



CONSTRUCTION RESEARCH JOURNAL

Promoting growth and development of the Construction Industry through Research

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THE MAIDEN ISSUE OF THE JOURNAL

The maiden issue of the Journal contains eight research papers. The papers cover five main areas of construction namely: procurement, housing, management, health and safety and maintenance. The titles of the papers in each of the five areas are listed as follows:

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The Editorial Board hopes that these papers will contribute towards the improvement of the construction industry in general.

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APPRAISAL OF MAINTENANCE MANAGEMENT STRATEGIES USED IN PUBLIC HOSPITAL BUILDINGS IN LAGOS STATE, NIGERIA.

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ABSTRACT

This study focuses on the evaluation of maintenance management strategies used in public hospital buildings in Lagos state. It also assesses the labour composition of maintenance operations. In achieving these objectives, opinions of maintenance officers of ten (10) hospitals in different local government areas of the state were sampled through well-structured questionnaires. The data collected were analyzed using descriptive and inferential statistics. From the analysis, the study reveals that majority of public hospitals do not have specific budget for maintenance programmes, maintenance policies, maintenance log book and maintenance manual to guide the operatives. About 98% of the sample does not understand the type of maintenance strategy being used for their maintenance operations. 78% of the maintenance work are only executed when there is a breakdown or in response to users' request. For labour composition, the cleaning of interior and exterior of the building, inspection of building elements, repairs and replacements of building elements are mainly carried out by in-house staff, while the repair and replacement of equipment is by outsourcing. The study also reveals that executing maintenance programmes using outsourcing gives latest innovations in technologies to work done and better access to special skills than in-source. In-source method, gives reduction in cost of operation, higher security, more flexibility in staffing, better adjustment to workload fluctuation and reduction in equipment downtime than out-source. Both methods claim to produce special expertise in labour, better control of services and higher quality of work. The study recommends proactive measures such as providing necessary training and support for maintenance staff and users of

these facilities and the provision of sufficient funds for maintenance programmes.

KEYWORDS: Maintenance management, Maintenance strategy, Hospital building and Public hospital.

BACKGROUND TO THE STUDY

It is highly desirable but hardly feasible to produce buildings that are maintenance-free, although much can be done at the design stage to reduce the volume of subsequent maintenance work. All elements of buildings deteriorate at a rate that is dependent on materials and methods of construction, environmental conditions and the use of the building. Building maintenance has often been neglected in the industry especially in the public sector. This is due to the fact that there is a preference for new buildings compared to the maintenance of existing ones. However, lack of adequate maintenance of buildings makes the environment decay and depress the quality of life. The condition of buildings also reflects public pride and affects the value of the buildings as well as adjoining buildings. Currently and for the future, the public needs to be re-educated that management and maintenance of existing properties is part of the overall process of building development. This means that planning, designing, construction and management is a cycle. Also, the availability of funds for capital developments calls for a need to have a better maintenance culture. Maintenance according to Smith (2003) means to keep in its existing state, preserve, continue in good operating condition; and protect. The RICS/ISVA working committee defined maintenance as "work undertaken in order to keep, restore or improve every facility, to an acceptable standard and to sustain utility and

value of the facility". It includes the built space, services, technology, maintenance, modification and adaptation, function and use, security, comfort, environmental health, costs and benefits of occupancy. Maintenance decisions are mostly ad-hoc in nature, which is a series of compromises between immediate physical needs of the building and availability of fund. This creates accumulated management expenditure due to arrears of maintenance works and complete failure of some elements in a building because of improper timing, planning and scheduling of work execution. This is very uneconomical to maintenance management and calls for an effective maintenance control with sound plans, recording of performance, comparison of performance with plan and taking corrective actions where appropriate. To successfully control maintenance, proper management policies and practices must be instituted. Furthermore, many organizations have tried to use standard production or facilities-oriented methods to control maintenance. This has and will not be successful. Public properties are very essential in the society in that they give value and meaning to all other types of properties. The misuse of these properties should be a concern to all stakeholders. This research examines the management and maintenance of public health buildings. Excellent examples are the various general hospitals established in different parts of the country.

