Civil and Sustainable Urban Engineering

Research Article
Volume 3(1), 2023, 1-15
https://doi.org/10.53623/csue.v3i1.139

Assessment of Maintenance Management Practice in Government-owned Tertiary Institution

Lucky Azubike Osuya[1]*, Olumide Afolarin Adenuga[1], Olalekan Shamsideen Oshodi[2]

[1]Department of Building, Faculty of Environmental Science, University of Lagos, Lagos, Nigeria
[2]Department of Architecture, Construction and Surveying, Anglia Ruskin University, Chelmsford, United Kingdom

*Correspondence: laosuya@yahoo.com

SUBMITTED: 28 October 2022; REVISED: 8 January 2023; ACCEPTED: 10 January 2023

ABSTRACT: The state of utilities and infrastructure within an academic institution plays a vital role in learning and the development of human capital. Hence, this study seeks to examine the management practices used in maintaining facilities in a government-owned tertiary institution and then examine the conditions of critical facilities and their related services in the institution. To achieve the study's goal, a questionnaire survey approach was used to collect information about users' and property managers' perceptions of maintenance management practices. The results revealed the existence of a maintenance policy covering critical systems and services. The discovery also implies that maintenance tasks are generated and planned in response to inspections and user requests. Respondents' perceptions of the state of facilities and utilities indicate that they are in good condition. While literature shows school infrastructure issues remain an ongoing concern, the majority of respondents affirm security and electricity as the most important critical infrastructure and services in the institution, amongst others. The most important limitation of the current study lies in the fact that the findings may not be generalizable to other tertiary institutions in Nigeria. Hence, more research needs to be done in order to gather more information about maintenance management practices in public universities and other educational institutions to improve critical facilities and services to enhance learning outcomes.

KEYWORDS: Maintenance management; functional infrastructure and services; educational system; preservation; school security; Nigeria

1. Introduction

Education is the bedrock of national development, and it contributes to the socio-economic development process in any society. As the world moves from an industrial age to a knowledge-driven economy, there is a need to develop new knowledge and improve human capital, especially in developing countries like Nigeria. In the literature, it has been established that the state of facilities and utilities in an academic institution affects students' preferences in selecting schools [1, 2], their academic performance [3–7], their psychomotor learning [8, 9], and their learning behaviors [10]. However, it is imperative to note that not all studies report a positive relationship between the state of school facilities and learning outcomes [5, 11, 12]. This inconsistency may be attributed to the method used, the

generalizability of survey findings, or the need to conduct more longitudinal surveys than cross-sectional studies. When these factors are considered together, it is clear that there is a growing need to improve educational facilities in order to improve learning outcomes, which has a long-term impact on the quality of human resources available to meet the society's developmental needs.

Several studies have focused on the maintenance management of facilities in Nigeria. Typical examples are the maintenance management of hospital buildings [13], school buildings [3, 14–16], and public housing estates [17]. Similarly, other researchers have focused on the maintenance management of school buildings in South Africa [18, 19] and building maintenance practices in Malaysian universities [20]. Results emanating from previous studies in Nigeria reveal that maintenance management is often neglected, which leads to the eventual dilapidation of existing infrastructure. In emphasizing the dire conditions of facilities in tertiary institutions, [21] reports that facilities in many universities in developing countries are becoming obsolete and grossly inadequate to achieve their objectives. Olusegun & Guyimu [15] opine that the continuous presence of stains, expired and irreplaceable decorative elements, missing tiles, discoloring surfaces, biological growths, failure of finishes, cracks, ponding water, weeds, fluid leakages, broken or missing panels, blocked pipe and drains, and open sewers are physical evidences of poor maintenance issues. Oyenuga et al. [22] attribute these problems to a lack of planned maintenance, a lack of maintenance policies, a lack of updated security systems, and a lack of qualified personnel, which are among the major factors influencing the deteriorating state of facilities in a university. According to studies, dilapidated, unhealthy buildings in a decaying environment, as well as poor conditions in our surroundings, depress the quality of life and contribute in some measure to antisocial behavior [22-24] and learning behavior [10], ultimately affecting the quality of learning outcomes [4]. The issue of facilities management practices is haphazardly addressed at all levels of the educational system in Nigeria. However, due to the strategic position of tertiary education in teaching practical and useful knowledge that society at large can model after and benefit from, the lack of an effective and efficient maintenance management practice at this level could have a negative effect on infrastructural maintenance operations in society at large. It can be deduced from the literature that Nigerian universities generally have maintenance departments that care for their individual school facilities and systems; however, studies clearly showed that gaps exist with reported negligence of building facilities that reflect a lack of definitive evidence of operations strategies and policy plan coverage that keep buildings functional and well maintained [15, 21, 22, 24]. Thus, this study sets out to evaluate (1) the maintenance management practice in the University of Lagos and (2) the current physical and functional state of critical infrastructure and services in the institution in the eyes of maintenance staff and students in the university. The significance is to appraise and highlight appreciably the important practice of maintenance management as it relates to and impacts the conditions of critical facilities and services in an educational institution, therefore requiring priority investments from the managing authorities. The findings in this research, hopefully, will significantly contribute meaningfully to the improvement, expansion, and preservation efforts of schools and campuses by stakeholders of the educational system and other public utilities in Nigeria and beyond. The hypothesis postulated for this study states that there is a significant difference in the perception of users and maintenance staff regarding the physical and functional state of facilities and services in

the institution. This hypothesis was postulated to determine whether or not the two independent categories of respondents (i.e., students who are the users and maintenance staff who are the operators) who have daily contact with building facilities hold the same or different opinions regarding the performance or conditions of facilities and their related services in the institution.

