content validity before administering it to the respondents.

RESULTS AND DISCUSSION

The demographic data of the respondents who participated in the survey are presented in Table 1.

Table 2: Demographic Data of the Respondents

Demography of Respondents	Frequency	Percentage (%)
Category of Respondents		
Facility/Property/Project Manager	74	34.4
Owner/Occupant/User	141	65.6
Category of Estate		
Government serviced estate	52	24.2
Government un-serviced estate	52	24.2
Private serviced estate	59	27.4
Private un-serviced estate	52	24.2
Education of Respondents		
OND	4	1.9
HND	33	15.3
B.Sc./B.Eng./B.Tech	133	61.9
M.Sc.	37	17.2
PGD	6	2.8
Ph.D.	2	0.9

The respondents were distributed among building managers (34.4%) and building owners (65.6%), as shown in Table 2. The results show that the generality of the respondents stayed in a private-serviced estate (27.4%), while the rest of the respondents were shared

amongst private-unserviced, government-serviced and unserviced estates (24.2% each). The results indicate that the respondents possessed varied levels of academic qualifications. Specifically, 1.9% of the respondents held an Ordinary National Diploma (OND), 15.3% had Higher National Diploma (HND), 61.9% possessed Bachelor's Degrees, and 20.9% had Post Graduate Degrees. This implies that the respondents had a significant level of formal education,which enabled them to comprehend the questions and provide appropriate responses to the various questions in the questionnaire.

The objective of the study was to assess the factors affecting the maintainability of mass housing units in Lagos State. To achieve this objective, twenty-two factors were presented to each survey participant through a structured questionnaire. Respondents were asked to rate the significance of each of the twenty-two hypothesized factors extracted from the literature. A 5-point rating scale was used, ranging from 1 (not significant) to 5 (highly significant). The calculated Relative Significant Index (RSI) values were interpreted as follows: RSI $\geq$ 0.76 (highly significant, HS), 0.67 $\leq$ RSI $\leq$ 0.75 (significant, SG), 0.45 $\leq$ RSI $\leq$ 0.66 (slightly significant, SS), and RSI $\leq$ 0.44 (not significant, NS). The results of the analysis are presented in Table 3.

Table 3: Factors affecting the maintainability of mass housing units.

Critical Systems	Private serviced estate		Private un-serviced estate		Government serviced estate		Government un-serviced estate	
	RSI	Remarks	RSI	Remarks	RSI	Remarks	RSI	Remarks
Building design complexities	0.81	HS	0.78	HS	0.78	HS	0.72	SG
Quality of building materials	0.82	HS	0.80	HS	0.82	HS	0.80	HS
Quality of construction	0.82	HS	0.80	HS	0.83	HS	0.80	HS
Age of the building	0.83	HS	0.79	HS	0.80	HS	0.77	HS
Building occupancy and level of use	0.82	HS	0.80	HS	0.80	HS	0.80	HS
Climate and weather conditions	0.82	HS	0.78	HS	0.78	HS	0.73	SG
Availability of maintenance resources	0.82	HS	0.79	HS	0.83	HS	0.83	HS
Management and maintenance policies	0.83	HS	0.78	HS	0.83	HS	0.83	HS
Access to utilities	0.82	HS	0.79	HS	0.85	HS	0.83	HS
User's behavior	0.82	HS	0.78	HS	0.80	HS	0.80	HS
Location of building	0.82	HS	0.77	HS	0.81	HS	0.74	SG

Critical Systems	Private serviced estate		Private un-serviced estate		Government serviced estate		Government un-serviced estate	
	RSI	**Remarks**	**RSI**	**Remarks**	**RSI**	**Remarks**	**RSI**	**Remarks**
Resident education and participation	0.82	HS	0.79	HS	0.80	HS	0.80	HS
Regular inspections and audits	0.82	HS	0.80	HS	0.84	HS	0.83	HS
Building systems accessibility	0.83	HS	0.80	HS	0.86	HS	0.84	HS
Availability of spare parts	0.82	HS	0.79	HS	0.83	HS	0.83	HS
Compliance with building code requirements	0.82	HS	0.78	HS	0.81	HS	0.82	HS
Environmental factors	0.82	HS	0.78	HS	0.79	HS	0.77	HS
Budget constraints	0.81	HS	0.78	HS	0.79	HS	0.80	HS
Technological advances	0.81	HS	0.77	HS	0.80	HS	0.80	HS
Building materials and finishes	0.83	HS	0.78	HS	0.81	HS	0.81	HS
Economic/financial capacity of the owner/occupant	0.83	HS	0.80	HS	0.82	HS	0.82	HS
Building size	0.83	HS	0.77	HS	0.80	HS	0.76	HS

