ASSESSMENT OF FACTORS CONTRIBUTING TO MAINTENANCE PROBLEMS IN HIGHER INSTITUTIONS IN NIGER STATE, NIGERIA

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Abstract
Maintenance generators degrade the quality standard of a building and if left unattended will definitely cause more damages and in the long–run, costly repairs. Maintenance staff are sometimes faced with the challenges of detecting the exact source of maintenance problems in buildings, this necessitated a research to assess factors that contribute to maintenance problems in higher institutional buildings and propose best practice criteria for effective maintenance management. Method of data collection was via questionnaire. The results from the data of the descriptive analysis were presented using Relative Important Index (RII). 101 questionnaires were administered with a response rate of 96.04%. Findings from the study revealed human/user factors and management related factors as the most contributory to maintenance problems of the studied higher institutions. The least considered best practice criteria was computerized maintenance management system (CMMS) with a mean score of 2.82. Several higher institutions maintenance departments lack a computerized work system. This may not be surprising giving the phobia many people still have for computers. Almost all the maintenance departments lack qualified computer personnel to operate an effective CMMS. This study will help the higher institution management tackle the identified major problems that results in deterioration of building facilities.

Keywords: best practice, costly repairs, factors, institutional buildings, maintenance.

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INTRODUCTION

Building maintenance is described in British Standard 3811(1984) as work done to keep a building in, or restore it to initial state or to a currently acceptable standard. The committee on building maintenance, Her Majesty's Stationary Office (H.M.S.O, 1972) defined acceptable standard (cited in Seeley, 1984) as one which sustain the utility and value of the building. This concept broadens the scope of maintenance to include alterations to a building but for the same use, conversions, which results in a change of use and value, extensions and renewal, and rehabilitation (Ikpo, 2006). In order to keep a building in acceptable condition, failures must be precluded. This implies that items that exhibit symptoms of failure have to be identified and renewed before failure occurs. This process is referred to as preventive maintenance. It depends primarily on the ability to predict the life span of all the components.

Ahmad (2000) observed that the maintenance of public buildings in Nigeria has not been given the required attention in Nigeria. The government focuses more on the construction of new buildings, while the maintenance of the old structures which commences immediately after the construction is completed is not given much attention. Olagunju (2012a and b) revealed that poor maintenance of residential buildings is very pronounced in developing countries, such as Nigeria, where little emphasis is placed on maintenance function and management. Adewunmi, Omirin, Famuyiwa and Farinloye (2011) opined that hostel accommodations for students in the University are poorly managed and overcrowding of these facilities contributes to poor maintenance and performance of the students. Oyenuga (2012) focused on identifying, major factors influencing deteriorating state of facilities and the lack of available maintenance policies in Lagos State University. Lateef, Khamidi, and Idrus (2011) further asserted that although maintenance funds is insufficient, poor administration of maintenance resources and services are also adding significantly to the maintenance backlog and dissatisfaction of users in higher institutions. Maintenance of public buildings has been adequately researched especially residential buildings. Several studies have been carried out on building maintenance especially on residential buildings in Nigeria (Zubairu, 2001, Cobbinah, 2010, Olagunju, 2012a., Odediran, *et al*., 2012, Vanduhe, 2012, Waziri and Vanduhe, 2013). A good number of researches have been carried out on maintenance of educational buildings outside Nigeria. Few studies have been carried out on educational buildings but mostly on hostel facilities in the southern part of Nigeria. Some of the studies centred on causes of maintenance

problems in residential buildings. However a gap in knowledge exists in categorizing the factors that contribute to maintenance problems in higher institutional buildings (academic and administrative) in Nigeria. With the growing intake of students on these building facilities, this research intends to assess the factors that contribute to the current state of the facilities. This study will help in detecting problems affecting higher institutional buildings and formulation of best practice criteria for effective management and maintenance works that will be useful both to the users and the Works Department of the higher institutions.

LITERATURE REVIEW

Building Maintenance Generators

The technology of maintenance is concerned with all the factors that influence and cause the need for maintenance work. Maintenance generators degrade the quality standard of a building as well at design and commissioning stage. The occurrence in the fabric of a building can result from many unrelated design decisions, unsuitable materials, incorrect assessment of loads, inadequate appreciation of condition of use and inadequate assessment of exposure. Factors responsible for building maintenance are listed below:

- Design factors;
- Human factor/the user;
- Environmental factors;
- Age of property/Building;
- Quality and appropriateness of material used;
- Faulty construction; and
- Faulty system (Sharma and Gahlot, 2006; Al-hammad, n.d).

