

Impact of Maintenance Management on Lifespan of Buildings: A Literature Review

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Abstract: *Maintenance is a key requirement for buildings to operate at their maximum efficiency throughout their intended lifespan. This study examined the consequences of building maintenance management on the longevity of the structure through the medium of a literature review. The study is purely a review of documented evidence hence data for the study were obtained from journal articles, manuals, reports, databases, and other published works. The studies that have been examined demonstrate that there are numerous significant issues related to building maintenance. These include electrical problems, insufficient oversight and procedures for maintenance, the deterioration of paint, the presence of moisture, the occurrence of exterior cracking, the proliferation of fungi or small organisms, and the decay or breakage of flooring or tiles. Also, repair problems might have management, technological, building user-related, or natural reasons as their root causes. Buildings with patent and latent faults have major problems that, if left unattended, would increase the expense of repairs, interfere with the building's efficient functioning, and shorten the building's lifespan. This study suggests that through the identification of the fundamental factors and the execution of a triumphant and efficient repair management strategy, it is advisable to limit the frequency of repairs as much as possible. In addition, government agencies must establish repair objectives, employ suitable strategies, manage sufficient resources, devise a continuous course of action, and perform periodic evaluations of their effectiveness and approaches.*

Keywords: Building management, Maintenance strategies, Building repair

1. Background of the study

The techniques and criteria employed to maintain inherent infrastructural amenities have exerted a noteworthy influence on the advancements in the realm of architectural engineering. In the years before World War II, service was done on a breakdown basis. The building sector began demanding improved repairs in the 1950s, which resulted in the creation of planned preventive maintenance (Wei et al., 2018). Reliability-centered management began to be used in 1960, and good routine maintenance helped maintenance transition from an emergency response to an organized approach in the 1980s. Management is the sum of all technical, managerial, and management measures taken throughout the building facility's life with the view to preserving or regaining the ability of the building to carry out its intended functions. This makes the goals of maintenance clear and emphasizes the area of the structure that requires maintenance work.

Building maintenance covers procedures and services to maintain, fix, safeguard, and take care of the structure's fabric (Taleghani, Tenpierik, Kurvers, & van den Dobbelen, 2013). Delay in maintenance tasks leads to obsolescence and affects the ability of the building to perform optimally for the duration of its design life (Sharmin et al., 2014). Consequently, all structures must be adequately maintained throughout their useful

lives for optimum performance. Less maintained structures are less durable and less dependable, which are very important architectural qualities. To avoid frequent repairs at the operation stage, maintenance needs should be considered at the design stage, and organizations should ensure adequate provisions have been made to ensure that there are enough personnel and funding for maintenance (Stavrakakis, Zervas, Sarimveis, & Markatos, 2012). Building degeneration may occur at varying speeds and calls for varying degrees of maintenance depending on the design, the quality of materials and construction, its function, and its location. No structure can ever be service-free, but good design and quality construction can reduce the amount of maintenance needed (Uribe, Martin, Garcia-Alegre, Santos, & Guinea, 2015). Buildings are designed to carry out their primary responsibilities in the most effective way possible; however, these buildings need to be properly maintained to perform the functions they were designed for. Once the construction is completed, the need for maintenance begins because all buildings and structures consist of materials and components linked together to form the desired unit of accommodation and all such materials and components will start to age from the moment they are incorporated into the building during the construction period.

Collectively, the individual aging of the materials and components will age the building. The rate at which this takes place will depend on several factors such as the expected life of any material or component, its position in the building, its degree of exposure, the external or internal climatic conditions of the building, the amount of use or misuse it received and its interaction with other materials or components. To minimise the need for maintenance, all design modifications that have to be made or suggested by an engineer must be implemented during the construction process and it must be verified that the structure is fully operational and creating benefits for the economy (Salamone, Belussi, Danza, Ghellere, & Meroni, 2016).