Universities need functional buildings and facilities to operate, and the buildings must achieve high functional performance standards [25]. Functional buildings in this context refer to the extent to which buildings allow users (i.e., both students and staff alike) to carry out their intended functions [16, 26]. These high-performance areas include indoor climate, acoustics, lighting, safety, security, convenience, indoor air quality, accessibility, administrative office space, workrooms, faculty dining areas, lecture theaters, conference areas, library resource centers, science facilities, arts and music studios, sport facilities, etc. These university assets and resources require maintenance to create suitable environments that support and stimulate learning, teaching, innovation, and research activities, and their value depends largely on the quality of maintenance invested in them [25]. The failure of these essential activities, which university buildings support, is a loss in value to the entire university community and society as a whole [25]. Without meeting the maintenance needs of these facilities, deterioration will set in with time due to the effects of various causes [13], and school buildings specifically are subjected to willful damage by students and fall into disrepair, resulting in major renovation works [27]. Building maintenance must be prioritized as long as buildings continue to support the university mission, because universities cannot function without functional buildings [20]. In Nigeria, universities continue to face immediate pressure to preserve existing colleges on their campuses, some of which were built over half a century ago and are now grossly inadequate to cater for their growing population. As a result, many times without numbers, school programs are altered and become irregular due to persistent strike actions by university managers [21, 28], primarily due to a lack of funding from the government [14], hence making maintenance programs difficult.

Furthermore, evidence of the non-implementation of a planned maintenance program in public universities in developing countries abounds in the literature. The lack of planned maintenance, according to Oyenuga et al. [22], has led to the physical deterioration of building facilities. This is also a peculiar problem in Malawi [29] and South Africa [18, 19]. In Malaysia, university management practices corrective and condition-based maintenance [20], while Au-Yong et al. [30] assert that the trend is more towards a reactive approach and observe the comments of Abdul Lateef et al. [31] that it is conditionally driven with constraints based on budget allocation. Comparably, in Hong Kong and the UK, where maintenance needs are planned for public buildings based on priority setting [32], According to Lateef et al. [25], much of the building maintenance management practices in universities focus on preventive, cyclical, and condition-based maintenance, as well as reliability-centered maintenance and root cause failure analysis [33]. However, the traditional maintenance management system, which revolves around planned maintenance and unplanned (ad hoc) maintenance, still remains very relevant [34]. The advocates of the application of a performance-based maintenance strategy to building maintenance rely on modern communication technology (such as instrumentation that measures the condition of equipment) to monitor the performance of building elements, associated services, and cost estimates [20, 29–33]. Performance-based maintenance has been adjudged to be most suitable

for the manufacturing industry as compared to the construction industry, with its limited application to high-tech electrical fittings, appliances, and mechanical components [20].

From a maintenance management perspective, top management is probably the most significant influence on maintenance culture [35]. However, maintenance managers are by necessity decision-makers, faced daily with the task of making decisions on how to plan work, obtain materials, guide workmen, organize the maintenance department, and a myriad of other matters [13]. Despite these challenging responsibilities for the maintenance managers, Asiabaka [3] observed that school managers and teachers who constantly use school facilities lack knowledge of facility maintenance planning and fail to integrate facility maintenance plans into the management of schools. The absence of maintenance plans or policy guidelines that describe the general guidelines for maintenance, repair, and renovation of buildings and infrastructure within the education system has been reported [19, 22, 24, 29, 30]. Waziri and Vanduhe [16] and Ogunbayo et al. [36] report from research findings that there is an apparent lack of maintenance culture and policy in developing countries, affecting both public and private buildings and facilities [24]. Facilities managers and school management authorities, therefore, have to realize that a well-maintained building and facilities are critical to delivering the university's core objectives; control cost, increase productivity, increase competitive advantage, and optimize service delivery [25, 37]. However, there is a great difficulty in discerning facts from bodies of literature and past research on the operation of a systemic national maintenance policy framework for critical infrastructure and services in developing countries, eliciting further inquiries. The integration of stakeholders' (students, staff, and the general public) development into maintenance management strategies for addressing maintenance problems in tertiary institutions is also very important [21]. Wall [27] reported the success of a grass-roots approach to maintenance in which the maintenance personnel were involved in the education of building users about maintenance generally and preventive maintenance in particular. The notion was to create in users an awareness of the importance of cleaning, inspection, and generally maintaining buildings as an element of caring for their immediate environment.