STATEMENT OF RESEARCH PROBLEM

Building maintenance had until recently been a neglected field and regarded as unimportant. It possesses little glamour, is unlikely to attract much attention and is frequently regarded as unproductive, although many of the managerial and technical problems are more demanding in terms of ingenuity and skill than those of new works. Hospital management frequently attempts to keep maintenance expenditure to a minimum, ignoring or misunderstanding the adverse long-term

effects of such a policy. More than one-third of the total output of the construction industry is devoted to this activity although this is inadequate to keep the nation's buildings in a satisfactory condition. Public buildings are viewed as government property. As a result, nobody accepts the responsibility of maintaining them once they are commissioned and put to use. Public hospitals are often neglected and left to deteriorate. These hospitals were put in place to provide succour but unfortunately they can hardly achieve this due to lack of maintenance culture, deterioration and inadequate fund even when there are maintenance policies in place. Most of these facilities are fast becoming obsolete; therefore there is a need to upgrade them. It is recognised that maintenance of public hospitals is very important. This study aims at evaluating the adequacy of maintenance strategies and policies of public hospital buildings in Nigeria.

OBJECTIVES OF THE STUDY

1. To examine the maintenance management system adopted in the study area.
2. To determine whether there is variation in the efficiency of maintenance work performed in-house or by outsourcing in public hospital buildings.
3. To determine the adequacy of funds provided for maintenance management in public hospital buildings.

OVERVIEW

Building maintenance is a complex and multifaceted activity which until recently has attracted very little attention. However, over the past decade, there has been a growing awareness of the economic and social importance of maintenance. Awareness on the benefits to be derived from the application of modern management or more effective use of scarce resources and higher standard of building accommodation is also high. The essence of building maintenance cannot be over-emphasised because the state of building

is not only for comfort but also for economic survival.

The British Institute of Facilities Management (BIFM) (2001) cited in Iyagba (2005) defines the term facilities management as 'the integration of multi-disciplinary activities within the built environment and the management of their impact upon people and the work place'. Barrett (1996) defines facilities management as 'an integrated approach to maintaining, improving and adapting the buildings of an organization in order to create an environment that strongly supports the primary objectives of that organization'.

Building maintenance commences the day a building is commissioned. Design materials, workmanship, functions, use and their inter-relationship will determine the volume of maintenance that will be required during the life time of a building. The building fabric also has to satisfy different user needs. The designer should identify what performance is required from the fabrics in terms of weather tightness, noise reduction, durability, and resistance to heat loss and other relevant criteria in addition to comfort and visual requirements. Much can be done at the design stage to reduce maintenance costs. Not many architects or contractors re-visit their buildings after the expiration of the defects liability period and few have a continuing responsibility for maintenance. There is rarely an obvious end product in building maintenance. Also, the effect of neglected public buildings, for example, will seldom be considered serious by the users as opposed to the obstruction caused by a lapse in operation following the neglect of equipment maintenance.

MAINTENANCE MANAGEMENT

Maintenance management is the selection of goals, planning, procurement, organization, co-ordination and the control of the necessary resources for their achievement (Adebayo, 1990). Management is concerned with the dynamics of circumstances and activities and

it is generally motivated by the need to economise in the use of resources and time in achieving predetermined objectives. In maintenance management, it is necessary for the property manager to identify the defects in a building that necessitate maintenance action through inspection of the building. This should be with a crew of professionals e.g. builders, architects, quantity surveyors, estate surveyors and engineers in large establishments. Once maintenance works is planned, it is the sole responsibility of the property manager to look at the scope of maintenance and the resources necessary for such maintenance work to be carried out. The resources include materials, labour and plants. For efficient and effective maintenance work, there should be a maintenance policy which should be planned and preventive maintenance, maintenance programme and adequate budget, prudent financial control, as built drawings and a maintenance checklist to enable a fair inspection of building elements to be carried out. The goal of maintenance management is to achieve economy in money, material and time resources, planned and co-ordinated maintenance programme, users' satisfaction and efficiency of the facilities.