Design Factors

Decision by designers in the process of designing has vital effect on the volume of maintenance work that will be required by the completed building. As such the role of the designer in building maintenance cannot be overemphasized. Inherent design problem such as complex specification, wrong design decision, incorrect assessment of loads condition upon which the building will be exposed and subjected to, will affect maintenance of the building in future. Unsuitable materials due to lack of knowledge of their characteristics and use of inadequate size of structural members will result in failure of building component. Faulty design will lead to faster deterioration of building structure. Adequate attention to maintenance needs of future at the time of design is essential to reduce maintenance problems.

Human Factor/The User

Human factor may be either socio-cultural or economic factors. Socio-cultural factors may include educational level of the developer, competency of the professionals involved in the design, construction and management of the project, and the attitude and culture of the end-users of the building. Also, the desire of building owners in the area of taste for modernity without regards to environmental implication may leads to high cost of maintenance. Human factor can be viewed from two aspects; Maintenance staff lack of maintenance culture and occupants misuse of buildings.

Deterioration occurs due to lack of appropriate maintenance culture on the part of the maintenance staff. Failure to provide the necessary capital, either due to inappropriate budgeting or inadequate allocation of financial resources hampers maintenance and thus leads to deterioration. Delay in attending to the maintenance job can also lead to more severe problem of maintenance. The deterioration may also be enhanced due to failure to carry out routine maintenance well in time, lack of knowledge about factors causing deterioration, poor planning, budgeting and allocation of inadequate monetary resources to enable maintenance activities to be undertaken, lack of awareness of maintenance needs among the users, using casual approach to repairs, failure to establish acceptable standards of maintenance and having a negative attitude of waiting until emergency measures becomes necessary.

The users of the building also contribute to its deterioration and this usually takes various forms. One of such ways is vandalism, which is the intentional damage and disfiguration of the building and its components such as doors, windows, furniture, electrical and sanitary fittings. Lack of security, lack of

awareness among users on the need to keep their surrounding tidy and failure to repair the areas damaged by vandalism are some of the causes which becomes sources of further deterioration in buildings. In some cases, the buildings are converted to different uses from the initial design purpose resulting in rapid deterioration of the building. Overuse and overcrowding of buildings can accelerate deterioration and contribute largely to the deplorable living condition in the structures. A building occupied by careful occupants will result in less maintenance than similar one occupied by careless occupants.

Environmental Factors

These refer to the effect of soil types, climatic condition (sun, rain, dust), and vegetation on the building maintenance. The severity of these environmental factors is based on the site and orientation of the building. For example, a structure built on firm, evenly slope, well drained and stable soil will require less work to maintain. On the other hand, building built on swampy soil may require more attention to maintain both the foundation and the building as an entity. Similarly, some building materials are sensitive to climatic factors like temperature, rainfall and humidity. For example, extremes in heat and cold can lead to cracks in concrete, if adequate expansion joints are not provided. While extremes sunshine and frequent rains can also makes paints on exposed external wall to fade faster in areas such as Maiduguri and Jos in Nigeria respectively. In addition, a building in an area of heavy rainfall such as Lagos and Port Harcourt in Nigeria is more likely to have maintenance problems of roof leakages or roofs blown away during heavy rainstorms. The chemical content of the atmosphere due to environmental pollution also affect the rate of deterioration of external finishes of a building. A building close to the sea for example in areas such as Lagos in Nigeria, is exposed to salty moist breezes from the sea which leads to chemical reactions on exposed wall surfaces and roof. High humidity may also affect some metabolic fittings and rust can easily occur.

Age of Building

The older the building is, the more the need for its maintenance (Sharma and Gahlot, 2006). As a building reaches its full life span, it depreciates at a fast rate and the cost of maintenance tends to be higher than in the early stages of occupation. The lives and property of the users at the apex of the building life tend to be in danger, if they are not evacuated on time or if building is not demolished for new site.

Faulty Materials

Similar to the effect of human factors on maintenance is the materials used in the construction of building. The following causes result in poor quality of construction which in turn, give rise to future maintenance problems; wrong selection of materials and specifications, use of substandard materials, inadequate inspection of materials, provision of inadequate facilities for storage at site, inconsistent mixing of materials at site, use of inappropriate materials in relation to use and use of stale/expired materials. A building owner should not think of using cheaper materials based on absolute scale. He should rather be concerned with cost-in-use of each alternative materials and this will assist him in evaluating the life cycle cost of each materials. This will in turn help him to select the best quality materials that will require less maintenance. Cheaper materials might require more frequent maintenance than high quality materials at the long run.