2. Materials and Methods

This study adopted a questionnaire-survey approach. The survey questions were set into two different questionnaires, one for the maintenance department staff respondents of the University of Lagos and the other for students (users) of the institution. Both structured questionnaires were then purposefully administered by hand for convenience to various user respondents in some selected classrooms, student hostels, and maintenance staff offices. The distribution of questionnaires among students and staff in this manner was effective, fair, and representative, so as to achieve the set objectives. A total of 100 structured questionnaires, made up of 80 questionnaires for user respondents and 20 questionnaires for maintenance management staff respondents, were sampled. In total, 85 questionnaires representing response rates of 84% (67 numbers) and 90% (18 numbers), respectively, were collated and analyzed using statistical methods (i.e., descriptive statistics and an independent sample t-test through the statistical software SPSS) to evaluate the perception of maintenance staff and students on building maintenance management practice, as well as the physical and functional state of critical facilities and services in the university. The independent sample t-test (group t-test) is a form of inferential statistics with samples typically consisting of an

independent population; the preconditions or requirements of the parametric test include independence, normality, and homogeneity of variance, which are determined to ensure correct use of the t-test [38, 39]. Where the data samples do not satisfy the parametric requirements, even after variable transformations such as logarithm transformation and/or rank transformation, a suitable nonparametric test (the Mann-Whitney U test) for the original date will be carried out [39]. It was hypothesized that the perception of maintenance staff and users differs depending on the condition of buildings and facilities at the university. The analysis of statistical significance was defined based on the following statistical hypothesis: If $p< 0.05$, reject H_0 and accept H_1 (the variances are significantly different, therefore, cannot assume equality of variances). If $p>0.05$ accept H_0 and reject H_1 (the variances are not significantly different, therefore we can assume equality of variances). H_0 and H_1, being the null hypothesis and alternate hypothesis, respectively [38, 40]. where 0.05 or 5% is the significant threshold [41].

3. Results and Discussion

This section presents the demographic characteristics of survey participants, the results and analysis of maintenance management practice, the conditions of critical infrastructure and services, respondents' awareness level of maintenance activities, and a hypothesis test.

3.1. Demographic characteristics of the respondents

Table 1. Characteristic of respondents.

Maintenance Staff Information	Frequency	Percent	Users Information	Frequency	Percent
Professional Background	3	18	Academic Qualification		
Architecture			Users (student)		
Building	1	6			
Civil Engineering	-	-	Undergraduate	34	52
Mechanical/Electrical Engineering	7	41	B.Sc	18	27
Quantity surveyor	-	-	PGD	2	3
Estate management	-	-	M.Sc/MBA	12	18
Others	6	35	Ph.D	-	-
Status of Maintenance Staff	10	56	Number of Years Resident in the Institution		
Senior					
Intermediate/Middle	3	17	Less than 1 year	31	46
Junior	5	28	1 – 2 years	5	8
Number of Years as Maintenance Staff			3 – 4 years	17	25
Less than 5 years	7	41	5 years & Above	13	19
5 – 9 years	3	18			
10 – 14 years	3	18			
15 – 19 years	2	12			
20 years & Above	2	12			

The demographic characteristics of the respondent are presented in Table 1 and cover information about the respondents' (i.e., maintenance staff and students') professional background, educational level, status, number of years as maintenance staff, and number of years of residency in the institution. According to the data in the table, staff respondents with a mechanical or electrical engineering background rank first with 41%, followed by others (such as housekeeping, accounting, business administration, and data processing) with 35%, architecture with 18%, and respondents with a building background with the remaining 6%. Further observation of the table reveals that the majority of the respondents hold senior-level positions and have spent at least five years working in the institution. The table shows that

52% of students (users) are undergraduates, 27% have a BSc, 18% have an MSc or MBA, and the remaining 3% have a PGD. Furthermore, 46% of the students have spent at least a year in the institution, 25% have spent 3–4 years, and 19% have spent at least more than 5 years.

3.2. Evaluation of Maintenance Management Practice

The aim of this section is to evaluate the maintenance management practices of the university. It assesses the opinions of maintenance staff respondents on the questions posed about the university's maintenance policy and its coverage in the institution, as well as the ways in which maintenance needs are identified and planned. According to the data in Table 2, 89% of the 16 respondents sampled said "yes" to the question of whether the university has a maintenance policy, while 11% said "no."

Table 2. Maintenance policy operation.

Factor	Frequency	Percent (%)
Yes	16	89
No	2	11

To further examine the maintenance policy plan and coverage in the institution, a scale of 0% to 100% was used, and the results are shown in Table 3. The results reveal that the majority of respondents (47%) indicate that the extent of maintenance policy coverage of critical infrastructure and services in the institution is about 60–80%. While 24% of responses are shown to be either 41–60% or 81% and above, with the least response being 6% covering 0–20% policy coverage.

Table 3. Scope of maintenance policy coverage on critical infrastructure and services.

Maintenance policy coverage (%)	Frequency	Percent (%)
0 -20	1	6
21 - 40	-	-
41 - 60	4	24
61 - 80	8	47
81 and Above	4	24

The data in Table 4 show respondents' perspectives on how building maintenance is generated in the institution. The majority of the respondents (53% indicate it is upon inspection), while 35% indicate it is upon request; the remaining 12% indicate it is upon occupancy by a new tenant.

Table 4. Method used in generating maintenance work in the institution.

Method	Frequency	Percent (%)
Upon inspection	9	53
Upon request	6	35
Upon occupancy of new	2	12

As shown in Table 5, the respondents' assessments of the different ways used by the maintenance department in planning maintenance work in the institution are highlighted. The results in the table indicate that the majority of 44% of respondents reveal that maintenance work is done on request, 33% indicate that there is a global maintenance plan covering all items of maintenance work, and 11% report that each supervisor plans their own maintenance activity or are not sure of the method being used by the maintenance department.

Table 5. Method used for planning maintenance activities in the institution.