STRATEGIES FOR EXECUTING MAINTENANCE

Maintenance has become a principal phase in the life cycle of built assets. The nature of hospital buildings requires that maintenance considerations be taken into account at the early stages of design. Maintenance management issues play a major role in the performance of existing facilities. The structures of maintenance organizations are examined together with programming and operational activities. Outsourcing of one or more maintenance services may lead to various difficulties, such as employee related issues, loss of skills, lack of internal expertise to manage contracts, potential loss of control, etc. On the other hand, outsourcing may result in cost savings, improved quality, and transfer of knowledge from outside specialists to in-

house personnel etc (Harris *et al.*, 1998; Atkins and Brooks, 2000; Valence, 2000). In a study of 34 American defence buildings including hospital buildings, Neely and Neathammer (1991) discovered that the major proportion of the maintenance budget of hospitals was spent on interior finishing and interior construction (52%), and on heating, ventilation and air-conditioning (HVAC) (29%). The rest of the budget (39%) was spent on electricity (13%), exterior envelope (13%), water and plumbing (10%), and other electricity systems, such as communications and low-voltage systems (3%).

Implementation Strategies

Planning the transition for the implementation of best maintenance practices is essential. Timelines, personnel assignments, documentation and all the other elements of a well planned change must be developed before changes can actually begin to take place (Smith, 2003). The following list of proactive maintenance organization attributes are significant parts of a new approach which need to be addressed in any transition plan.

(i) Maintenance skills training Determine what the training is meant to accomplish. Performing a job task analysis (JTA) will help define the skill levels required of maintenance employees. The job task analysis should be followed with an assessment of employees' knowledge and skill levels. Thereafter, the gap between required and available skills is analysed to determine the amount and level of training necessary to close the gap.

(ii) Work order system The work order is the primary tool for managing labour resources and measuring departmental effectiveness. A computerised maintenance management system will help in defining changes to, or complete restructuring of existing work order system. The work order will be the backbone of the new, proactive maintenance organization's work execution information system, and feedback from computerised maintenance management system.

(iii) Planned, preventive maintenance tasks and procedures It involves development of maintenance task documentation which include a standardised list of required parts, material and consumables. It should identify the craft and skill levels required to perform a task and the frequency of performance.

(iv) Maintenance engineering development If the organization does not have a maintenance engineering section, one should be established. Its responsibilities should include evaluating preventive maintenance action effectiveness, developing predictive maintenance techniques/procedures, performing condition monitoring, planning/scheduling, conducting investigations of failures including root cause analysis, and performing continuous evaluation of training effectiveness.

(v) Establishment, assignment and training of maintenance planner/scheduler The function of the planner/scheduler is pivotal to proactive maintenance. He must be familiar with the maintenance process, he must also be a good administrator and have the appropriate level of authority to carry out his role of labour usage scheduling and interfacing between many departments within an organization. His responsibilities include providing detailed job plan instructions, determining part requirements for planned job, providing necessary drawings for jobs, ensuring drawings are revised and current, arranging for special tools and equipment, co-ordinating equipment downtime with production/operations. Inform production/operations of job progress etc.

• **Maintenance inventory and purchasing integration/revamping:** The cost of (parts) inventory is almost always an area where cost reduction can be substantial. With the help of suppliers and equipment vendors, purchasing can usually place contracts or Basic Order Agreements (BOA) that guarantee delivery lead time for

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designated inventory items. Begin by identifying facility's parts, material and consumable requirements. All the inventory requirements data should be entered into the computerized maintenance management system.

Computerized maintenance management system: An effective CMMS is critical to an organized, efficient transition to a proactive maintenance approach. It is a phenomenon that can impede or prevent one from ever achieving the standards of Best Maintenance Practices.

It is also good to determine that the output data is adequate to meet each user's individual requirements.

Management reporting/performance measurement & tracking: The CMMS output should provide maintenance engineering, production/operations, purchasing, accounting and upper management with accurate, effective and useful tools for evaluation and management.