Faulty Construction/Poor Workmanship

The following factors will give rise to maintenance problem during the service life of the building; lack of supervision during construction period, failure to monitor the work adequately, failure to understand and follow exactly the specifications / drawings, failure to replace the defective work, lack of skilled labour and over-emphasis on need for quantity rather than quality output.

Faulty System

Inadequate knowledge on the part of the designer, unsatisfactory design details, inability of the builder to follow specifications/drawings, inadequate testing of the system before commissioning, failure to follow maintenance instructions and inability of the owner to operate the system as instructed can generate maintenance problems in building structures. According to Akinsola *et al.* (2012), other factors that attribute to poor maintenance include inadequate routine maintenance, an ineffective maintenance programme, lack of proper inspections on a planned basis, changing standards or/and tastes and Inadequate data to enable the preceding items to be properly carried out.

Maintenance Funds

The distribution of funding for maintenance works is determined by factors such as organization's policy, asset management plan, the asset in question, current condition and age profile, operational requirements and backlog maintenance (Al-hammad, n.d). Maintenance personnel experience difficulties in determining the maintenance standard of a building because of the inadequate maintenance resources allocated from top management. Organizational and maintenance objectives are not properly understood at top management level; therefore allocation of maintenance resources is insufficient to meet maintenance needs (Lateef, Khamidi, and Idrus, 2011). Funds for maintenance works are not provided as and when due hence delays are experienced in carrying out the work, further deterioration of building components and additions to maintenance backlogs. Lateef *et al*. (2010) further asserted that maintenance is budget-driven and not need-driven. Maintenance is only carried out subject to availability of funds which automatically puts off proactive maintenance until when funds are available to perform the tasks.

Building maintenance objectives has connections with core organizational objectives, and must be understood by the top management, strategic and operational level of management in order to improve the allocation of resources for maintenance needs. The personality of the maintenance manager and his dexterity come into play in giving maintenance budget its place through proper awareness to management of the importance of maintenance and its relationship with the organization's objectives; provided that the budget has bearing on the overall success of the organization.

RESEARCH METHODOLOGY

A Mixed method approach (Qualitative and Quantitative) research approach was adopted for this study for collecting and analyzing data. The population of the study comprised the maintenance staff of the Works and Maintenance department in the various higher institutions in Nigeria. Six higher institutions in Niger state were selected. The list containing the records of the maintenance staff of the Works and Maintenance Department of each of the six selected higher institutions were used as the sampling frame, while Works and Maintenance Department of each of the six selected higher institution was used as the sampling unit. Primary data was sourced for this study using self – administered Questionnaire on all the maintenance staff of the six selected higher institutions. A physical survey was also observed by the researcher to further validate the data from the respondents. The sample size of 101 was used because all the maintenance staff were easily assessable by the researcher. Thus, all the staff were chosen for the study. Six higher institutions {1 Federal (A), 1 State (B), 2 Polytechnics (C and D), and 2 Colleges of education (E and F)} were selected for the study using purposive sampling technique, from which the maintenance departments were drawn. The selected higher institutions gave a good representation of higher institutions in Nigeria, (see table 1).

The "closed ended" type of questionnaire was adopted for this study. The questionnaire was designed for the maintenance staff in the higher institutions studied. The questionnaire had two sections namely: A and B. Section A provided information on respondent's profile such as profession, years of experience and educational qualification, in order to ascertain the reliability of the information provided. Section B focused on the major factors contributing to maintenance problems in the higher institution, and best practice criteria for effective maintenance management. 31 factors were considered for this study and were identified through extensive literature review and from a physical survey by the researcher (see tables 7 and 8). The questions covered the variables necessary to measure maintenance of higher institutional buildings. The respondents were asked to rank the category of factors contributing to maintenance problems using a five – point Likert scale of 1 – 5, where; 5 = most contributory, 4 = more contributory, 3 = Neutral, 2 = slightly contributes, and 1 = Does not contribute. Descriptive and inferential statistics were used to analyze the qualitative data obtained for this study. The results of the data analysis were presented using Relative Important Index (RII). Cronbach's Alpha was the inferential statistical tool to test for the reliability of the data obtained for the study. These analyses were done with statistical packages, SPSS (Statistical Package for Social Science version 16.0) and Microsoft Excel.

