American Journal of Civil Engineering
2024; 12(1): 10-16
http://www.sciencepublishinggroup.com/j/ajce
doi: 10.11648/j.ajce.20241201.12
ISSN: 2330-8729 (Print); ISSN: 2330-8737 (Online)

Measures to Improve the Maintenance of University Buildings in Nigeria

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To cite this article:

Lesanmi Ayokunle, Clinton Aigbavboa, Ngcobo Ntebo, Douglas Aghimien, Olubusola Adesominu. (2024). Measures to Improve the Maintenance of University Buildings in Nigeria. *American Journal of Civil Engineering*, *12*(1), 10-16.
https://doi.org/10.11648/j.ajce.20241201.12

Received: December 1, 2023; **Accepted**: January 5, 2024; **Published**: January 18, 2024

Abstract: Sustainable measures for effectively maintaining buildings have become essential to sustainable building development with the growing influx of building portfolios worldwide. This is so, considering building maintenance problems have become a global menace. It has been ascertained that improving building maintenance operations for sustainable considerations will benefit university facilities in terms of profitability, user well-being, and increased lifespan. Although studies abound on the maintenance of university buildings in Nigeria, its barriers, and the factors affecting it, very few studies have touched on the solutions to maintenance problems and the measures to improve the maintenance management of these buildings. Therefore, this paper presents the findings from assessing the measures to improve the maintenance of buildings in six selected higher education institutions in the country. The study embraced a quantitative approach, and data were gathered from maintenance managers, supervisors, and technicians working in the Works Departments of the selected public institutions. Data collected was analyzed using descriptive statistics such as percentile and factor analysis. Findings revealed that human, materials resources, and policy improvement measures, computerized approach to management, assessment, and feedback mechanism measures, less sabotage and quick response measures, and improved funding, design, and construction measures are the most viable measures to improve building maintenance in these universities.

Keywords: Maintenance, Building Maintenance, Measures, Higher Education Institutions

1. Introduction

Building maintenance has consistently been rendered irrelevant, with little recognition among building developers and the construction industry [13]. This absence of recognition has resulted in a lack of knowledge about its scale and importance in building construction and management. However, like all other matters, buildings are subject to deterioration; deterioration in buildings is inescapable. Therefore, they need constant maintenance and devotion to keep them in a state to serve their intended purpose. Public buildings are no exception to this rule. Because of the multitude of users who access and use public buildings daily and the hordes of funds generated by state

institutions, regular maintenance is needed to extend such buildings' lifespan and ensure ease of use.

HEIs must discharge their duties and functions with their infrastructural assets and facilities. These infrastructures and facilities are the trademarks of HEIs regarding their capabilities to produce a conducive teaching and learning environment [23]. The quality of an HEIs is measured by its academic staff's quality and its infrastructural environment. Educational infrastructure is the driver and catalyst of efficient teaching and learning processes, research, and innovation in the education system. Subsequently, Abdul-Lateef [1] dismissed university buildings as bricks and mortar but with a protective skin around their users, enhancing their environment's outlook. Developing these infrastructures and facilities is highly cost-intensive, making maintenance management a complex and challenging endeavor.

Musa and Ahmad [23] reiterated that maintaining infrastructural standards and academic innovations is essential in enticing students to a university. Lee and Scott [21] advocated for the understanding, nourishing, and developing university buildings through adequate maintenance, just like living organisms. Madumane [22] added that sound maintenance policies are essential to keep HEI buildings at a high standard, so they continue to be a source of attraction. Gulua [17] opined that selecting an appropriate maintenance strategy is required to keep university buildings at their optimum functional state. Furthermore, the well-being of a nation is reflected in the state of its infrastructure [27]. However, the story in Nigeria is entirely different, as building maintenance is neglected and not given any attention, especially in public buildings.

Maintaining these higher education buildings has become daunting due to insufficient funds, inadequate budgetary allocation, and many other factors. Oladapo [28] identified under-funding as one of the factors affecting maintenance and suggested that a tenth of the project cost should be budgeted for efficient maintenance repairs. Akinsola et al. [5] revealed that environmental and climate conditions, unavailability of funds, and socio-political factors such as wilful damage, vandalism on the part of students, and indecision from the university management all influence the building maintenance management program in Nigeria. As a result, the abysmal condition of buildings in public HEIs in Nigeria and students' discontent has been well documented [4].

Therefore, governments, university management, and maintenance departments must find solutions to their building maintenance problems. Thus, it is obvious that the discussions around issues mitigating maintaining university buildings and the corresponding measures to solve these problems cannot be avoided, considering the effect of buildings and facilities on the quality of education. Therefore, assessing the measures to improve the maintenance of university buildings in Nigerian institutions is essential. Based on this background, this study investigated the measures to solve maintenance problems plaguing public tertiary institutions in southwest Nigeria, with a vision to help tertiary institutions, governments, and stakeholders explore ways to adopt an effective maintenance system for their buildings and infrastructure. This would point university management and maintenance departments in the right direction regarding the specific measures to cater to their building maintenance problems.