Method used in planning maintenance activities	Frequency	Percent
Each supervisor plan his own maintenance activity	2	11
There is a global maintenance plan covering all item of maintenance work	6	33
Maintenance works are done as per request	8	44
Other	2	11

3.3. Conditions of Selected Critical Infrastructure and Services

This section assesses users' and maintenance staff's responses to their perceptions of the physical and functional states of some selected critical facilities and services in the institution. A Likert-type scale format from 1 (very bad) to 5 (very good) was used to enable these measurements. The score in Table 6 shows the mean score distribution with a corresponding standard deviation (SD), ranked in order of significance. The results of the descriptive statistics reveal that the overall mean score for maintenance staff perception about the physical and functional states of critical infrastructure and services was 3.48 (SD = 1.14) and for users was 3.25 (SD = 0.74). From Table 6, security had the highest mean score value of 4.38 (SD = 0.77) while telecommunications ranked lowest with a mean score value of 3.69 (0.95) for staff. While for users (i.e., students), electricity ranked highest with a mean score of 3.55 (SD = 1.08) and telecommunication ranked lowest with a mean score of 2.97 (1.0), indicating positive perception amongst both respondents.

Table 6. Descriptive statistics on condition of selected critical infrastructure and services.

Critical infrastructure and services	**Maintenance staff perspective**			**Users' perspective**		
	Mean score	**SD**	**Rank**	**Mean score**	**SD**	**Rank**
Security	4.38	0.77	1	3.49	1.06	2
Clean water supply	4.27	0.80	2	3.16	1.06	7
Electricity supply	4.12	0.70	3	3.55	1.08	1
Waste water disposal	4.00	0.71	4	3.19	1.08	6
Garbage disposal	4.00	0.56	5	3.41	1.19	3
Sanitation of the environment	3.93	0.62	6	3.40	0.94	4
Human traffic control/access control	3.93	0.73	7	3.14	1.15	8
Cooling system	3.83	0.72	8	3.03	1.10	10
Level of cleanliness of the environment	3.71	0.83	9	3.40	1.10	5
Drain system	3.71	0.73	10	3.12	0.96	9
Telecommunication system	3.69	0.95	11	2.97	1.10	11

1 Very bad, 2 Bad, 3 Average, 4 Good, 5 Very good

Table 7. Descriptive statistics on physical conditions of building elements.

Building Elements	**Maintenance Staff (N=18)**			**Users N=67**		
	Mean	**SD**	**Rank**	**Mean**	**SD**	**Rank**
Sanitary fittings	4.00	0.68	1	3.00	0.90	11
Roof structures	3.86	0.54	2	3.52	0.93	2
Walls	3.83	0.56	3	3.29	0.92	5
Floor/Wall tiles	3.79	0.70	4	3.23	0.96	6
Floor slab	3.79	0.58	5	3.58	0.85	1
External painting	3.79	0.58	6	3.03	1.01	10
Drains	3.71	0.73	7	3.12	0.96	9
Beam/Column	3.69	0.63	8	3.38	0.97	4
Nettings	3.62	0.65	9	2.88	0.98	12
Internal painting	3.50	0.76	10	3.17	0.92	8
Ceiling	3.43	0.85	11	3.45	0.92	3
Doors	3.40	0.91	12	3.19	0.96	7

Note that 1 represent Very bad, 2 Bad, 3 Average, 4 Good, 5 Very good

Table 7 shows how respondents rated the physical condition of building elements on a 5-point Likert scale ranging from (1) very bad to (5) very good. The results reveal that sanitary fittings were ranked highest and judged to be in good condition by maintenance staff, while the remaining building elements on the table, such as roof structures, walls, floor/wall tiles,

etc., are ranked average for both maintenance staff and users. except for the netting, which was deemed in poor condition by users and ranked last.

To assess the level of awareness of maintenance activities in the institution, maintenance staff were asked how often they undertake inspection work, and users were asked how often they observe inspection activities on the following listed building elements and services: A five-point Likert scale of (1) never to (5) very frequently was used for the measurement. The results as indicated in Table 8 reveal that maintenance staff undertake inspections of the electricity system "frequently" and "sometimes" undertake inspections of cleaning services, drains, generator installations, refuse and waste disposal, fumigation works, and roof structures. External paintings and floor slabs, on the other hand, are "rarely" inspected. For users, items such as the electrical system, refuse, and waste disposals are "sometimes" observed to be inspected, and nettings, doors, internal paintings, drains, beams and columns, and ceilings, as indicated in the table, are observed by users to be "rarely" inspected by the maintenance staff.

Table 8. Level of awareness of respondents on inspection of building elements and services.

Building element/services	Frequency of inspection undertaken by maintenance staff			Frequency of inspection as observed by users		
	Mean	**SD**	**Rank**	**Mean**	**SD**	**Rank**
Electrical system	4.07	1.14	1	3.17	1.15	4
Cleaning services	3.88	1.22	2	3.40	1.14	1
Generator installation	3.81	0.98	3	2.66	1.09	18
Refuse and waste disposal	3.62	1.39	4	3.29	1.07	2
Cooling system	3.36	1.08	5	2.72	1.23	14
Landscaping work	3.36	1.15	6	3.18	1.03	3
Sanitary fittings	3.33	1.23	7	2.72	1.23	13
Drain	3.23	1.09	8	2.86	1.03	10
Doors	3.08	1.26	9	2.86	1.02	7
Nettings	3.00	1.28	10	2.61	1.06	19
Fumigation	3.00	1.04	11	2.94	0.97	5
Roof structure	3.00	1.18	12	2.88	1.13	6
External painting	2.85	1.28	13	2.83	1.05	12
Floor/wall tiles	2.85	0.90	14	2.66	0.96	17
Floor slab	2.79	1.19	15	2.85	0.96	11
Beam/column	2.75	1.06	16	2.86	0.99	9
Walls	2.75	0.97	17	2.86	0.92	8
Ceiling	2.71	0.91	18	2.70	1.05	16
Internal painting	2.69	1.25	19	2.70	1.08	15