Table1: Sample size of maintenance staff

Higher Institution	Maintenance staff personnel
A	27
B	14
C	20
D	5
E	14
F	21

RESULTS AND DISCUSSION

Test of Reliability of Research Instrument

A reliability analysis was conducted for the scales using Cronbach's Alpha. As summarized in Table 2, several of the scales that represent the constructs appear to have a good degree of reliability since each computed statistic is within the required scale of 0.60 – 0.75 which is acceptable (Reynaldo and Santos, 1999). This shows that the data obtained for this study was reliable and adequate to give the required findings and results.

Table 2: Reliability Analysis using Cronbach's Alpha

Construct	Cronbach's Alpha	Number of Items
Factors Contributing to Maintenance Problems	0.754	31
Best Practice Criteria	0.736	15

Response to Questionnaires Administered

Questionnaires were self administered on the maintenance staff of the studied higher institutions. 101 questionnaires were administered and 97 were retrieved giving a response rate of 96.04%. The results of section A of the questionnaire on respondents' demographic information which included professional background, years of experience and academic qualification are presented in the tables given in table 3,

Table 3: Response Rate of Questionnaire Distribution

Name of Higher Institutions	Number of Questionnaires distributed	Number of Questionnaires returned	Response Rate (%)
A	27	26	96.30
B	14	14	100.00
C	20	19	95.00
D	5	5	100.00
E	14	12	85.71
F	21	21	100.00
Total	101	97	96.04

Table 3 above showed the questionnaire distribution to the maintenance staff in the studied higher institutions of learning. It was easier to retrieve this number since the numbers of maintenance staff in each higher institution were not large and majority of the respondents were present as at the time of distribution. The response rate for this study was seen to be very adequate for the subsequent analysis, because it is well above the acceptable response rate for a mail or a face-to-face administered questionnaire which is between 50 and 85%.

Table 4: Respondent's Professional Background

Profession	Frequency	Percentage (%)
Architect	17	17.53
Electrical Engineer	20	20.62
Mechanical Engineer	13	13.40
Civil Engineer	9	9.28
Quantity Surveyor	18	18.56
Builder	10	10.31
Estate Surveyor	8	8.25
Town Planner	2	2.06
Total	97	100.00

Table 4 shows that 20.62% of the respondents are Electrical Engineers, followed by Quantity Surveyors with 18.56% response rate. Architect, Mechanical Engineers, Builders, Civil Engineers and Estate Surveyors had a response rate of 17.53%, 13.40%, 10.31%, 9.28% and 8.25% respectively. Town Planners had the least percentage of 2.06 %. This inferred that the respondents have sound academic background and have the required basic theoretical knowledge to provide the information for this study.

Table 5: Respondent's Years of Experience

Years of Experience	Frequency	Percentage (%)
1 – 5	32	32.99
6 – 10	42	43.30
11 – 15	12	12.37
16 – 20	6	6.19
Above 20	5	5.15
Total	97	100.00

Table 5 showed the respondent's years of experience. Majority of the respondents had 6 – 10 years working experience with a response rate of 43.30%. 32.99% had about 5 years working experience, while 12.37% had between 11 – 15 years working experience, while 23.71% had between 11 and above 20 years working experience. Therefore it could be inferred that majority of the respondents had satisfactory work experience to provide the required information for this study.

Table 6: Respondent's Academic Qualification

Educational Qualification	Frequency	Percentage (%)
Ordinary National (OND)	10	10.31
Higher National Diploma (HND)	43	44.33
Bachelors (Bsc / B.Tech / B.Eng)	34	35.05
Masters (Msc / M.Tech / M.Eng)	6	6.19
Others	4	4.12
Total	97	100.00

The analysis in the table 6 above revealed that close to half of the respondents (44.33%) mostly had HND as highest academic qualification while 35.05% had Bachelors (Bsc / B.Tech / B.Eng) while 6.19% had Masters (Msc / M.Tech / M.Eng).

Factors Contributing to Maintenance Problems

The factors contributing to maintenance problems were individually ranked and further categorized into seven factors to determine which of the factors contribute most to maintenance problems in the higher institutions.