Return on investment (ROI) analysis: Justification of everything in business today is based on cost. In the planning and implementation of the changes, upgrades, etc., there is need to separate the development costs from the routine and normal operating costs of the facility to determine the total cost of implementing Best Maintenance Practices. The key performance indicators are the productivity/operating cost, maintenance labour costs, maintenance material costs, inventory carrying costs, and reliability/availability data.

Evaluate and integrate use of contractors: A final item to consider when incorporating Best Maintenance

Practices is integrating the use of Contractors into facility maintenance and maintenance costs for in-house performance and compare them to the costs of contracting out selected efforts. This is likely to be a function of total facility size and operating costs. Some of the maintenance or maintenance engineering efforts that may be considered as potential candidates for contractor performance include; Maintenance (performance of), Capital Improvement and/or Expansion Programmes, Condition Monitoring (e.g., Facility Performance Tests) etc. Any maintenance activities that do become a contractor function must still have relevant information/data collected and entered into the CMM.

Contractors or Own Staff

The choice between employing tradesmen directly or employing contractors to execute maintenance work is made according to which offers the greatest advantage in terms of cost, quality and convenience. Direct labour is more economic than contract work by at least the profit margin. Competition has emerged for the normal method of resourcing using established in-house maintenance operation. The wider use of contractors and the development of 'partnerships' which include both the provision of contractors and the total management of the maintenance support are methods open to the maintenance manager. Building maintenance is not a single industry and is executed by contractors working for profit and by commercial enterprises and public authorities as an adjunct to other functions. Contractors have constituted the more flexible part in that they are subject to direct economic pressures and can respond fairly to the changes in the pattern of demand. Direct labour organizations are rather more rigid in structure and the previous absence of a profit motive required the substitution of other forms of motivation and objective. In all cases,

services should be effective and the total economical. When deciding how to obtain right people, either by direct employment using contract staff or both may be influenced by the form of construction, use of building, or maintenance policy. There are general recommendations that will provide correct proportions of direct and contract for all maintenance departments. In making a decision the maintenance manager should compare the costs and services provided by contractors with his own directly employed labour force, taking into account the availability of labour and the type of location of buildings to be maintained. Generally, maintenance workloads tend to fluctuate, particularly with redecorations where external work is seasonal. Some have argued that it would be better to confine direct labour to little more than emergency and scheduled maintenance, and to use contractors for the seasonal, major specialist work. Many independent direct labour organizations would not accept this approach, though contractors generally need long-term contracts to give the employer good service on advantageous terms. They are affected by Local Government Planning and Land Act, which was designed to provide greater flexibility, better accountability and firmer financial discipline to local government. Under part iii of the Act, provisions were introduced so that where local authorities continued to operate direct labour organizations they must compete for work with private contractors, keep their accounts on a trading basis and earn a specified rate of return, to ensure that they would be cost-effective in operation.

The issues raised above are problems because they affect the successful implementation of maintenance culture. Also they have the tendency of further impoverishing direct labour organizations, becoming an impediment to industrial growth, eroding confidence of the average Nigerian in practicing this culture and in the ability of the Nigerian government to strengthen the nation's economy.

In general, the two alternative ways to provide maintenance services are (1) full outsourcing where contractors are hired to provide all maintenance services; and (2) the use of in-house maintenance staff. Selective outsourcing refers to the use of contractors to perform some of the services, and at the same time, employing in-house maintenance staff to provide other selected maintenance services. The choice between employing tradesmen directly to execute maintenance work or engaging an independent contractor for that purpose should be decided according to which offers the greater advantage in terms of cost, quality, and convenience. The advantages and disadvantages of directly employed labour are discussed at length by King *et al.* (1984), Holland (1987), Lee (1987), and Chanter and Swallow (1996). These advantages and disadvantages should be weighed in relation to factors such as nature of work, volume of work, response time, location, quality, security, availability of space, market condition, cash flow, and total costs (Lee 1987).