Note: 1 Never, 2 Rarely, 3 Sometimes, 4 Frequently, 5 Very Frequently

3.4. Test of Hypothesis

H_1: The perceptions of maintenance staff and users (i.e., students) on the general condition of buildings and facilities in the institution differ.
H_0: The perceptions of maintenance staff and users (i.e., students) on the general condition of buildings and facilities in the institution do not differ.

To test this hypothesis, the data distribution of users and maintenance staff respondents was first subjected to a normality test using the Kolmogorov-Smirnov-Shapiro-Wilk test. The results show that the data observed were not normally distributed at p =.000, which is less than the 0.05 significant level as shown in Table 9, thus suggesting that the independent t test assumption of normality is not tenable and would not be appropriate to conduct the test. Note that for small sample sizes, $n \leq 50$ fits the normal test for Shapiro-Wilk, and for large sample sizes, $n > 50$ fits Kolmogorov-Smirnov [38, 39]. In addition,

Gerald [38] reports that the t-test cannot be applied for small sample sizes ($n \leq 30$). Therefore, a nonparametric test (Man-Whitney U test) will be used to conduct the test.

3.5. Mann-Whitney U Test

To assess the difference in perception between maintenance staff and users on the condition of buildings and facilities in the institution, a Mann-Whitney U test was conducted due to the non-normality of the variables as shown in the results indicated in Table 9.

Table 9. Test of normality.

	Respondents	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
General condition of building and facilities	Users	0.290	66	0.000	0.744	66	0.000
	Maintenance staff	0.394	17	0000	0.678	18	0.000

[a]Lilliefors Significance Correction

As given by SPSS, the test results in Table 10 show the user respondents (n = 66) with a total sum of ranks equal to 2645.50 and, by contrast, larger than the maintenance staff n=17 = 17) with a total sum of ranks equal to 840.50. The mean comparison of the distribution shows the maintenance staff respondents having a larger mean rank (49.44) than the user respondents with a mean rank of 40.08.

Table 10. Ranks.

	Respondents	**N**	**Mean Ranks**	**Sum of Ranks**
General condition of buildings and facilities	Users	66	40.08	2645.50
	Maintenance staff	17	49.44	840.50
	Total	83		

This difference in mean rank results, as shown in Table 11, revealed no statistically significant difference in the perception of maintenance staff and users on the condition of building facilities: U = 434.500, z = -1.604, p = 0.109 (which is greater than 0.05, i.e., p > 0.05), with a small effect size of r = 0.176. Therefore, H_1 is not supported; H_0 is accepted. The findings thus suggest that the opinions of the staff and users on the general conditions of buildings and facilities do not differ.

Table 11. Test statistics[a]

	General condition of buildings and facilities
Man-Whitney U	434.500
Wilcoxon W	2845.500
Z	-1.604
Asymp. Sig. (2-tailed)	.109
Exact Sig. (2-tailed)	.119
Exact Sig. (1-tailed)	.059
Point Probability	.016

a. Grouping Variable: Respondents

Note that the effect size for a non-parametric test can be calculated by hand using the formula $r=Z/\sqrt{N}$, where Z is the Z statistics and N is the sample size, where r = 0.1 represents a small effect, r = 0.3 represents a medium effect, and r = 0.5 represents a large effect [42]. Estimates of effect size are useful for determining the practical or theoretical importance of an effect,

the relative contribution of different factors or the same factor in different circumstances, and the power of an analysis [38, 42]. The most basic and obvious estimate of effect size when considering whether two data sets differ is the difference between the means [42].

4. Discussion of finding

The analysis of the data collected in this study reveals a number of important findings regarding maintenance management practice in the institution. First, the outcome of the findings in Table 2 revealed significant results on the operation of the maintenance policy in the university, as nearly 90% of the staff interviewed affirmed its existence; consequently, Table 3 showed the extent of the policy's coverage on critical systems and services (such as security, lightning, safety, waste and water supply management, access control, mechanical maintenance and retrofit, cleanliness, etc.) stands at about 80%. Second, the method used by the maintenance department in generating and planning maintenance work is by inspection and users' request, as shown in Tables 4 and 5, respectively. Finally, as shown in Table 6, the majority of maintenance staff identified security as one of the most important critical infrastructures and services at the university, whereas students prioritize electricity among other things. The conditions of buildings and facilities in the institution were revealed to be in good condition according to the perception of users and the maintenance department staff in Table 7. The positive response of users to the question of awareness of maintenance activity on campus (Table 8) confirms the users' knowledge of the institution's maintenance programs.