Today, it has become extremely difficult for emerging economies like Nigeria to make sure that every structure is in the best possible shape and quality to retain its serviceability and meet its functional needs (why?) (Salamone, Danza, Meroni, & Pollastro, 2017). Adopting a reliable preservation or protection strategy is necessary. The need for proper and organized maintenance of structures is becoming more widely recognized among engineers because of public buildings (Pritoni, Salmon, Sanguinetti, Morejohn, & Modera, 2017).

This should come under the methodology

1. Review of Related Literature 3.1 Types of maintenance.

Different methods of management exist. However, the two basic categories are scheduled and unscheduled maintenance. Schedule management includes preventive, forecasting, and anticipatory (These are not the standard terminologies pls) upkeep, while general and necessary repairs are included in un-schedule management. The need to avoid breakdown or deterioration of building assets such as the roofing, plumbing system, fittings fixtures exteriors and interiors is the major goal of preventative care, which entails the use of scheduled programs of routine inspections, changes, and upgrades (Hosseini, Fakhar, Kiani, & Eslami, 2019). Predictive maintenance, as the name suggests, is predicting failures before they happen, locating the fundamental causes that trigger the faults' symptoms, and removing those reasons before they do serious harm. Preventive care, on the other hand, refers to a preventative repair strategy that aims at addressing the underlying reasons for failure to prevent failures from occurring. Additionally, maintenance duties have been classified as "predictable" and "avoidable" (Reference) Predictable maintenance is routine, recurring work that might be needed to preserve an item's desirable qualities as well as to fix or replace the product once it has reached the end of its useful lifetime. The work is necessary to fix problems brought on by subpar design, improper installation, or the use of subpar materials is known as avoidable maintenance (Matsui, 2018). The term "appropriate condition" in building maintenance can

be understood as the preservation of a structure in a condition that enables its usage for the intended purpose with the least amount of capital outlay.

Across the construction industry, many definitions are used when it comes to the different types of maintenance. It can quickly get confusing when people talk about preventive maintenance, condition-based maintenance, or predictive maintenance which invoke different meanings in the minds of readers. There are 9 types of maintenance split between preventive maintenance and corrective maintenance. Preventive Maintenance is done before a failure occurs and consists of maintenance types like Time-Based Maintenance, Failure Finding Maintenance, Risk Based Maintenance, Condition Based Maintenance, and Predictive Maintenance. Corrective maintenance is done after a failure has occurred either as Deferred Corrective Maintenance or as Emergency Maintenance (Hupje 2022).

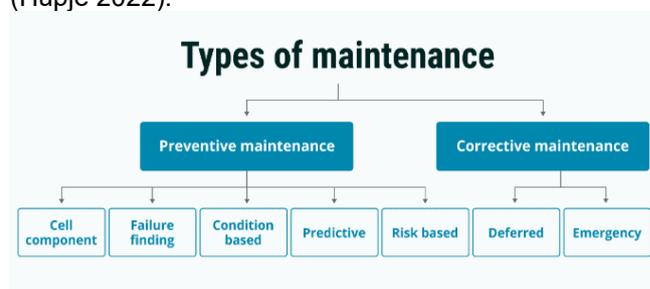


Figure 1: Nine (9) types of maintenance
Source: (Hupje 2022).

2. The Study

3.1 Maintenance Component

The components of maintenance are numerous. Seeley (Walker, Khan, Katic, Maassen, & Zeiler, 2020) has mentioned a few maintenance-related elements. These are listed below with a brief description.

3.1.1 Servicing

Servicing, often known as routine upkeep, is simply a clearing procedure carried out at scheduled times of different frequency. A few instances of servicing include daily mopping of floors, weekly cleaning and dusting of windows, and frequent painting for protection and adornment every four years. However, when more advanced equipment is developed, more intricate maintenance regimens become essential. Regardless facilities are used frequently and due to how the weather and climatic conditions affect the parts of the building, servicing is required (Uribe et al., 2015).

3.1.2 Rectification

Retraction work often takes place rather early in the construction's lifespan, though it can also happen occasionally later. It results from a design flaw, an inherent flaw in or an inappropriate component, damaged goods during shipping or setting up, and

improper assembly (Uddin, Wei, Chi, & Ni, 2021). Since it is available, repair is a useful strategy for lowering maintenance expenses. The only thing required, at least in theory, is to make sure that components and materials are installed properly and are appropriate for their intended use. By creating and using performance requirements and setup codes, correction work might be minimized. Retraction is the solution to ingrained flaws in the building process' planning, building, or deployment phases.