PROBLEMS ASSOCIATED WITH INEFFECTIVE MAINTENANCE ACTIVITIES IN ORGANISATIONS

According to Adenuga (2000), various problems of varying magnitudes and origins are encountered in the process of maintenance. Some of these problems are:

Design Problem

Some fundamental maintenance problems originated from the design of the building. These types of problems are usually hard to solve as they may involve a complete reconstruction of the entire building or large sections of it. It may be avoided or at least, drastically reduced by involving the required professional experts, including highly competent and experienced maintenance managers at the design stage.

Problem of Skill

Some maintenance managers and their crew

men and technicians lack the desired experience, technical know-how, etc) for the job.

Research and Development Problems

lack of adequate funds and interest in research. In fact, research and development directed towards building maintenance is minimal in the country.

Adequate Finance and Financial Management

there is no thought of the fund that will be available for maintenance when the building is designed. No funds are set aside for the replacement of the assets. Esenwa stated that indiscipline and ignorance on the part of users of facilities often lead to equipment facility breakdown. In such situations, maintenance becomes problematic. A manual can be provided to assist. A management which de-emphasized training, continuing and continuing education (CPD) can not possess any effective maintenance programme.

lack of efficient inventory system leads to equipment shortage of materials and spare parts. Lack of data and poor information processing capability is a handicap to effective maintenance.

Attitudinal Problem

Attitude of the public towards public buildings, to say the least is negative and generally retrogressive. There is no discernible maintenance culture in the country.

Problems emanating from Political Interference

Use of obsolete equipment and project delays are imposed owing to the interference of undue political influence on technical decisions. There should have been purely technical decisions. Little or no attention is given to our advancement of technology and our cultural environment. No long term

arrangements are made for the supply of essential spare/service parts for the continued maintenance of the buildings.

RESEARCH METHODS

The nature of the problem to be solved in this study requires that primary data be collected on maintenance projects and management staff of public hospital buildings. For this reason, structured questionnaires are used to collect data on a number of variables influencing the efficiency and performance of maintenance management practices in public hospitals. The focus of this research is the appraisal of maintenance management practices in public hospital buildings. The population of this study is maintenance staff of selected hospital buildings. This research covers public hospital buildings in Lagos State, Nigeria. From the comprehensive list of public hospitals, ten (10) public hospitals were selected using stratified random sampling method. Questionnaires designed for this study were directed to the maintenance staff of these selected public hospital buildings. Eight (8) questionnaires were sent out to each of the ten selected public hospitals. Thus a total of eighty (80) questionnaires were sent out to the ten selected public hospitals from which fifty (50) completed questionnaires were returned and used for the analysis. The data collected by questionnaires were complemented with personal interviews. Secondary data were also obtained from theories and research findings. Data collected were analyzed using descriptive and inferential statistics as applicable.

DATA ANALYSIS AND DISCUSSION

The analysis of the data collected are presented and discussed as follows:

Maintenance Experience of Respondents

The on-the job experience of maintenance managers who are the respondents of this study is analysed and presented in Table 1

of craftsmen and technicians lack the desired skills (experience, technical know-how, etc) required for the job.

Research and Development Problems

There is lack of adequate funds and interest in this direction. In fact, research and development directed towards building maintenance is minimal in the country.

Inadequate Finance and Financial Budgeting

Usually there is no thought of the fund that will be available for maintenance when the building is being designed. No funds are set aside for the eventual replacement of the assets. Esenwa (2000) stated that indiscipline and ignorance on the part of users of facilities often lead to persistent facility breakdown. In such situations, maintenance becomes problematic. (Users' manual can be provided to assist). Establishment which de-emphasized training, retraining and continuing education (CPD) can hardly possess any effective maintenance programme.

Absence of efficient inventory system leads to frequent shortage of materials and spare parts. Lack of data and poor information processing is a handicap to effective maintenance.

Attitudinal Problem

The attitude of the public towards public buildings, to say the least is negative and generally retrogressive. There is no discernible maintenance culture in the country.