Note: HS= highly significant, SG= significant, SS= slightly significant, NS= not significant

From Table 3, the results show that building design complexities have RSI values ranging from 0.72 to 0.81. Private-serviced and un-serviced estates, as well as government-serviced estates, show higher RSIs (0.78–0.81), indicating high significance of design complexities in these estates. However, in government un-serviced estates, the RSI drops to 0.72 (SG), suggesting that building design is less critical compared to serviced estates. The quality of building materials and construction remains highly significant across all estate types, with RSIs between 0.80 and 0.83. This consistency reflects the importance of material and construction quality for the maintainability of all housing units. Similarly, the age of the building is highly significant across the board, with values ranging from 0.77 to 0.83, indicating that the older the building, the more critical maintenance becomes, especially in private serviced estates with an RSI of 0.83. Building occupancy and level of use are other highly significant factors, with RSIs between 0.80 and 0.82 across all estates. This emphasizes that how frequently buildings are used impacts their maintainability. Climate and weather conditions, however, show some variability. While private and

government-serviced estates score high (0.82), government un-serviced estates show a lower RSI of 0.73 (SG), reflecting a reduced influence of weather on un-serviced estates. The availability of maintenance resources and spare parts is a critical factor across all estate types. Government estates, both serviced and un-serviced, exhibit the highest RSIs at 0.83, underscoring the importance of having resources readily available to maintain these properties. Private estates also reflect the high importance of these factors, though with slightly lower RSIs (0.79–0.82). Management and maintenance policies maintain high significance across all estate types, with RSIs ranging from 0.78 to 0.83. This reinforces the universal need for strong management and clear policies to ensure housing units are maintained effectively. Likewise, access to utilities scores highest for government-serviced estates with an RSI of 0.85, showing its importance.

In private un-serviced estates, the RSI is 0.79, though still highly significant. User behavior, education, and participation are crucial for all estates, with RSIs between 0.78 and 0.82, reflecting the importance of engaging residents in maintenance practices. Building systems accessibility is notably higher in government estates, with an RSI of 0.86 in serviced and 0.84 in un-serviced estates. Private estates score slightly lower but still reflect the critical nature of system accessibility. Compliance with building code requirements is highly significant for all estate types, with RSIs ranging from 0.78 to 0.82, indicating that regulatory compliance is essential for maintaining these housing units. Similarly, the economic and financial capacity of owners or occupants is a crucial factor, with RSIs between 0.80 and 0.83, as financial resources are vital for regular maintenance. Technological advances show slightly lower RSIs, especially in private un-serviced estates (0.77), but remain highly significant across the board. Finally, the size of the building is critical for all estate types, with RSIs ranging from 0.76 to 0.83, suggesting that larger buildings require more resources and attention for maintenance. In summary, all critical factors are highly significant across estate types, but serviced estates (both private and government) exhibit higher RSI values, indicating better infrastructure, resources and maintenance capacity. Government un-serviced estates, though significant, show slightly reduced emphasis on factors like climate, building design and location, suggesting potential areas for improvement.

Test of hypothesis

This research postulated a hypothesis to analyze the factors affecting maintainability of mass housing units, which is illustrated as follows.

H_o: There is no significant difference in the perception of the facility manager and users on the factors affecting maintainability of mass housing units.

The hypothesis was tested using an independent sample Mann-Whitney U test. The results are presented below in Table 4.