Table 7: Mean Scores of Factors Contributing to Maintenance Problems

Factors Contributing to Maintenance Problems	Mean score	Rank
Inadequate funds and high maintenance cost	0.84	1
Having a negative attitude of waiting until emergency measures becomes necessary	0.84	2
User's misuse of building facilities	0.83	3
Failure to replace the defective work	0.8	4
Failure to establish acceptable maintenance standards	0.78	5
Top management not interested in maintenance	0.78	6
Poor workmanship	0.77	7
Over emphasis on need for quantity rather than quality output	0.77	8
Wrong design decision	0.76	9
Lack of planned maintenance programme	0.76	10
Inadequate routine maintenance	0.76	11
Lack of awareness on maintenance	0.75	12
Lack of maintenance culture by maintenance staff	0.75	13
Failure to follow maintenance instructions	0.75	14
Lack of maintenance manual	0.72	15
Wrong selection of materials and specification	0.72	16
Use of Substandard materials	0.73	17
Lack of supervision during construction period	0.73	18
Overcrowding of building facilities	0.71	19
Lack of knowledge about factors causing deterioration	0.69	20
Wrong type of foundation on particular soils	0.69	21

Inadequate inspection of materials	0.68	22
Age of building	0.68	23
Incorrect assessment of loads condition	0.67	24
Failure to understand and follow exactly the specifications/drawings.	0.67	25
Inadequate Knowledge of sizes of structural members	0.65	26
Extreme weather condition on materials and components	0.65	27
Inadequate testing of facilities before commissioning	0.6	28
Provision of inadequate storage facilities for materials	0.57	29
Unsatisfactory design details	0.58	30
Complex specification	0.55	31

Table 7 above showed the overall ranking of 31 factors contributing to maintenance problems in higher institutions in Niger State. Inadequate funds and high maintenance cost ranked first, followed by having a negative attitude of waiting until emergency measures becomes necessary. Next in line was user's misuse of building facilities, failure to replace the defective work, failure to establish acceptable maintenance standards, use of substandard materials, top management not interested in maintenance, and poor workmanship. Complex specification was observed to have ranked the last of factors contributing to maintenance problems. 85% of the factors contributing to maintenance problem in the table were obtained through closed ended questions, while 15% were obtained through open ended questions.

Table 8: Mean Scores of Categorized Factors Contributing to Maintenance Problem

Factors contributing to maintenance problems	Mean Score	Rank
Design Factors		
Wrong design decision	0.76	1
Incorrect assessment of loads	0.67	2
Inadequate Knowledge of sizes of structural members	0.65	3
Complex specification	0.55	4
Human/User Factors		
Having a negative attitude of waiting until emergency measures becomes necessary	0.84	1
Users misuse of building facilities	0.83	2
Failure to establish acceptable maintenance standards	0.78	3
Lack of maintenance culture by maintenance staff	0.75	4
Overcrowding of building facilities	0.71	5
Lack of knowledge about factors causing deterioration	0.69	6
Faulty Materials		
Use of Substandard materials	0.73	1
Wrong selection of materials and specification	0.72	2
Inadequate inspection of materials	0.68	3
Provision of inadequate storage facilities for materials	0.57	4
Faulty Construction		
Failure to replace the defective work	0.80	1
Poor workmanship	0.77	2
Over emphasis on need for quantity rather than quality output	0.75	3
Lack of supervision during construction period	0.73	4
Failure to understand and follow exactly the specifications/drawings.	0.67	5
Environmental Problems		
Wrong type of foundation on particular soils	0.69	1
Age of building	0.68	2
Extreme weather condition on materials and components	0.65	3
Faulty System		
Inadequate routine maintenance	0.76	1
Failure to follow maintenance instructions	0.75	2
Inadequate testing of facilities before commissioning	0.60	3
Unsatisfactory design details	0.58	4
Management Related Factors		
Inadequate funds and high maintenance cost	0.84	1
Top management not interested in maintenance	0.78	2
Lack of planned maintenance programme	0.76	3
Lack of awareness on maintenance	0.75	4
Lack of maintenance manual	0.72	5

The findings in Table 8 showed the ranks of category of factors contributing to maintenance problems in the six (6) higher institutions studied. The results are somewhat different from the findings of Akinsola *et al.* (2012) because in this study, the individual factors were further categorized into seven categories. The

study revealed that design factor problems were mostly due to wrong design decisions (0.76), followed by incorrect assessment of loads (0.67), inadequate knowledge of sizes of structural members (0.65) and Complex specification (0.55).