2. Literature Review

The intention and purpose for which public institution buildings are built can only be achieved and maintained if subjected to an appreciable amount of maintenance activities. Maintaining public building assets has become a fundamental strategic advantage for any organization over its peers in the wake of increasing competition [18]. Hence, in Brazil, the government's introduction of administrative reform created an expansion of items the state could buy and how much public funds could be spent. This reform has improved public procurement and contracting in public institutions, limiting corruption and preserving public interest [6].

Additionally, Talib [38] opined that one of the measures to improve the building maintenance of university buildings is to initiate a periodic assessment and condition monitoring of building services to evaluate user satisfaction. This notion was echoed by Hassanain et al. [19], who posited that their study revealed that a lack of feedback from building users and stakeholders contributed to building defects in universities. They also advocated incorporating maintenance concerns in university buildings' design and construction processes at different phases. Also, Ardil, Uçar, and Sandhu [8] and Irigaray, Gilabert, Jantunen, and Adgar [10] posited that software developers need to develop a model that enhances maintenance practices and implementation.

In Africa, literature has revealed that the paucity of funds and investments is a significant problem for African HEIs. Increasing the maintenance budget and financial support from the government and private sector can help reduce maintenance work backlogs. Andile et al. [7] also advocated for improvements in budgeting and funding as this will significantly help execute maintenance operations and reduce the rate of dilapidation of buildings in Ghana. Another proposition to solve maintenance problems in Africa is developing a maintenance program predicated on the reports of conditional assessment of buildings [7]. These reports will guide and inform maintenance practices and strategies. Quayson and Akomah [32] supported this idea, stating that maintenance managers should conduct periodic assessments of buildings to create an inventory of components to be replaced before they break down. This amounts to public institutions adopting preventive maintenance over unplanned maintenance, which wastes scarce resources.

In addition, Odediran et al. [26] said that their research demonstrated that building inspection, which involves more technicalities than managerial, was the third-ranked approach utilized in Nigerian HEIs. This is essential so that the administrative personnel can be aware of the condition of the

buildings. The outcome of this inspection is an audit report of the buildings' conditions, which will assist in formulating time-bound policies. Finally, strategic planning is paramount because the methodology to manage a component in a building can be different from another building with the same feature. The building maintenance officers must be proactive and compliant to design and implement effective maintenance management processes.

3. Research Methodology

The study investigated the measures to improve building maintenance in public tertiary institutions in southwestern Nigeria. The survey approach adopted was the quantitative approach. Research data were collated through questionnaires presented to maintenance managers, supervisors, and technicians working in the Works Departments of the six selected public universities. The study adopted a structured questionnaire in tandem with information from the review of related literature. The questionnaire entailed two sections, A and B. Section A consisted of background information questions to gain insights into personal information such as academic qualifications and respondents' years of experience. This section of the research instrument offers quality checks to the data from the other section. Section B presented questions to identify the common maintenance defects affecting these institutions. The study adopted a 5-point Likert scale. Out of 165 questionnaires sent out to the various maintenance departments of the target institutions, 107 were received and ascertained fit for analysis, representing about a sixty-five percent (65%) response rate.

Cronbach's alpha coefficient was adopted as it is the most used indicator of internal consistency. According to Pallant [31], the preferable values are 0.8 and above, but values above 0.7 are acceptable. This method measures the reliability of each field of the questionnaire and the mean of the whole field. Between 0.0 and +1.0 is the typical range for Cronbach's alpha; the greater the value, the higher the degree of internal consistency. For the measures to improve the maintenance management of university buildings in the identified institutions, the Cronbach alpha value of 0.800 was determined. To analyze the respondents' demographic data, a percentile was used; nevertheless, Factor Analysis was used to analyze the measures to solve maintenance problems in HEIs.

4. Findings and Discussions

4.1. Background Information of Respondents

The result of the respondents' background information shows that (47.2%) have either a bachelor's or a master's degree, while about (9.4%) are Ph.D. holders. This indicates that most (56.6%) respondents are well-educated professionals. Most of these respondents (65.1%) have acquired between 5 and more than 15 years of experience working with the maintenance unit. This indicates that most of the personnel in these institutions' works/maintenance departments are highly qualified. They are mostly bachelor's and master's degree holders. Furthermore, these staff are equally experienced, most of whom have spent between six and 15 years maintaining their university buildings.