Table 4: Mann-Whitney U test on the perception of the facility managers and users

Factors	Category of Respondents		Mann-Whitney U	Z	p-value	Remarks
	Managers N=74 Mean Rank	Users N=141 Mean Rank				
Building design complexities	117.06	103.24	4546.5	-1.98	0.048	S
Quality of building materials	104.83	109.66	4982.5	-0.70	0.481	NS
Quality of construction	107.32	108.35	5167	-0.15	0.881	NS
Age of the building	113.90	104.90	4780.5	-1.36	0.173	NS
Building occupancy and level of use	103.70	110.26	4898.5	-0.96	0.336	NS
Climate and weather conditions	112.68	105.54	4870.5	-1.08	0.279	NS
Availability of maintenance resources	105.02	109.56	4996.5	-0.63	0.526	NS
Management and maintenance policies	107.91	108.05	5210	-0.02	0.983	NS
Access to utilities	108.95	107.50	5146.5	-0.20	0.840	NS
User's behavior	104.45	109.86	4954.5	-0.76	0.449	NS
Location of building	108.85	107.55	5154	-0.19	0.851	NS
Resident education and participation	100.52	111.93	4663.5	-1.65	0.099	NS
Regular inspections and audits	107.89	108.06	5208.5	-0.02	0.980	NS
Building systems accessibility	110.03	106.94	5067	-0.43	0.667	NS
Availability of spare parts	105.92	109.09	5063	-0.46	0.647	NS
Compliance with building code requirements	100.61	111.88	4670	-1.70	0.090	NS
Environmental factors	110.82	106.52	5008.5	-0.61	0.539	NS
Budget constraints	102.49	110.89	4809.5	-1.25	0.213	NS
Technological advances	106.66	108.71	5117.5	-0.30	0.765	NS
Building materials and finishes	105.22	109.46	5011.5	-0.61	0.542	NS
Economic/financial capacity of the owner/occupant	104.45	109.86	4954.5	-0.74	0.459	NS
Building size	111.01	106.42	4994.5	-0.66	0.507	NS

Note: p is significant at *p≤0.05, S= significant, NS= not significant

Table 4 shows that the perceptions of managers and users significantly differ (p=0.048) the consideration of building design complexities as a factor affecting maintainability of mass housing units. The results show a higher ranking of building design complexities by managers (MR=117.06) as compared to the ranking of building users (MR=103.24). Meanwhile, respondents' perceptions of other factors affecting maintainability are not significant. Hence, the null hypothesis H_o for all the factors is accepted except for building design complexities for which the null hypothesis H_o is rejected.

DISCUSSION OF FINDINGS

The results of this study provide important insights into the factors affecting the maintainability of mass housing units across different estate types in Lagos. Based on the Pareto Principle, the study revealed that the most influential factors varied between private-serviced estates, private un-serviced estates, government-serviced estates, and government un-serviced estates. While many of these factors align with those identified in previous studies, this research also provides values in the aspect of investigating the buildings based on their ownership characteristics, thereby offer practical contributions to the body of knowledge.

In private serviced estates, the key factors affecting maintainability include the age of the building, management and maintenance policies, building systems accessibility, building materials and finishes, the economic/financial capacity of the owner, and building size. These findings are consistent with previous research by Zubairu (2001) and Makinde (2014) who emphasize the role of building design and financial capacity in determining maintenance outcomes. However, this study adds to the literature by identifying management and maintenance policies, and building systems accessibility, as critical maintainability considerations in serviced estates, where reliance on centralized services and organized management structures plays a significant role in determining the effectiveness of maintenance efforts.

In private un-serviced estates, the study found that building systems accessibility, economic/financial capacity of the owner, quality of building materials, quality of construction, building occupancy and level of use, and regular inspections and audits were the primary factors affecting maintainability. This aligns with the work of Talib et al. (2014), which highlights the importance of regular inspections and audits, and financial capability for building maintenance. The significance of occupancy levels and construction quality, as observed in this study, echoes the findings of Ogunbayo et al. (2022), which identify inadequate construction practices and over-utilization of building resources as key drivers of maintenance challenges. The current study underscores the need for improved construction standards and regular audits in privately managed un-serviced estates to ensure long-term sustainability.

In government-serviced estates, predominant factors include building systems accessibility, access to utilities, regular inspections and audits, quality of construction, availability of maintenance resources, availability of spare parts, and management and maintenance policies. These findings confirm earlier studies, such as those by Obi and Ubani (2020), who discuss the significance of spare part availability and utility access in maintaining public infrastructure. However, this study provides more granular insights into the challenges specific to serviced estates where the efficient operation of centralized systems, such as water and power supplies, is crucial to building maintainability. The availability of spare parts, highlighted as a critical factor in this study, builds on Talib et al. (2014) by emphasizing its importance in reducing maintenance delays and costs, particularly in publicly managed estates where procurement processes can be slow.