3.1.3 Replacement

The issue of separating management from enhancement has not been adequately addressed by numerous definitions. However, it tends to agree that regular upkeep should incorporate logical components of improvement, such as replacing an obsolete component with a more recent model. When work is done to make a facility more efficient to use by including amenities that were not there before, it deserves to be categorized as an improvement. Consequently, it makes sense to broaden the definition of management to include some limited enhancement (Taleghani et al., 2013).

3.2 Maintenance Problems

Building upkeep problems are frequently viewed as a failure or inadequacy in the building's fulfillment of its functions, legal obligations, or user demands. These issues can be present in the construction of the building, materials, products and services, or other amenities (Sharmin et al., 2014). The majority of building defects show themselves throughout the building's operative phase and maintenance, although they can also exist before and throughout the construction period. Building flaws are often divided into latent and patent types (Royapoor & Roskilly, 2015). During an examination during building and the project's Defects Liability Period (DLP), patent flaws can be easily identified. Latent flaws typically manifest themselves while the building is occupied. Windows and decorations are the architectural features that require the most sleuthing (Peffer et al., 2016). Most mechanical parts have flaws in the wiring, the air conditioning system, and the drainage setup. General unhappiness with some of the supplies, machinery, and standards selection and purchase contributed to operational issues after taking over the construction. Electrical issues 18%, plumbing issues 32%, cracks 29%, painting issues 14%, floor issues 9%, and elevator maintenance 21% are the major maintenance issues in buildings (Shakeri et al., 2017). Additionally, sanitary difficulties, water leaks, elevator stops, and moisture are major maintenance challenges. Several categories including management issues, issues relating to human resources, and issues relating to technology can be used to classify the frequent issues that functioning and upkeep units in Saudi Arabia encounter (Kleiminger, Beckel, Staake, & Santini, 2013). The management and upkeep of the sector have been

dealing with the following 14 challenges: Top management issues, personnel issues, and technological problems. To learn more about the causes of defects, the variables influencing the administration of maintenance, and the oversight of maintenance methods on low-cost buildings, a survey was carried out in a Town, in Ethiopia. Several difficulties with upkeep were identified by the study and evaluated in declining order of their weight (Stavrakakis et al., 2012) as follows:

- a) Spilling pipes, water incursion through roofs, cellars gardening, beneath slabs of concrete and asphalt, watering systems, and radiant heating systems are examples of leaks. The most frequent issues are with sanitary items, such as sinks, baths, and faucets (Taleghani et al., 2013). It was noted that leaks in toilets and outflows alongside the requirement for tap replacement are the most made inquiries regarding hydro sanitary facilities.
- b) Peeling paint: The building facade, particularly the plastered walls, ceilings, beams, and columns, suffered greatly from peeling paint.
- c) The wall was cracking; the cracks ranged in width from a few microns to five millimeters or more. There were extensive fissures throughout the length of the walls, beams, columns, ceilings, and floors. Additionally, a diagonal crack with a very tiny tip and increasing thickness from the beginning was discovered at the corner of the door.
- d) Damp: about 60% of the buildings suffered damp-related issues. Digging moisture, rising moisture, and leaks in wiring are likely to be the three most typical sorts of dampness. Unintentional water from failing pipes, downspouts, and roofing flashings can result in moisture.
- e) Aging or distortion of the roof; among the roof flaws discovered included obstructed gutters, leaking downpipes, leaking roofs, broken roof tiles, sliding roof tiles, as well as faulty frieze and frieze board.
- f) Broken tiles: Cracked, damaged, and unstable tiles constituted the main issues in the investigated schools.
- g) A defective electrical system; significant issues with lamps, light bulbs, plugs, fuse boxes, routers, and cables; an insufficient supply of energy; a power outage; and adequate wiring and fixtures.
- h) MOLD or Fungi; the development of MOLD or fungi is a typical result of too much moisture.