According to reports, most institutions in developing countries lack a policy framework for dealing with maintenance issues [16, 19, 22, 29]. While some institutions may have a working framework like the university under study, factors such as a lack of maintenance culture, underfunding, etc., may hinder effective and efficient maintenance management and operation, resulting in deteriorating conditions of facilities [22, 25]. Some of Nigeria's top public universities were built decades ago, so regular maintenance (such as plumbing repairs, roof repairs, electrical repair works, etc.) may not necessarily result in improved facility functionality, but considerations for replacing critical parts, upgrading or overhauling the system, or adding new facilities to accommodate an increasing population of students may be required to improve the learning environment.

While past studies have shown that the state of school facilities has an effect on students' academic success, healthy living, school selection choice, learning behavior, and psychomotor activities [2, 4, 5, 8, 10], The other important dimension that is often neglected is school security, and [43] observe that there are a relatively small number of scholars and practitioners who compile data in this area with limited opportunities for debate and discussion. Studies have shown that narrowly focusing on security has led many educational institutions to ignore some of the services and school conditions that are essential to academic achievement, student well-being, and school safety [44]. It has also been observed that security threats, absence of safety needs, and non-protection of lives and property create a very hostile environment for educational attainment as no effective teaching and learning can take place in an environment filled with threats of insecurity, wars, communal crises, kidnapping of students and school personnel, wanton destruction of school facilities, and other insignificantly powerful tools and devices of insecurity, as in the case with some states

in Nigeria and some other countries in the subregion where all levels of education have been negatively battered as a result of the activities of insurgent groups [45–47].

This problem is not peculiar to Nigeria; the U.S. faces a similar challenge where horrific school shootings and other forms of violence in academic institutions have led governments at all levels and stakeholders to seek ways to best address the problem and protect the school environment [43, 48, 49]. In an attempt to address this challenge, the National Association of School Psychologists [50] cites research findings that suggest that restrictive school security measures have the potential to harm school learning environments, particularly when extreme physical measures are overemphasized or armed security guards are universally increased. Installing surveillance cameras and metal detectors in schools as a strategy may undermine the learning environment, negatively impeding learning. It recommends that such an extreme strategy be undertaken based on the needs of individual schools and communities. In some cases, the decisions to implement strict security measures rely more on high-profile events, parent demands, and the opinions of school leaders and their stakeholders than they really do on solidly rooted data [43]. As public awareness and concern about school security and safety grows at home and abroad, exacerbated by media coverage of various cases of school invasion and kidnapping by insurgent groups in a section of the country, governments at all levels, communities, and stakeholders must take immediate action to address these problematic threats to the school learning climate. Research on the issue of school security and safety in Nigeria is fragmented, thus requiring a multidisciplinary approach to look at its different dimensions in the educational system and communities alike for policy measures, implementation, and general governance.

5. Conclusion

The present study seeks to examine (1) the management practices used in maintaining facilities in a Nigerian public tertiary institution and (2) assess the conditions of critical facilities and services using the University of Lagos as a representative case. The findings in this study revealed that the institution operates an established planned maintenance program for its critical facilities and services that depends mostly on inspection and user requests to generate maintenance work. The perceptions of the respondents (i.e., maintenance staff and students) on the state of building facilities in the institution do not differ and are assessed to be in good condition, as affirmed by the hypothesis tested. The study highlights the need for embedding technology into the building maintenance process. This is essential for providing a secured, safe, and functional space that meets the needs of students and lecturers and promotes positive impact and excellence. Furthermore, the findings in this study have set the stage for other future research opportunities, which can probably look at (1) harmonizing and synthesizing existing literature in the field of undergraduate study at all levels of the educational system (2) collaboratively examine actual maintenance management methods or strategies used for maintenance of critical infrastructures in public schools, as well as general public utilities and services; and (3) develop a strategic national maintenance management framework for education infrastructure and public utilities in developing countries at a macro-level. This can assist the government and policymakers in gathering and organizing feedback that can be used to develop a national maintenance policy framework and action plan for public schools in order to create healthier and more functional infrastructure systems and associated services in society. This study is limited to a representative institution, and this

affects the generalizability of the results. In addition, low response rates associated with quantitative research are also a limitation. However, the current study captures the perception of the staff of the maintenance department (i.e., employees directly responsible for the maintenance of facilities) as well as students' perceptions of the state of critical facilities and services in the institution. Hence, the study provides adequate information about the maintenance management process and the users' opinions on the objectives set out at the inception of the study.

Competing Interest

The authors declare no conflict of interest.

References

[1] Price, I.; Matzdorf, F.; Smith, L.; Agahi, H. (2003). The impact of facilities on student choice of university. *Facilities*, *21*, 212–22. https://doi.org/10.1108/02632770310493580.

[2] Widiastuti, K.; Susilo, M.J.; Nurfinaputri, H.S. (2021). School space selection preferences: Architectural perspective toward formal school. *International Journal of Evaluation and Research in Education*, *10*, 502. https://doi.org/10.11591/ijere.v10i2.20726.

[3] Asiabaka, I.P. (2008). The Need for Effective Facility Management in Schools in Nigeria. *New York Science Journal*, *1*, 10–21.

[4] The Impact of School Infrastructure on Learning: A Synthesis of the Evidence. (accessed on November 2022) Available online: http://documents.worldbank.org/curated/en/853821543501252792/The-Impact-of-School-Infrastructure-on-Learning-A-Synthesis-of-the-Evidence.

[5] Earthman, G.I. (2017). The relationship between school building condition and student achievement: A critical examination of the literature. *Journal of Ethical Educational Leadership*, 4, 1–17.