Similar factors were identified in government un-serviced estates, with building systems accessibility, access to utilities, regular inspections and audits, availability of maintenance resources, availability of spare parts, and management and maintenance policies being the

most significant. The findings reiterate those of Olagunju (2012) who emphasizes the importance of effective management policies and resource availability in sustaining the performance of government-built housing units. However, our study also shows that in un-serviced estates, where residents have less access to organized services, availability of utilities and spare parts becomes even more critical. This insight points to the need for policy reforms that promote more involvement of residents in maintenance activities, as well as government initiatives to ensure the timely provision of spare parts and utilities.

An important finding from the Mann-Whitney U test was the significant difference in the perceptions of facility managers and users regarding building design complexities. This suggests that facility managers, with their technical expertise and operational experience, may be more attuned to the impact of poor design on long-term maintenance. This result is consistent with the findings of Zubairu (2001) who reports that inadequate design was a major cause of maintenance problems in Nigerian buildings. However, the current study adds a new layer of understanding by emphasizing that users may not fully recognize the role of design in maintenance challenges, potentially leading to mismatched expectations between occupants and maintenance teams.

The findings of this study largely corroborate those of previous researchers such as Salisu et al. (2019), who identified multiple factors influencing the quality of maintenance services in mass housing units, including environmental pollution, water and power instability, and suboptimal regulatory enforcement. However, the current study provides a more detailed categorization of factors across different estate types, allowing for a deeper understanding of how estate management structures, service provisions, and user behavior influence maintainability. In this respect, the study makes a significant contribution by not only validating previous research but also offering a more nuanced framework for assessing maintainability challenges in mass housing.

The study makes a notable contribution to the literature by emphasizing the importance of building systems accessibility across all estate types. Regardless of whether estates are serviced or un-serviced, the ease with which maintenance personnel can access building systems (such as electrical, plumbing, and HVAC systems) was found to be a crucial determinant of maintainability. This factor has received limited attention in previous research but emerges from this study as a key operational challenge that must be addressed through better design and planning.

Additionally, the research highlights the role of management and maintenance policies, particularly in government-managed estates, where effective policies can mitigate the impact of financial and resource constraints on building performance. These insights suggest that improving maintainability requires not only technical solutions but also stronger institutional frameworks and governance structures; a point that is critical for policymakers and housing authorities to consider.

In summary, this study provides a comprehensive analysis of the factors affecting the maintainability of mass housing units in Lagos. By comparing the findings across different estate types, it offers new insights into the operational and management challenges specific to each context. While the study confirms many factors previously identified in the literature, it also highlights new areas of focus, such as building systems accessibility, and

the importance of user engagement in maintenance activities. These findings contribute to a deeper understanding of maintainability in mass housing and offer practical recommendations for improving housing performance in rapidly urbanizing regions like Lagos.

CONCLUSION

The study concludes that the factors affecting maintainability vary in different categories of buildings. Maintainability of private serviced estates is predominantly affected by the age of the building, management and maintenance policies, accessibility of building systems, quality of building materials and finishes, the economic capacity of owners, and building size, while maintainability of private un-serviced estates is predominantly affected by the quality of building construction and materials, occupancy level of use, regular inspections and audits, accessibility of building systems, and the economic capacity of owners. Furthermore, government-serviced estates are affected by the accessibility of building systems, and regular inspections and audits, while government un-serviced estates are affected by the availability of maintenance resources, management and maintenance policies, accessibility of building systems, and availability of spare parts.

Building design complexities also significantly affect maintainability across all estate types. Practical implications highlight the need for better system accessibility, flexibility of designs, spare part availability, and stronger maintenance programs, especially in government and private un-serviced estates. Improving these areas will lead to better building maintainability and more sustainable housing.

Key recommendations include regular maintenance programmes for un-serviced estates, ensuring system accessibility in design, increasing spare part availability, and providing government financial assistance for un-serviced estate owners. Engaging residents in maintenance through awareness and training fosters shared responsibility, while ongoing monitoring is critical to identifying areas for continuous improvement.

The findings offer practical insights into housing policy and sustainable development, stressing the need for strategic, collaborative maintenance interventions, as Collaborative among governments, private owners and residents are essential for improving housing maintainability.

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