4.2. Measures to Improve the Maintenance of University Buildings in Nigeria

In assessing the measures to improve the maintenance of university buildings, factors identified from the literature review were presented to respondents to indicate their agreement/disagreement with the measures to solve maintenance problems in HEIs in Nigeria. The data were subjected to factor analysis (FA) to examine and classify the discovered factors into larger, more manageable groups. The acquired data's suitability must be established first for this to be done effectively. Correlation matrix assessment reveals the presence of values greater than 0.3. The sampling acceptability KMO metric reached a value of 0.570. This value exceeds the minimum value of 0.5 [35]. Bartlett's sphericity test established the correlation matrix's factorability and was statistically significant (<0.05).

Table 1. *Component Matrix/Rotated factor matrix.*

	Factors (components numbers)			
	1	**2**	**3**	**4**
Adopting a sound maintenance approach and policies	0.712			
A better-quality control system for maintenance projects and operations	0.690			
Using authentic and durable building materials during construction	0.657			
Improved maintenance personnel skill set and competence	0.621			
Improved building user behaviour and awareness	0.550			
Adoption of a computerized maintenance management systems		0.869		
Accurate maintenance task planning and scheduling		0.718		
Adoption of mechanism to get prompt and adequate feedback from building users		0.712		
Performance measurement of maintenance strategies		0.500		
Less vandalism and destruction by university building users			0.855	
Quick response time to maintenance complaints			0.839	
Provision of adequate funding				0.853
Incorporation of maintenance considerations in building designs and construction processes				0.704

Principal component analysis (PCA) with varimax rotation was used to conduct FA after it was determined that the data

collected complied with all requirements. Additionally, four (4) factors with eigenvalues greater than one were extracted with the eigenvalues stationed at the traditional high value of 1. The PCA's final statistics and extracted components accounted for about 63% of the total cumulative variance. This satisfies the requirement that the factors account for at least 50% of the variation [37]. The four extracted components and the factors loading on them are displayed in Table 1. According to Spector [36], a variable has a distinct component structure when it has a significant factor loading (loading > 0.50) on just that component. As a result, factors with 0.5 and higher are significant and are discussed under each primary component.

4.3. Discussion of Extracted Factors

Human, Materials Resources, and Policy Improvement Measures

The first principal component accounts for 30.966% of the total variance explained and has five factors loading on it. These factors include adopting a comprehensive maintenance approach and policies, a better-quality control system of maintenance projects and operations, using authentic and durable building materials during construction, improving maintenance personnel skill set and competence, and improving building user behavior and awareness. Considering the descriptions of these factors, the component was therefore named "Human, Materials Resources, And Policy Improvement Measures."

Omar, Ibrahim, and Omar [30] conducted research that necessitated competent maintenance managers and technicians to plan, schedule, and implement an effective maintenance strategy to improve building maintenance. Straub [38] contends maintenance personnel should know about building defects and proffer lasting maintenance solutions and their cost implications. Furthermore, Saqib, Farooqui and Lodi [34] stated that their study indicated that maintenance personnel's experience and expertise are critical factors for effective maintenance operations in Pakistan. Wahid and Corner [41] opined that including top managers in a maintenance management team and the technicians' expertise is a critical performance indicator for any building maintenance management strategy.

Furthermore, Ferreira [16] opined that introducing the correct application of maintenance management tools can increase efficiency in Brazil's public institutions' maintenance services. Raposo et al. [33] reasoned that the evolution of preventive maintenance of buildings in Brazil had reduced public spending on repairs and renovations. Preventive maintenance has created an avenue for more judicious use and redeployment of resources to new building constructions and expansions.

Computerized Approach to Management, Assessment, and Feedback Mechanism

12.835% of the total variance explained is accounted for by the second principal component. The factors under this component include; the adoption of computerized maintenance management systems, accurate maintenance task planning and scheduling, adoption of mechanisms to get prompt and adequate feedback from building users, and performance measurement of maintenance strategies. This component was then named "Computerized Approach to Management, Assessment, and Feedback Mechanism" based on the attributes of its factors.

According to Atkinson, Waterhouse, and Wells [11], one of the measures to improve building maintenance is to measure the performance of the maintenance strategy deployed. They posited that performance measurement performs three critical tasks: coordinating, monitoring, and diagnosing. These functions improve the efficiency of buildings and user satisfaction. In agreement, Nik-Mat, Kamaruzzaman, and Pitt [24] postulated that performance measurement of building maintenance operations is vital to assessing building performance through analyzing user feedback.

Additionally, researchers touted maintenance task planning and scheduling as a measure to improve building maintenance. According to Omar, Ibrahim and Wan Omar [29], monitoring and supervising building conditions and maintenance operations should be supported by planning and scheduling those activities.