Table 8 also showed that having a negative attitude of waiting until emergency measures becomes necessary had the most contribution to human/user factors causing maintenance problems, with mean score of 0.84. This particular factor was observed to have caused further deterioration to building components in the higher institutions, especially on the hostel and lecture hall buildings. Next in line was user's misuse of building facilities (0.83), which was as a result of vandalism of building components such as electrical, plumbing, windows and doors. This was very evident in some of the hostel buildings. Furniture/fittings problems was more apparent in lecture halls because the users (students) misuse them. Electrical socket outlets are overloaded; also some of the electrical fittings are stolen from their respective places in the building. Failure to establish maintenance standards ranked third (0.78) due to lack of available maintenance resources to restore the affected building component to its original standard, followed by lack of maintenance culture by maintenance staff (0.75). Overcrowding of building facilities and lack of knowledge about factors causing deterioration ranked fourth and fifth, with means of 0.71and 0.69 respectively. Most of the hostel facilities are overcrowded. With the growing in-take of students in these higher institutions, more students are still admitted into these institutions and allocated accommodation bed spaces, which are very limited. The over population of students in the long run have a negative effect on the building components, which are over used for the required number of users it was intended for. Top management also lacks interest in maintenance and do not provide funds to maintain the existing buildings and provide more hostel facilities for the users. The office buildings are not left out. Office spaces are overcrowded and thereby weaken some of the building components. The maintenance staff sometimes lack knowledge about factors causing the maintenance problems. By the time the cause of these problems are realised, the components would have further deteriorated thereby leading to maintenance backlog, increased in funds, endangering the safety of the users. It was also found out that some of the maintenance staff lack the expertise to tackle the maintenance problems.

In addition, Table 8 showed faulty materials factors contribution to maintenance problems. Use of substandard materials ranked first with a mean score of 0.73, next was wrong selection of materials and specification (0.72), inadequate inspection of materials (0.68) and provision of inadequate storage facilities for materials (0.57). Substandard materials resulted in continual replacement of door handles as was investigated in IBBU. Some of the electrical fittings purchased in FUTMinna are of substandard materials, which hitherto gave rise to occurring electrical maintenance problems. Some of the materials are not also inspected before purchase is made and used on the building facilities, thereby contributing to more maintenance problems. Majority of the sampled higher institutions also lack storage facilities to store materials for future maintenance works.

Failure to replace the defective work was the leading contributing factor in faulty construction (0.80), followed by poor workmanship (0.77), over emphasis on need for quantity rather than quality output (0.75), lack of supervision during construction period (0.73), and failure to understand and follow exactly the specifications/drawings (0.67). The study revealed that maintenance staffs sometimes fail to replace defective works which further deteriorate the components and may result in building failure. The delay in rectification also contributes to maintenance backlog. Poor workmanship also results in structural failure as can be seen in COE Minna buildings which had structural problems. It could be seen that some of the construction activities that took place before post occupancy involved the use of unqualified workers which resulted in future maintenance problems on the sampled buildings.

Table 8 also showed the mean scores of faulty system factors contributing to maintenance problems. The factors were ranked in the following order of importance. Inadequate routine maintenance (0.76), failure to follow maintenance instructions (0.75), inadequate testing of facilities before commissioning (0.60) and unsatisfactory design details (0.58).

Wrong type of foundation on particular soils had the highest mean score in environmental factors contributing to maintenance problems in the studied area (0.69), the next was age of building (0.68) and extreme weather condition on materials and components (0.65). The last two factors were most evident in Bida Polytechnic and Zungeru Polytechnic, due to the fact that the structures are very old for over 25 years. Some of the structural components are still in good condition but the facade of the building lack maintenance which was clear on the walls, floors and roof components.

Inadequate funds and high maintenance cost and top management not interested in maintenance were observed as the leading contributing management related factors in these higher institutions. These

particular factors have the most adverse effect on maintenance practices in higher institutions in Nigeria. It could be seen that lack of funds delayed maintenance activities which further deteriorate building components. These components eventually become weaken and fail. Maintenance backlog continue to become inevitable to overcome as funds released will have to be used to solve old problems before new ones are solved. Top management are also not interested in maintenance and lack proper knowledge on the long run negative effects of lack of maintenance. They are also not willing to release large chunks of resources on executing maintenance and will instead divert the funds to other uses within the institution.

The results of these aforementioned factors affected the performance of the users (students and staffs) negatively who are directly involved with the buildings. Lack of awareness on maintenance and lack of maintenance manual were observed as the two least contributing factors. All the higher institutions studied lack a maintenance manual which should guide the maintenance staff in executing their jobs and also the users in utilizing the building facilities appropriately. These factors are also very important to be given considerations. Users also lack maintenance culture and are not aware of the implications of misuse of the facilities of the higher institution as a whole and the users themselves. Inadequate funding and high maintenance cost was ranked the most contributory factor. This finding agrees with the findings of Lateef, Khamidi and Idrus (2010) that lack of funds have been identified as one of the major maintenance problems facing higher institutions. Top management takes time to approve resources to execute maintenance works, and within that period of time, building components deteriorate further thereby threatening the safety of the users and give a poor image to the institution as a whole.