The cooling, electrical, and water hygienic facilities accounted for 55% of all problems with upkeep, accounting for 86% of the issues (Sitton-Candanedo, Alonso, Garcia, Munoz, & Rodriguez-Gonzalez, 2019). The remaining issues pertain to doors, windows, woodworking, networks, interaction, staircases, decoration, interior, concrete, floors, structures, and foundations. Poor water drainage, malfunctioning ventilation, air conditioning, or heat pumps, poor insulation or soundproofing, structural weaknesses that

cause cracks or break down, deficient or defective electricity or lighting, and insufficient fire protection systems are just a few examples of standard building defects (Spataru & Gauthier, 2013). Additionally, a building flaw could be the cause of rat or pest infestation, drying out hardwood decay, condensation, or fungus. Due to the deterioration of current structures as well as the development of new ones, repairs may grow more difficult. Common issues that affect maintenance departments at various institutions are primarily related to keeping infrastructure functional. The first issue is with human resources, which comprises employee talent and experience. The second issue is one of quality performance, which is mostly dependent on suitable tools, equipment, and materials. Finally, management issues can be characterized as maintenance plans, strategies, budget allocation, and so forth.

3.2.1 Cause of Maintenance Problems

Once the building has been turned over, upkeep becomes necessary quite sometime after Atta, H.I. (2023). Aerosolisation and Bioaerosols in Aeromicrobiology. <https://doi.org/10.1016/B978-0-323-96122-6.00008-6>wards. Early on, flaws in the structure could result from its design. Repair problems are caused by design modifications, lax building and oversight, and other factors during the building process. As part of the building contract, a guarantee period against defects of six or twelve months is typically stipulated. If a flaw is discovered during this time, the contractor is responsible for paying to have it fixed. The facility manager should oversee providing additional maintenance programs once that time is over. The building should be fully operational and create benefits for the economy, according to the expected response (Seyedolhosseini, Masoumi, Modarressi, & Karimian, 2020). Insufficient upkeep work is a result of the repair organization's lack of supervision. A study made the argument that poor building maintenance can result from staff receiving insufficient training. In maintenance projects, the specification of inappropriate materials is a constant issue (Salamone et al., 2016). Building quality is influenced by the resources that are accessible and pertinent to user needs. Although appropriate material is accessible, there is not enough of it. Employees may still be prevented from performing maintenance tasks (Revel & Arnesano, 2014). Building flaws are frequently caused by inadequate requirements, material selection, workmanship, and oversight (Singh et al., 2017). In addition, the most important cause of the flaws is found to be bad design choices. Architecture causes, craftsmanship causes, Ingredients drives, and absence of Safety causes are the root causes of repair issues, listed in a decreasing list (Schwee et al., 2019). The primary cause of the lack of funding for repair is a poor management strategy and policy (Pop et al., 2018). Injuries and crashes can result from inadequate upkeep of public structures and infrastructure (Stavarakakis, Androustopoulos, & Vyörykkä, 2016). Uncomfortable conditions, accidents, and human injuries can result from neglected structures and infrastructure. The effects

of subpar maintenance as well as the incident's root causes, including poor leadership, a subpar maintenance culture, and subpar work ethics among technicians (Walker et al., 2020). Pipe leaks and defective electric systems were caused by shoddy construction and the use of subpar materials (Taleghani et al., 2013). These components' paint peeled because of constant exposure to the sun, rain, wind, and humidity. Some of the underlying reasons for construction flaws can be quickly identified, while others may require a thorough examination by relevant professionals. In conclusion, one piece of evidence regarding the cause of construction flaws may not be sufficient. It is important to look at potential root causes from many perspectives (Royapoor & Roskilly, 2015). Various building issues can be caused by construction flaws. Which parts have been inflated will determine where the shortage came from. A foundation, floor, or wall defect may be the direct result of a soil problem, a water problem, or even a craftsmanship problem. If someone is having issues with the foundation, the issue may be due to the soil or water (Shakeri et al., 2017). Development Materials, Poor Building, Bribery, Insufficient oversight, Poor Design, Environmental Condition, Lack of Repair, Architectural Type and Change in Use, and Placement of Building are the primary causes of construction flaws and failures (Salamone et al., 2016). Lack of management culture, the age of the building, apathy toward maintenance duties, subpar construction, insufficient funding but expensive upkeep, and the capacity of staff members who perform maintenance all contribute to poorly maintained government buildings. Numerous academics investigated the variables influencing the management of repairs to buildings and presented their results. These elements might be regarded as the root causes of problems with buildings.