Problems emanating from Political Decisions

Certain obsolete equipment and project designs are imposed owing to the preponderance of undue political influence on what should have been purely technical decisions. Little or no attention is given to our level of technology and our cultural background and environment. No long term

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Descriptive results of job experience (years)
of managers

Years	Frequency	Percentage
Less than 10 years	2	4.0
10-19 years	35	70.0
20-29 years	7	14.0
30 years and above	6	12.0
Total	50	100.0

Table 3 shows that majority (70%) of the respondents had worked for less than 10 years. 14% of the respondents had 10-19 years of job experience respectively.

Descriptive results of length of selected maintenance departments

Employees	Frequency	Percentage
Less than 10	19	41.3
11-30	22	47.8
31-40	5	10.9
41 and above	4	8.0
Total	46	100.0

Table 3 shows that 47.8% of the respondents had 11-30 workers, 41.3% employed less than 10 workers, and the remaining (10.9%) employed 31-40 workers. The results show that the maintenance departments selected for the study are adequately

Descriptive results of respondents that possess written maintenance policy

Maintenance policy	Frequency	Percentage
No response	1	2.0
Yes	10	20.0
No	39	78.0
Total	50	100.0

Table 3 indicates that majority (70%) of the respondents did not indicate whether or not they have a written maintenance policy. Only 2% had a policy while only 2% had a policy. The results indicate that maintenance departments of public hospitals neither possess nor operate a policy in carrying out their

Table 4 Descriptive results of types of maintenance policy operated

Maintenance policy	Frequency	Percentage
No response	49	98.0
Emergency	---	---
Unplanned	---	---
Planned	1	2.0
Total	50	100.0

Table 4 shows that majority (98%) of the respondents did not indicate that they operate any of the three selected policies. Only one (2%) respondent operated a policy which is planned maintenance policy. The results indicate that maintenance departments of public hospitals do not operate any policy in carrying out their services.

Table 5 Percentage of respondents that possess and use maintenance log book

Possession of log book	Frequency	Percentage
No response	42	84.0
Yes	1	2.0
No	7	14.0
Total	50	100.0

Table 5 shows that majority (84%) of the respondents indicate whether they use maintenance log book or not. 14% do not have a log book while only one (2%) respondent has and uses a log book. The results indicate that the use of maintenance log book is not a popular practice among maintenance departments of public hospitals.

Table 6 Percentage of respondents that operate maintenance manuals

Maintenance manual	Frequency	Percentage
No response	42	84.0
Yes	8	16.0
No	---	---
Total	50	100.0

Table 6 shows that only 16% of the respondents prepared maintenance manuals for the properties they maintain. The result indicates that the preparation of maintenance manuals is also not popular among maintenance departments of public hospitals.

Table 7 Maintenance strategy adopted by selected maintenance departments of public hospitals

Maintenance strategy	Frequency	Percentage
No response	12	24.0
Corrective maintenance	---	---
Preventive maintenance	---	---
Condition-based maintenance	---	---
The combination of the above	38	76.0
Total	50	100.0

Table 7 shows that majority of the respondents (76%) use a combination of corrective, preventive and condition-based maintenance strategies. The result indicates that maintenance departments of public hospitals do not rely on only one strategy but prefer adopting all the three strategies,

Table 8 Maintenance timing adopted by selected maintenance departments of public hospitals

Maintenance timing	Frequency	Percentage
At the end of its useful life time recommended by the maker	10	20.0
When it has failed to a point at which it cannot perform its required function	1	2.0
A response to breakdowns or user requests	39	78.0
A significant deterioration in a unit	---	---
In accordance with a predetermined plan at regular intervals	---	---
When there is a condition survey report from regular inspection from those elements	---	---
Total	50	100.0

Table 8 shows that majority (78%) of the respondents replaced building components only after it had broken down. 20% of the respondents replaced building components at the end of its useful life and the remaining 2% carried out replacement or maintenance only when components could not perform their required functions. These results imply that maintenance departments of public hospitals practice corrective maintenance.