[6] Mendell, M.J.; Heath, G.A. (2005). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air*, *15*, 27–52. https://doi.org/10.1111/j.1600-0668.2004.00320.x.

[7] Uline, C.; Tschannen-Moran, M. (2008). The walls speak: the interplay of quality facilities, school climate, and student achievement. *Journal of Educational Administration*, *46*, 55–73. https://doi.org/10.1108/09578230810849817.

[8] Rojo-Ramos, J.; González-Becerra, M.J.; Gómez-Paniagua, S.; Carlos-Vivas, J.; Acevedo-Duque, Á.; Adsuar, J.C. (2022). Psychomotor Skills Activities in the Classroom from an Early Childhood Education Teachers' Perspective. *Children*, *9*, 1214. https://doi.org/10.3390/children9081214.

[9] Ekundayo, H.T. (2012). School facilities as correlates of students' achievement in the affective and psychomotor domains of learning. *European Scientific Journal*, *8*, 208–2015.

[10] Leung, M.; Fung, I. (2005). Enhancement of classroom facilities of primary schools and its impact on learning behaviors of students. *Facilities*, *23*, 585–94. https://doi.org/10.1108/02632770510627561.

[11] Bower, A.J.; Urick, A. (2011). Does High School Facility Quality Affect Student Achievement? A 2-Level Hierarchical Linear Model. *Journal of Education Finance*, *37*, 72–94.

[12] McKenzie, K.; Schweitzer, R. (2001). Who Succeeds at University? Factors predicting academic performance in first year Australian university students. *Higher Education Research & Development*, *20*, 21–33. https://doi.org/10.1080/07924360120043621.

[13] Adenuga, O.A. (2012). Maintenance Management Practices in Public Hospital Built

Environment: Nigeria Case Study. *Journal of Sustainable Development in Africa*, *14*, 185–201.
[14] Babatope, B.A. (2010) Problems of facilities in South-West Nigerian universities and the way forward. *Journal of Educational Administration and Policy Studies*, *2*, 39–43.
[15] Olusegun, O.J.; Guyimu, J. (2015). Design Inadequacies and the Maintenance of University Buildings in Ile-Ife, Nigeria. *SSRN Electronic Journal*, 5, 2015. https://doi.org/10.2139/ssrn.2784478.
[16] Waziri, B.S.; Vanduhe, B.A. (2013). Evaluation of Factors Affecting Residential Building Maintenance in Nigeria: Users' Perspective. *Civil and Environmental Research*, *3*, 19-24.
[17] Segun, A.O.; Owolabi, O.S.B. (2015). The Challenges of Building Maintenance in Nigeria (A Case Study of Ekiti State). *European – American Journals*, *3*, 30-39.
[18] Buys, F.; Nkado, R. (2006). A survey of maintenance management systems in South African tertiary educational institutions. *Construction Management and Economics*, *24*, 997–1005. https://doi.org/10.1080/01446190600851009.
[19] Xaba, M.I. (2012). A qualitative analysis of facilities maintenance — a school governance function in South Africa. *South African Journal of Education*, *32*, 215–26. https://doi.org/10.15700/saje.v32n2a548.
[20] Lateef Olanrewaju, A.; Idrus, A.; Faris Khamidi, M. (2011). Investigating building maintenance practices in Malaysia: a case study. *Structural Survey*, *29*, 397–410. https://doi.org/10.1108/02630801111182420.
[21] Ibiyemi, A.; Mohd Adnan, Y.; Daud, M.N.; Adenipekun, M. (2014). An Examination of the Structure of Sustainable Facilities Planning Scale for User Satisfaction in Nigerian Universities. *Construction Economics and Building*, *14*, 58–73. https://doi.org/10.5130/AJCEB.v14i3.4157.
[22] Oyenuga, S.O.; Akinsola, O.E.; Hussaini, P.O.; Fatokun, A.O. (2012). Maintenance of university facilities in developing country: case study of Lagos State University Ojo Nigeria. *Mediterranean Journal of Social Sciences*, 3, 69-75. http://doi.org/10.5901/mjss.2012.v3n11p69.
[23] Lee, R., Wordsworth, P. and Lee, R. (2001). Lee's building maintenance management, 4th ed.; Blackwell Science: Malden, USA.
[24] Usman, N.D.; Gambo, M.J.; Chen, J.A. (2012). Maintenance culture and its impact on the construction of residential buildings in Nigeria. *Journal of Environmental Science and Resources Management*, *4*, 69–81.
[25] Lateef, O.A.; Khamidi, M.F.; Idrus, A. (2010). Building Maintenance Management in a Malaysian University Campus: A Case Study. *Construction Economics and Building*, *10*, 76-89. https://doi.org/10.5130/AJCEB.v10i1-2.1593.
[26] Odediran, S.J.; Opatunji, O.A.; Eghenure, F.O. (2012). Maintenance of residential buildings: users' practices in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences*, *3*, 261–5.
[27] Wall, D.M. (1993). Building maintenance in the context of developing countries. *Construction Management and Economics*, 11, 186–93. https://doi.org/10.1080/01446199300000018.
[28] Offem, O.O.; Anashie, A.I.; Aniah, S.A. (2018). Effect of strikes on management and planning of educational activities in Nigerian universities. *Global Journal of Educational Research*, *17*, 1. https://doi.org/10.4314/gjedr.v17i1.1.
[29] Bowazi, K.M. (2011). Maintenance of University Facilities in Developing Countries. Master Thesis, University of Cape Town, Cape Town, South Africa.
[30] Au-Yong, C.P.; Ali, A.S.; Chua, S.J.L. (2019). Maintenance priority in high-rise housings: practitioners' perspective versus actual practice. *Journal of Engineering Research*, *7*, 167–77.
[31] Abdul Lateef, O.A.; Khamidi, M.F.; Idrus, A. (2011). Appraisal of the building maintenance management practices of Malaysian universities. *Journal of Building Appraisal*, *6*, 261–75. https://doi.org/10.1057/jba.2011.3.