The primary variables impacting maintenance, based on an investigation about variables impacting the upkeep of public structures in Penang, Malaysia, are a lack of scheduled upkeep, a shortage of resources to upkeep the building, a lack of appropriate maintenance standards, a lack of substitute items and components, and a failure to satisfy maintenance requests (Stavarakakis, Koukou, Vrachopoulos, & Markatos, 2008). Based on these findings, maintenance unit workers should be held to higher standards of efficiency and effectiveness. According to user insight, the absence of preventive upkeep, poor craftsmanship, the design determination factor, and the utilization of inferior materials had the most impacts on household renovations in Nigeria (How/ where is the evidence?). The functionality and strength of the building are seriously jeopardized by these elements, which would cause a rapid decline. The absence of exchanges between repair companies and clients, ignorance of the advantages of preservation, the absence of suitable replacement elements and parts, and innovations in technology were the least important factors (Stavarakakis et al., 2012). The following variables affected the upkeep of housing in public as well as private rental properties in Nigeria: layout and adequate craftsmanship, material

norms, outlining of working sketches, creation oversight, funding analysis, external factors, usage, valuation shifts and advancements, insufficient waste disposal plan, crashes, sunlight, gradual amortization, aging, damage, safeguarding of cultural background, value of the property, and accidents. The findings showed that the most important elements influencing home upkeep were correct layout and fabrication, resource requirements building oversight, and elaboration on operational plans (how did you arrive at this conclusion?)

3.2.2 Effect of Maintenance Problems

Buildings with patent and concealed flaws are a severe problem, and failing to address them will probably increase the expense of rectification, interfere with the building's smooth functioning, and shorten its useful life (Revel & Arnesano, 2014). A physical issue that renders a structure less valuable, efficient, healthful, or a condition triggering frailty is known as a building flaw. Defects produce hazards that can result in many catastrophic injuries. Most abnormalities can be found early on through observable or audible symptoms. Minor flaws can become significant ones if they aren't fixed right away, leading to failure or rapid collapse, threatening lives, and costing more money to fix. If the repair business's work is not finished or responds slowly, many security issues may arise for the occupants (Salamone, Belussi, et al., 2017). Uncomfortable conditions, accidents, and injuries to individuals can result from poorly maintained structures and facilities (Rostampour & Keviczky, 2018). Gypsum and other cosmetic defects only damaged the building's appearance; they did not endanger anyone's safety. The visual appeal of surfaces such as walls and floors can also be negatively impacted by defective tiles (Roselyn et al., 2019). Defective building construction raises the overall cost of the result as well as the potentially high cost of repair. The structure could completely fail because of poor planning. Building repair problems may harm a project's cost, length, and resources. Failures and flaws can result in wasteful spending and delays. They are also causing disputes between the parties concerned. Additionally, if this problem is not addressed and managed, it will result in more serious issues in subsequent building initiatives (Sehar, Pipattanasomporn, & Rahman, 2017). A building's lifespan will eventually be shortened if upkeep is not performed, which will necessitate its demolition. However, regular maintenance will ensure that the structure is returned to its original state and lengthen its lifespan. The buildings that are unable to be managed will suffer deterioration and eventually fail (these are head knowledge, no evidence) As a result, the building's functioning will be lost, and there will be a significant cost for new construction. Upkeep issues that are promptly resolved reduce costs associated with upkeep and prevent the need for substitute construction (Sharmin et al., 2014). Due to the incorrect treatment of upkeep concerns, there will also be major issues with the protection of those who use the building and the building.