Table 9: Mean Scores of Overall Category of Factors Contributing to Maintenance Problems

Overall Category of factors contributing to maintenance problems	Mean Scores	Overall Rank
Human/User Factors	0.79	1
Management Related Factors	0.77	2
Faulty Construction	0.75	3
Faulty Materials	0.69	4
Environmental Problems	0.68	5
Faulty System	0.67	6
Design Factors	0.66	7

Table 9 showed the overall category of factors contributing to maintenance problems which answered the first objective of this research. It could be seen that the three main factors contributing to maintenance problems are human/user factors (0.79), management related factors (0.77 and faulty construction (0.75). Design factors ranked the least with a mean score of 0.66. The first three factors therefore calls for immediate attention in order to improve on the maintenance practices of the higher institution and provide a sound and conducive environment for learning, research and other management activities within the higher institutions. Lee and Scott (2009) and Lateef, Khamidi, and Idrus (2011) gives credence to the findings of management related factors in this study. Maintenance personnel at the operational level find it difficult to obtain adequate resources for maintenance needs which always exceed the allocated budget. Top management argue that funds allocated for maintenance works should be diverted to other management needs. Top management need to be enlightened and be more involved in the issue of maintenance management within the higher institution so as to create a better working and living environment for improved performance.

Respondents Perception of Best Practice Criteria for Maintenance Management

Table 10 showed the ranks of 15 best practice criteria for effective maintenance management in higher institutions in Niger State. Maintenance inspection should be carried out regularly was ranked as best practice criteria followed by qualified maintenance personnel and maintenance budget should be put in place with mean scores of 3.55, 3.52 and 3.48 respectively. The least considered best practice criteria was computerized maintenance management system (CMMS) should be put in place with a mean score of 2.82. This agrees with the findings of Lateef, Khamidi, and Idrus (2010) and Buys and Nkado (2006) that several higher institutions maintenance departments lack a computerized work system. This may not be surprising giving the phobia many people still have for computers. Almost all the maintenance departments lack qualified computer personnel to operate an effective CMMS. The maintenance directors are not aware of the benefits associated with a CMMS. This particular best practice is a very important factor to be considered by the institution management. As technology is advancing, maintenance staff

and even the users of the building facilities will need to familiarize themselves with latest maintenance technologies which are mostly computerized and install them on their building maintenance activities.

Table 10: Mean Scores of Best Practice Criteria for Maintenance Management

Best Practice Criteria for Maintenance Management	Mean Score	Rank
Maintenance inspection should be carried out regularly	3.55	1
Qualified maintenance personnel.	3.52	2
Maintenance budget should be put in place	3.48	3
Quick response from maintenance staff	3.44	4
Training and research in maintenance	3.32	5
Awareness of maintenance to users	3.31	6
Top management to be enlightened and involved in maintenance.	3.22	7
Maintenance policy should be put in place	3.20	8
Setting acceptable maintenance standards	3.19	9
Availability of maintenance manual	3.17	10
Feedback mechanism from users to staff	3.14	11
Inventory and recording (Maintenance data bank)	3.13	12
Yearly building condition survey	2.92	13
Prioritize maintenance – emergency, urgent, routine.	2.89	14
Computerized maintenance management system (CMMS) should be put in place	2.82	15

CONCLUSIONS

The study categorized 31 individual causes of maintenance problems into 7 categories of factors contributing to maintenance problems in the higher institutions of learning. It was founded out that human/user factor and management related factors were found to be the most contributory factors. 15 best practice criteria for effective maintenance management were also ranked, with maintenance inspection as the leading best practice in the higher institutions studied. Computerized maintenance management system (CMMS) was ranked the least criterion. This was due to lack of computers in the Maintenance Departments of all the studied higher institutions and lack of expertise in the skill of computer operations.

The following recommendations were made:

a. Auditing of buildings and quality assurance on new buildings from inception to completion stage should be carried out, so as to ascertain their physical and structural stability.
b. Building inspection should be carried out quarterly to identify components that are about to fail so they can be rectified early. Users do not have to report defect before maintenance staff check and rectify it promptly.
c. A computerized maintenance management system (CMMS) should be put in place for effective maintenance management and keeping data bank maintenance records. This is to aid work schedules and prompt attention to all scheduled maintenance works
d. Maintenance staff should be trained and re-trained on advanced maintenance technologies as implemented in other developed countries, so as to improve their expertise.
e. The higher institution management can enter into partnership with private developers to provide more hostel accommodation for the users on and off – campus, so as to eradicate or reduce the problem of overcrowding accommodation spaces.
f. The maintenance department can carry out out-sourcing services to other higher institutions / organizations to generate funds for maintenance works which will reduce delay and further deterioration of components in situations where funds are not released on time.