Less Sabotage and Quick Response Measures

The third principal component accounts for 9.406% of the total variance explained. The factors under this component include less vandalism, destruction by university building users, and quick response time to maintenance complaints. This component was then dubbed "Less Sabotage and Quick Response Measures" based on the attributes of its factors.

According to Ugwu et al. [40], building users and occupants dislike abusing and vandalizing building components and facilities. Its frequency of occurrence has made it a significant problem that should be solved for efficient maintenance management of buildings. Adenuga et al. [3] also mentioned less vandalism in their research as a solution to improve the maintenance of facilities. Adamu [2] posited that university accommodations are insufficient and overpopulated; worse, these accommodations are being vandalized by students.

Abdul-Lateef [1] confirmed the frustration of university building users with the response time of maintenance departments to their complaints and the quality of the maintenance services eventually carried out. Quick execution of repair works is almost impossible. Therefore, it is for maintenance departments to hire more staff to beat time lapses in response to maintenance complaints.

Improved Funding, Design, and Construction Measures

The last principal component extracted contains two loading factors, accounting for 9.103% of the variance explained. These factors are the provision of adequate funding and the incorporation of maintenance considerations in building designs and construction processes. Seeing the underlying attributes of these factors, this component was subsequently named "Improved Funding, Design, And Construction Measures."

One of the unique solutions to maintenance problems has

been highlighted to be adequate funding. It is evident that university stakeholders must ensure proper funding for maintenance departments to execute educational buildings' maintenance operations successfully. It is believed this is one of the most effective ways to improve the maintenance of academic facilities. Dabara et al. [15] found that funding is mostly the stumbling block for most maintenance programs and strategies; therefore, the effectiveness of any maintenance process can ultimately be improved by the availability of funds. Ofide et al. [27] added that maintenance strategies are subject to funding; it affects whatever system to adopt. This overdependence on available funds was also noted by Buys et al. [12].

Arditi [9] stated that the degree to which maintenance is factored during the building's design and construction stages dramatically affects its overall performance. Chohan et al. [14] complained about a faulty building design's consequences and repercussions as a global menace affecting building maintenance. Therefore, architects and engineers must incorporate future maintenance considerations into their designs and processes.

5. Conclusion and Recommendations

This study sought to investigate the measures to improve the maintenance of public university buildings in Nigeria. The study was able to determine the qualification and experience of the personnel in the maintenance units of these institutions by using a survey approach with quantitative data gathered from maintenance officers, supervisors, and technicians within six selected public tertiary institutions. This gave credence to their knowledge of the issues discussed and their ability to participate in the survey. The study also investigated the solutions to building maintenance problems in these tertiary institutions.

Findings revealed that most of the personnel in these institutions' works/maintenance departments are highly qualified. They are mostly bachelor's and master's degree holders. Furthermore, these staffs are equally as experienced, most of whom have spent between six and 15 years maintaining their university buildings. The measures to improve the maintenance of university buildings are classified as human, materials resources, and policy improvement measures, computerized approach to management, assessment, and feedback mechanism, less sabotage and quick response measures and improved funding, design, and construction measures.

HEIs are burdened with creating a robust learning environment that prepares students for society by imparting their scientific knowledge. University is an environment where knowledge is generated so it can be applied for the good of humanity. Unfortunately, the education system in Nigeria has been plagued with a series of challenges, chief of which is inadequate funding which is more prevalent in public universities [20]. It's been established stated that the trickle-down effects of this abysmal higher education funding are poor infrastructure and dilapidated buildings. This major problem has led to a lack of infrastructure, buildings, and equipment. It has also resulted in the accumulation of outdated and rapidly dilapidating infrastructure. Public universities' physical structures and facilities that should offer student perks of learning, teaching, and modernization are grossly inadequate and unusable.

It is, therefore, compulsory for higher institution management and maintenance departments, by extension, to implement the measures assessed in this study. It is also recommended that the Nigerian government and the Ministry of Education prioritize sufficient funds for maintenance operations in HEIs. The current maintenance allocations should be improved, and maintenance implementation processes should be monitored. Furthermore, it is recommended that university managements employ experienced maintenance personnel to populate their works/maintenance departments. This will bring their expertise to bear in tackling building defects permanently. Some highly technical maintenance operations can also be outsourced to competent firms to execute.

The findings of this study will contribute significantly to the knowledge about the solutions to maintenance problems of university buildings. This will help maintenance units on the appropriate area of focus. More research can still be conducted to investigate other measures to improve maintenance not captured in this study, especially in private tertiary institutions. This will provide a more robust view of the different solutions that can be applied to building maintenance problems in different settings and scenarios.

Conflicts of Interest

The authors declare no conflicts of interest.

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