3.3 The maintenance functional performance curve [The P-F Curve]

The curve shows that as a failure starts manifesting, the equipment deteriorates to the point at which it can be detected (point "P"). If the failure is not detected and mitigated, it continues until a functional failure occurs (point "F"). The time range between P and F, commonly called the P-F interval, is the window of opportunity during which an inspection can detect imminent failure and give you time to address it. It is important to realize that Condition Based Maintenance (CBM) as a maintenance strategy does not reduce the likelihood of a failure occurring through life-renewal but instead is aimed at intervening before the failure occurs, on the premise that this is more economical and should have less of an impact on availability. In other words: condition monitoring does not fix machines and condition monitoring does not stop failures. Condition monitoring only lets you find problems before they become a failures. An important concept within Condition Based Maintenance is the P-F curve.

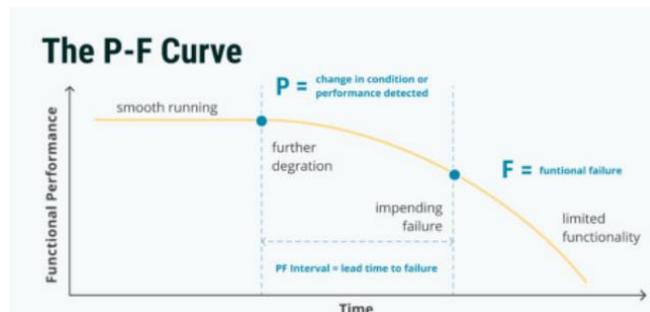


Figure 2: The maintenance functional performance curve [The P-F Curve]

Source: (Hupje 2022)

3.4 Maintenance Policy

A company's repair division, which is overseen by an operations supervisor, is crucially important. Establishing and managing repairs are under the purview of the upkeep manager. In a smaller company, an employee may do the tasks alongside his or her other responsibilities, but in a larger company, a different group of individuals would oversee repair alone. The preservation department's core responsibilities are advice, institutional, control, and various.

The state of the structure's components and services is related to maintaining them for them to satisfy the requirements needed to function as intended (Taleghani et al., 2013). According to academics, maintenance oversight encompasses a wide range of activities that can be viewed as an effective use of funds to ensure that processes and assets meet client demands. By selecting the best upkeep approach for each building component, maintenance oversight aims to determine the ideal mix of building repairs (Tien, Wei, Calautit, Darkwa, & Wood, 2020). To maintain high-quality services, upkeep management practices should be continually evaluated (Spataru & Gauthier, 2013).

Numerous unfavorable public remarks revealed that Malaysia's educational facilities are underperforming (Singh et al., 2017). According to the repair management procedures used in Gaza's public medical centers, proper upkeep is used in most facilities whereas preventative upkeep is only used in a small number (Singh et al., 2017). Additionally, they discovered that due to the inexperienced maintenance workers and the scarcity of replacement supplies, they noticed variations in how requests for repairs were handled. Additionally, many hospitals lacked a strategy for upkeep. They added that the maintenance department has to maintain all the facilities and components of the building and ensure that the auxiliary systems are functioning properly. Lastly, they suggested that for the upkeep workers to perform their responsibilities properly, they need both have the necessary expertise and training. Additionally, every hospital should have a supply of all spare parts on hand so they can respond quickly to any repair need.

3.5 Proposal for Maintenance Solutions

Ensuring that every building's quality is at the highest level to maintain its serviceability and meet its functional needs has grown to be an important task for emerging nations (Wang et al., 2021). Adopting a decent safety strategy is required, or you could say it is building upkeep. The area that is most closely tied to the building industry is building management. Practicing upkeep on buildings has become commonplace following the completion of a construction project. Building upkeep, in general, refers to any activity that could help a building live longer and continue to serve its purpose (Saginar, Weinstein, & Worzala, 2020). An appropriate schedule for upkeep should be established to carry out maintenance tasks effectively (Kunhoth, Karkar, Al-Maadeed, & Al-Ali, 2020). It is the responsibility of maintenance management to use tools and techniques to increase productivity, lessen the effects of unexpected interruptions, and cut costs (Breitinger, Tully-Doyle, & Hassenfeldt, 2020). By combining viewpoints and operations that are typically divided, a systemic preservation control model enhances a facility's efficiency. Typically, repair management platforms have not considered the criteria of user value systems. Facilities are only useful, though, provided they can keep giving their intended customers the services they need. If this doesn't happen, the building's presence will be pointless or useless (Mahdavinejad et al., 2018). The main reason there aren't enough finances for upkeep is because of inept leadership plans and policies. Oversight should be able to control every asset needed for the facility to function well. To promote excellent service, it is necessary to constantly change the upkeep oversight methodology used. In addition, the author went on to say that service work was required not only to document any flaws but also to rectify them.