[32] Shen, Q. (1997). A comparative study of priority setting methods for planned maintenance of public buildings. *Facilities*, *15*, 331–9. https://doi.org/10.1108/02632779710188324.
[33] Gouws, L.; Trevelyan, J. (2006). Research on Influences on Maintenance Management Effectiveness. In Engineering Asset Management; Mathew, J., Kennedy, J., Ma, L., Tan, A., Anderson, D., Eds.; Springer: London UK, pp. 72–79. https://doi.org/10.1007/978-1-84628-814-2_6.
[34] Zulkarnain, S.H.; Zawawi, E.M.A.; Rahman M.Y.A.; Mustafa, N.K.F. (2011). A Review of Critical Success Factor in Building Maintenance Management Practice For University Sector. *Zenodo*, 1-5. https://doi.org/10.5281/ZENODO.1082233.
[35] Eti, M.C.; Ogaji, S.O.T.; Probert, S.D. (2006). Strategic maintenance-management in Nigerian industries. *Applied Energy*, *83*, 211–27. https://doi.org/10.1016/j.apenergy.2005.02.004.
[36] Ogunbayo, B.F.; Aigbavboa, C.O.; Thwala, W.; Akinradewo, O.; Ikuabe, M.; Adekunle, S.A. (2022). Review of Culture in Maintenance Management of Public Buildings in Developing Countries. *Buildings*, *12*, 677. https://doi.org/10.3390/buildings12050677.
[37] Opoku, A.; Lee, J.Y. (2022). The Future of Facilities Management: Managing Facilities for Sustainable Development. *Sustainability*, *14*, 1705. https://doi.org/10.3390/su14031705.
[38] Gerald, B. (2018). A Brief Review of Independent, Dependent and One Sample t-test. *International Journal of Applied Mathematics and Theoretical Physics*, *4*, 50. https://doi.org/10.11648/j.ijamtp.20180402.13.
[39] Liang, G., Fu, W. and Wang, K. (2019). Analysis of *t*-test misuses and SPSS operations in medical research papers. *Burns & Trauma*, *7*, s41038-019-0170–3. https://doi.org/10.1186/s41038-019-0170-3.
[40] Pelosi, M.K.; Sandifer, T.M. (2003). Elementary statistics: from discovery to decision. John Wiley & Sons: New Jersey, USA.
[41] Nachar, N. (2008). The Mann-Whitney U: A Test for Assessing Whether Two Independent Samples Come from the Same Distribution. *Tutorials in Quantitative Methods for Psychology*, *4*, 13–20. https://doi.org/10.20982/tqmp.04.1.p013.
[42] Fritz, C.O.; Morris, P.E.; Richler, J.J. (2012) Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General*, *141*, 2–18. https://doi.org/10.1037/a0024338.
[43] School security: What we know and what we need to know; Final report to the Spencer Foundation. (Accessed November 2022). Available online: https://ed.buffalo.edu/content/dam/ed/safety-conference/security%20complete%20with%20references%201.28.20%20(002).pdf
[44] For Safety's Sake: A Case Study of School Security Efforts and Their Impact on Education Reform. (Accessed on November 2022) Available online: https://www.researchgate.net/publication/254700497_For_Safety's_Sake_A_Case_Study_of_School_Security_Efforts_and_Their_Impact_on_Education_Reform
[45] Ismaili, B.A.; Ibrahim, N.I.; Mohammed, I. (2022). Education and Security Challenges in Nigeria: Implication for Education for All. *Journal of Pedagogical Research*, *1*, 08.
[46] Nigerian Security Challenges and the Plight of Students and Teachers in Institution of Learning in Nigeria. (accessed on November 2022) Available online: https://www.globalacademicgroup.com/journals/the%20intuition/KPEE.pdf.
[47] Olaniyan, O.D. (2015). Effect of Boko Haram Insurgency on the Nigerian Education System. *Journal of Research Development*, *24*, 1–9.
[48] Mayer, M.J.; Nickerson, A.B.; Jimerson, S.R. (2021). Preventing School Violence and Promoting School Safety: Contemporary Scholarship Advancing Science, Practice, and Policy. *School Psychology Review*, *50*, 131–42. https://doi.org/10.1080/2372966X.2021.1949933.

[49] Crawford, C. and Burns, R. (2022) School Culture, Racial Composition, and Preventing Violence: Evaluating Punitive and Supportive Responses to Improving Safety. *Social Sciences*, *11*, 270. https://doi.org/10.3390/socsci11070270.

[50] National Association of School Psychologists (2018) School security measures and their impact on students [Research summary]. Bethesda, MD: Author. (Accessed November 2022) Available Online:https://www.nasponline.org/Documents/Research%20and%20Policy/Research%20Center/School_Security_Measures_Impact.pdf.