References

Adewunmi, Y., Omirin, M., Famuyiwa, F., and Farinloye, O. (2011). Post-Occupancy Evaluation of Post Graduate Hostel Facilities. *Facilities*. 29(3). 149 – 168.

Ahmad, A. (2000). *Management System in Maintenance of Infrastructure*. Kaduna, Nigeria: Fahimta Publishing Company.

Al-hammad, A.M. (n.d). Principles of Maintenance. College of Environmental design. Retrieved from http://faculty.kfupm.edu.sa/ARE/amhammad/ARE-457-course-web/Prince_Maint.pdf on 12th Nov 2012.

Akinsola, O.E., Hussaini, P.O., Oyenuga, S.O., and Fatokun, A.O. (2012). Critical Factors Influencing Facility Maintenance Management of Tertiary Institutional Buildings in South West Nigeria. *Mediterranean Journal of Social Sciences*. 3(11). 489 – 496.

British Standard Institution, BS 3811 (1984). *Glossary of Maintenance Management Terms in Terotechnology.* London: British Standard Institute.

Buys, F., and Nkado, R. (2006). A Survey of Approaches to Maintenance Management in Tertiary Institutions in South Africa. *Construction Management and Economics*. 24(10), 997 – 1005.

Cobbinah, P.J. (2010). Maintenance of Buildings of Public Institutions in Ghana. Case Study of Selected Institutions in the Ashanti Region of Ghana. Unpublished Msc Thesis. Department of Planning, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Ikpo, I. J. (2006). *Building Maintenance Management.* Calabar, Nigeria: Manson Publishing Company.

Lateef, O A, Khamidi, M. F. and Idrus, A. (2010). Building Maintenance Management in a Malaysian University Campuses: A Case Study*, Australasian Journal of Construction Economics and Building,* 10 (1/2), 76-89.

Lateef, O A, Khamidi, M. F. and Idrus, A. (2011). Appraisal of the Building Maintenance Management Practices of Malaysian Universities. *Journal of Building Appraisal.* 6(3), 261-275.

Lee, H.H. and Scott, D. (2009). Overview of Maintenance Strategy, Acceptable Maintenance Standard and Resources from a Building Maintenance Operation Perspective. *Journal of Building Appraisal,* 4(4), 269 – 278.

Odediran, S.J., Opatunji, O.Y. and Eghnure, F. O. (2012). Maintenance of Residential Buildings: Users' Practices in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences* 3(3):261-265

Olagunju, R.E. (2012a). Predictive Modelling for Sustainable Residential Building Maintenance in Developing Countries: A Nigerian Case. *Interdisciplinary Journal of Contemporary Research in Business.* 4(6). 1237 – 1283.

Olagunju, R.E. (2012b). Sustainability of Residential Buildings in Nigeria: An Appraisal of the Factors that Influence Maintenance of Residential Buildings' Standard. *Civil and Environmental Research.* 2(4). 20 – 29.

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(11), 23 – 35.

Reynaldo, J. And Santos, A. (1999). Cronbach's Alpha: A Tool for Assessing the Reliability of Scales. *Journal of Extension.* 37(2), 85 – 98.

Seeley, I. H. (1984). *Building Maintenance*, 2nd Edition, London: Macmillan Publishers Ltd.

Sharma, S., and Gahlot, P.S. (2006). *Building Repair and Maintenance Management.* New Delhi: CBS publishers.

Vanduhe, B.A. (2012). "An Investigation of Factors affecting Residential Building Maintenance". Unpublished B.Eng. Project submitted to the Department of Civil and Water Resources Engineering University of Maiduguri, Nigeria.

Waziri, B.S., and Vanduhe, B.A. (2013). Evaluation of Factors Affecting Residential Building Maintenance in Nigeria: Users' Perspective. *Journal of Civil and Environmental Research*. 3 (8), 19 – 24.

Zubairu, S.N. (2001). The most Frequently Recurring Maintenance Problems in Government Office Buildings in Nigeria. *Nigeria Institute of Architecture Journal.* 11(136): 8-12.