Therefore, there is a chance of reducing the effects of upkeep issues of buildings from the beginning of design, since the ideas created using brainstorming methods

should be adopted during the development phase or initial stage of build. If the structure's repairs are resolved, the building's maintenance costs will inevitably decrease. Consideration should be given to important scheduled upkeep qualities when planning and performing upkeep tasks to improve the upkeep efficiency of public buildings. These qualities include the ability to adopt repair tools and techniques, the expertise and expertise of the service manager, the length of the scheduled upkeep interval, the quality of spare parts and materials, the skill and knowledge of the maintenance labour, the budget allocated for the acquisition of upkeep data, the dependability of upkeep data, and the frequency of inspections and tracking (Kaur, Bhatia, & Stea, 2022). The examiner advises practice along with the provision of interaction platforms including meetings and feedback surveys that involve all the essential parties, from investors to consumers, to increase the efficiency of the repairs and to sustain efficiency.

Although many organizations still follow the old idiom "if it isn't broken, don't fix it" when it comes to maintenance, when considering long-term cost, corrective maintenance costs are higher than preventive maintenance costs over the long term. Studies have shown that unscheduled corrective maintenance is more than three times the cost of scheduled maintenance repairs. This system will always be used as an emergency measure when a piece of structure or equipment fails unexpectedly. Organizations and institutions should investigate planned maintenance rather than corrective maintenance, as it will save a lot of issues that can arise due to system failure as well as the saying goes penny wise pound foolish.

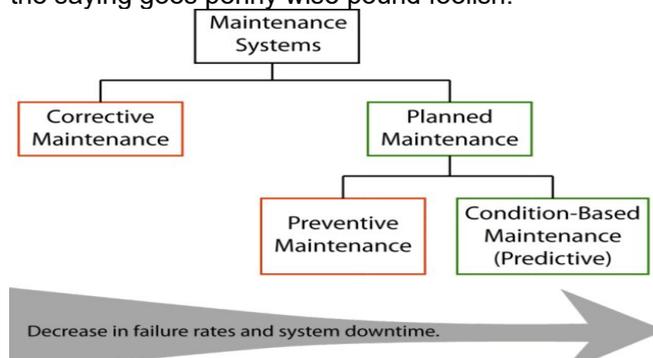


Figure 3: The two basic types of maintenance systems, show the decrease in failure.

Source: (Sellathamby, Moore, and Slops, 2010).

It is crucial to determine the most frequent issue the maintenance department is experiencing. Like this, it is crucial to assess the current state of the office of maintenance, including the organization, standard operating procedures (SOP) for repairs, mission and vision, departmental goals, and range of responsibilities. It is only logical to suggest an appropriate strategy that could be used to address the issue that the maintenance workforce is experiencing after difficulties have been identified. The maintenance department workers should be held to higher standards of effectiveness and efficiency (Mahdavinejad et al., 2018). Atta, H.I. (2023). Painting jobs, etc., should be done especially since as a

structure's life increases, so should its age. The efficacy of the output is determined by the planning and execution of a strategy for the aspect (Uribe et al., 2015). By viewing the building in individual facility components such as the framework, superstructure, concludes, fittings, and inside or outside services, it is possible to study repairs related to buildings. For good maintenance efficiency, it is crucial to identify maintenance issues in the building sector and to comprehend the potential sources of faults at the design stage, the building stage, and the service stage. The helpful option is to incorporate upkeep inputs enabling ease of upkeep throughout the design phase to reduce design faults (Stavarakakis et al., 2012). Therefore, involving building experts in the design stage could aid in preventing problems with upkeep. One strategy to reduce flaws and achieve excellent maintenance procedures is to solicit advice from trained and competent members of the building sector (Stavarakakis, Karadimou, Zervas, Sarimveis, & Markatos, 2011). In addition, there should be a connection between the requirements for materials and installation oversight.