Table 9 Sources of service for selected maintenance types/components

Maintenance type	In-house staff (%)	Selective outsourcing (%)	Full outsourcing (%)
Cleaning interior	100.0	---	---
Cleaning exterior	96.0	4.0	---
Inspection of building systems	100.0	---	---
Inspection of equipment	80.0	20.0	---
Repair and replacement of building systems	54.0	6.0	---
Repair and replacement of equipment	14.0	86.0	---

Table 9, shows that in-house personnel is the only method used for inspecting building systems and for interior cleaning of components/elements by all (100%) of the respondents. In-house staff are equally used for exterior cleaning by majority (96%) of the respondents. In-house staff are equally used for inspection of equipment and for repairing and replacing building systems by majority (86% and 54% respectively) of the respondents. However, selective outsourcing is used for repairing/replacing of equipment by majority (86%) of the respondents. These results tend to indicate that maintenance departments of public hospitals rely on outsourcing for maintenance of equipment only but rely on in-house staff for other maintenance works.

Assessment of Efficiency of Sources of Service

The study attempted at determining the efficiency of in-source and out-sourcing of maintenance service. To achieve this, twelve efficiency parameters listed in Table 10 were selected. The efficiency of the two sources of maintenance service was assessed by requesting the respondents to rank maintenance works carried out by in-sourcing and out-sourcing using five ranks namely: not important, rarely important, averagely important, very important and highly important. The assessments (ranks) of the respondents on the sources of service are analysed to determine the ranking of the parameters in the two sources of service. The results are presented in Table 10.

Table 10 Ranking of sources of service based on efficiency of maintenance operation

Agency of Maintenance Operations	Out-sourcing		In-sourcing	
	Mean	Rank	Mean	Rank
Quality of work	3.98	1	3.50	4
Access to special skills	3.92	2	1.52	11
Latest technologies	3.70	3	1.34	12
Control of service	3.38	4	3.40	5
Special expertise	3.32	5	2.76	9
Reduced equipment expenditures	3.30	6	2.54	10
Removal of penalties for delay	2.98	7	2.84	8
Flexibility in staffing	2.72	8	3.12	7
Minimum equipment downtime	2.34	9	3.60	2
Adjustment to workload fluctuation	2.34	9	3.38	6
Security	2.26	11	4.48	1
Reduced Cost	2.08	12	3.52	3

Results in Table 10 show that while quality of work ranks first in the variables of efficiency of maintenance operation done by out-sourcing, it ranks fourth in in-sourcing. While access to special skills and latest technology rank second and third respectively in out-sourcing, they rank eleventh and twelfth respectively in in-sourcing. Control of service, special expertise, reduced equipment expenditure and removal of penalties for delay rank fourth, fifth, sixth and seventh respectively in out-sourcing but these parameters rank fifth, ninth, tenth and eighth respectively in in-sourcing. Flexibility in staffing and workload fluctuation rank eighth and ninth respectively in out-sourcing but rank tenth and sixth in in-sourcing. While high security, minimum equipment downtime and reduced cost rank first, second and third (highest) in in-sourcing, they rank eleventh, eighth and twelfth (lowest) respectively in out-sourcing. These results indicate that the respondents' scoring of the importance of the efficiency parameters differs in two sources of service.

DISCUSSION OF FINDINGS

The study revealed that majority of public hospitals selected for this study do not have a maintenance policy, maintenance manual or a book to guide the maintenance work being carried out. Most of the problems faced in executing building maintenance operations are inadequacy of funds, lack of specific budget for maintenance, insufficient skilled employees and shortage of materials to carry

out effective maintenance and repair of the facilities. Therefore, maintenance needs have to be prioritized. Service maintenance, corrective maintenance, and deferred maintenance are mostly done by selective outsourcing. In-house personnel are mostly engaged in routine maintenance and preventive maintenance. The staff used for interior and exterior cleaning are mostly obtained by full in-sourcing. Inspection and repair and replacement of building systems/equipment are mostly delivered by in-sourcing. The findings indicate that out-sourcing and in-sourcing are the two methods of providing maintenance services and each has distinct advantages and disadvantages.