One of the most crucial factors that should be considered, according to an examination of repair processes in government office buildings, is how they are maintained (Stavarakakis et al., 2012). Additionally, efficient maintenance should be performed, which will lead to an improvement in these practices. The

Department of Maintenance should oversee all maintenance tasks and properly consider every user complaint. The program for upkeep should also be examined to see which maintenance issues have been resolved and how to address any outstanding issues. A suitable maintenance administration model could be useful in resolving leadership challenges like distributing funds, a variety of problems with upkeep, a lack of historical upkeep data, the propensity of deputed personnel to shirk accountability, the accessibility of competent personnel, and safety and ecological issues (Stavarakakis et al., 2008). For a successful and efficient repair procedure, a building handbook that includes an operation and maintenance (O & M) manual, as-built drawings, health and safety documentation, standard operating procedures, and more, must be produced and followed (Uribe et al., 2015). Additionally, the building user guide helps those who live in the structure make the most use of the architectural elements, services, and systems to maintain a pleasant and secure place to work.

A model comprising reliability-centered maintenance, the P-F curved, and an O & M manual could serve as an effective guide for the decision-making process. Although reliability-centered maintenance is not a type of maintenance, it is a decision-making process, a methodology to develop or improve a preventive maintenance program that is both effective and efficient.

Maintenance type	Preventive Maintenance					Corrective Maintenance	
	Time based	Failure finding	Risk based	Condition based	Predictive	Deferred	Emergency
Task type	Scheduled Overhaul / Replacement	Functional Test	Measurement of condition	Calculation and extrapolation of parameters	Inspection or Test	Repair/ Replace	Repair/ Replace
Objective	Restore or replace regardless of condition	Determine if hidden failure has occurred	Restore or replace based on a measured condition compared to a defined standard	Determine if failure is imminent and intervention is required	Determine condition and conduct risk assessment to determine when next inspection, test or intervention is required.	Restore or replace following failure. Result of a Run to Failure Strategy or an unplanned failure.	Restore or replace following unplanned failure.
Interval	Fixed time or usage interval e.g. 1 month, 1,000hrs or 10,000 km	Fixed time interval (can be set based on risk assessment e.g. SIL)	Fixed time interval for condition measurements/ inspections	Continuous online monitoring of parameters, intervention as required	Time based interval between tasks and scope of task is based on risk assessment	Not applicable, but intervention is deferred to allow for proper planning & scheduling.	Immediate intervention required.

Figure 4: Comparison of maintenance types. Source: source (Hupje 2022).

3. Conclusion

Any country's public buildings are extremely significant assets and keeping them in a regularly operational form is a difficult task for developing nations like Nigeria. Negligent upkeep causes a building's fabric and finishing to age, deteriorate, and fail, which is damaging to the residents and its contents. Work on maintaining public buildings combines all specialized, managerial, and management tasks with an efficient and successful program. Plumbing, electrical, sanitary, completing, cracks, stripping paint, moisture, and other building and related to service problems appear to be the most prevalent. Repair problems might have management, technological, building user-related, or

natural reasons as their root causes. There are many significant reasons, including poor upkeep management, insufficient funds but high and unanticipated expenses, the age condition of the building, natural disasters, insufficient contractor and building supervision, the use of inadequate supplies and construction, the lack of qualified labour and quality components, design flaws, and earth settlement, among others. The most important areas for improvements in the public sector are the absence of adequate maintenance departments, programs, plans, and policies. Buildings' service lives would be shortened, and extra rectification costs would be incurred if major problems like patent and latent flaws were not addressed. Inadequately maintained buildings and amenities can make users uncomfortable and even result in accidents and injuries.

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