CONCLUSION

The study has shown that public hospitals in Nigeria do not have budgetary allocations for maintenance. As a result, all maintenance expenditures have to be within the annual budgetary allocation of the hospitals. This practice limits the volume of fund available for the maintenance of their facilities. Many of the public hospitals do not have or operate maintenance departments or units, which is not good either for now or for the future. The public needs to be re-educated that management and maintenance of existing properties is part of the overall process of building development. This means that planning, designing, construction and management is a cycle and needs to be worked at.

The performance of buildings is likely to be enhanced if maintenance managers efficiently communicate with building users and are aware of users' concerns and take action to eliminate these concerns. Some of the users' maintenance-related concerns are not likely to develop if maintenance managers are in constant communication with designers during the design phase and after the buildings have been put in service. The annual budgetary allocation should be well managed to meet expenditure for maintenance and more funds should be provided in the annual budget for maintenance. Also, the decision to use outside contractors or in-house personnel should not be

made indiscriminately but should be based on the type of maintenance and the nature of the maintenance work involved. There should be regular routine inspections but this would be useless, where the faults noticed cannot be repaired because of lack of finance and inadequate resources.

While concerns about cleaning and repair/replacement appear to be high among hospital users, these are certainly not on maintenance managers' priority lists when they maintain public hospital buildings. This situation may be due to the fact that maintenance managers are not in touch with the hospital users and are not fully aware of their problems. Effective communication and interaction between maintenance managers and hospital users should be encouraged.

From the foregoing, it is clear that public hospitals cannot be effectively maintained with the existing practices and funding. The need for a change in the maintenance management practices of public hospitals is inevitable if they are expected to deliver medical services effectively. Public hospitals must establish maintenance units, have maintenance plans, budgets and adequate funds and adopt good maintenance management practices.

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References

- Adebayo, S.O. (1990) *Building Maintenance: and Nigeria Economy*. Department of building Technology, Yaba College of Technology, Yaba, Lagos.
- Adenuga, O. A. (2000) Building Collapse: Causes Preventions and Remedies *Shelter Watch*, Habitat Communications, Lagos 1(4), 6-15.
- Atkin, B. and Brooks, A. (2000) *Total Facilities Management*. Ed, Blackwell Science, Oxford.
- Barret, P.J. 1996. *Asset Management Handbook*. Ed. Commonwealth of Australia: Australian National Audit Office.
- Chanter, B. and Swallow, P. (1996) *Building maintenance management*. Ed, Blackwell Scientific, Oxford, England.
- Esenwa, F.O. (2000) Maintenance and Rehabilitation of Capital Assets. *Journal of Nigerian Institute of Quantity Surveyors*, 15(1), pp
- Harris, A., Giunipero, L.C. and Hult, G.T.M. (1998) Impact of organizational and contract flexibility on outsourcing contracts. *Industrial Marketing Management*, 27, 373-84.
- Holland, B.K. (1987): Managing single family. *The Institute of Real Estate Management*, Chicago. 20(15), 4-9.
- Iyagba, R. O. A. (2005): *The menace of sick buildings a challenge to all for its prevention and treatment. An Inaugural Lecture*. University of Lagos, Lagos, Nigeria.
- King, C. S., Langendoen, C., and Hummel, L. H. (1984). *The successful On-site manager*. The Institute of Real Estate Management, Chicago.
- Lee, R. (1987). *Building Maintenance Management*, 3rd Ed., William Collins Sons & Co. Ltd. London.
- Neely, E.S. and Neathammer, R. (1991) Life-cycle maintenance costs by facility use. *Journal of Construction Engineering and Management*, 117(2), 310-20.
- Smith, R. (2003) Best Maintenance Practices. *Journal for maintenance and Management*. 16(1). pp
- Valence, G. (2000) Strategic Management and outsourcing maintenance of public schools in New South Wales. *Proceedings of the CIBW70 International Symposium on Facilities Management and Maintenance*, Brisbane, Australia, 439-46.