
Managing Building Maintenance Cost Using Life – Cycle Costing. (A Case Study of the Public Buildings in Port Harcourt, Rivers State)

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Abstract

Maximizing resources and fulfilling the intended purpose and life span of a building requires good maintenance activity at an affordable and realistic cost. This study examines the management of building maintenance using the Life – Cycle Cost model. The paper considers man’s need to live and work in comfortable, healthy and good houses. It also considers some of the types of building maintenance and cost of maintenance through the use of Life –Cycle Costing during the design stage of the building. Based on our findings, it is important to keep a maintenance – based design at the design stage of the building in order to keep the building in its optimum state throughout its life span. The study recommends that the use of a cost model which considers the maintenance cost of the building as part of the cost of the building, in addition to the acquisition and running cost during the design stage should be encouraged. This will help to reduce and control the maintenance cost of the building.

INTRODUCTION

People across the globe desire and aspire to live and work in comfortable, healthy and good houses devoid of risk. Unfortunately, many buildings in Nigeria are far from this, they are in deteriorated, uncomfortable, in unhealthy state and constitute serious hazards to occupants due to poor design, poor construction, bad usage, lack of the will for maintenance, bad/poor materials and fittings and lack of funds for maintenance etc. Buildings are required to provide conducive and safe environment for users.

Buildings are permanent structures standing in a place for the habitation of man. They can be simple dwellings or complex fixed structures of wood, bricks, concrete or other materials with services and amenities such as electricity and plumbing etc. Every building has its expected lifespan and expected to be maintained within this life span in order to function and fulfill its purpose and aesthetics. This maintenance activity can be periodic or preventive depending on the nature of building and the life span. BS3811 (1984), defines maintenance as work undertaken in order to keep or restore every facility of the building to an acceptable condition.

The Federal Republic of Nigeria, National Building Code (First Edition - 2006) defined a building as any structure or enclosure of space with a roof and walls for protection of life and property. A building is a structure with a roof and walls standing more or less permanently in one place. Buildings are designed and constructed with an expected life span, within which the building is expected to be maintained in order to meet its intended purpose. Maintaining a building is at a cost, and the resources available are relatively scarce, limited in supply, not readily available and has become, one of man’s major challenges. It becomes important to manage the available resources in order to keep the building in good condition throughout its expected life span. Buildings must be continuously maintained throughout its life span to

avoid deterioration, dilapidation and unhealthy for habitation. Following the scarce nature of this resource, we must be careful and committed to managing the limited resources to meet our needs.

Building maintenance according to **The Urban Homesteading Assistance Board and Department of Housing Preservation and Development of the City of New York**, is the work carried out on a regular basis (periodically) to keep the building in good working condition. It is an activity associated with repairs before and after it is broken down. Maintenance is also an activity undertaken to prevent a building or its component from failing or to repair a building to keep it in proper working condition, thereby fulfilling the purpose of the building. Maintenance in buildings is an operation that is being executed on a continuous basis to maintain the building in a safe and best form during its life span for everyday use. **MD Azree Othuman Mydin (2015)** in his research explains that the need for maintenance is influenced by the desire to protect a building at its early stage and to retain the importance and value of investment, keeping the building in a condition to accomplish its purpose.

Building maintenance is the art of keeping something in proper condition and it requires resources to carry out these repairs. It is an action associated with the repair of a building or its component before or after it is broken down. It can also be seen as an action taken to prevent a building or its component from failing or breaking down or to repair a building or its components to keep it in proper working condition.

Building maintenance work is generated by a whole range of factors that affect building structures such as corrosion, structural failures, wear and tear, low initial expenditure, time, incorrect specification, poor design and details, damage by users, use of new building materials and technology, poor supervision and workmanship etc (Ivor H. Seeley 1996). At the design stage, some of the building designers are yet to consider the financial burden on the client on the running and maintenance cost of the building, instead they pay more attention to innovative designs at the expense of good economic design and construction. These designers, during the design stage, concentrate on the acquisition cost of the building leaving out the running and maintenance costs of the building during its life span. This operating and maintenance cost during the life span of the building can be many times the initial cost of the building.

Buildings are usually expected to provide healthy, safe and conducive environment for the user's daily activities and comfort. Building maintenance work should commence as soon as the construction is completed and the building handed over to the users. Maintenance should be considered during the design stage, when materials to be used for building are considered. Faremi and Adenuga (2012), are of the opinion that efforts should be made during the design of the building to reduce the amount of maintenance work that will be done during the life span of the building. Adejimi (2005), in his work, describes building maintenance as an activity undertaken for the preservation of buildings, keeping it in its initial functional, structural and aesthetic states. According to Kiong and Akaseh (2017); Building maintenance is describe as activities undertaken in a building in order to preserve and restore the building to a functional condition but not enhancing any component unless very necessary.

In order to accommodate operational and maintenance cost of the building, cost model such as Life –Cycle Costing is adopted at the planning and design stage of the building to capture future cost (maintenance cost) during the life span of the building. Life - Cycle Costing does not only consider the initial cost of the building but considers the costs of operating and maintaining the building throughout its effective life. It considers both the present and future cost of the building through the comparison of the costs of different components, designs, materials and constructional techniques (Ivor H. Seeley 2010). Life – Cycle Costing is a

technique to estimate the total cost of ownership (OGC 2003). Applying the Life – Cycle Costing (LCC) technique in the building projects will help at the design stage to consider and analyse:

- i. Every cost associated with the building; initial cost, operating and maintenance cost.
- ii. Compare cost of various materials, designs, construction methods during the stage, thereby taking decisions based on certain information.

THE PROBLEM

The growing rate of dilapidated buildings across our cities and institutions in Nigeria is creating a major concern. Most of the public and private buildings lack adequate maintenance, making them unfit for habitation, loose value and unoccupied, thereby not fulfilling the intended purpose for its acquisition. According to Olanrewaju et al (2015), most public and private buildings in Nigeria are faced with challenges of maintenance, resulting in deteriorations. Inadequate or poor maintenance activity is as a result of some factors such as lack of finance, design challenges, planning challenges, poor management of the building etc. Buildings are constructed and maintained with very large sums of money if they must function and fulfill intended purpose. But this resource (money) is scarce, limited in supply. Good management of this resource (money) is required. Most of the dilapidated, abandoned buildings across different parts of our cities is as a result of lack of funds, as very huge sum of money is required for their maintenance. Some of them require more than double the initial cost of acquisition for their maintenance. Example is the Rivers State Secretariat Complex (Point Block Building) in Port Harcourt, Rivers State, it is the tallest building in Port Harcourt as at date, with seventeen (17) floors. It is only partially in use due to maintenance challenges ranging from Lift Carrier to services challenges such as water supply, etc. Also the Pan African Bank Building, located on Azikiwe Road also owned by Rivers State Government is also being underutilized due to poor maintenance challenges.

According to Atamewan and Effanga (2017), building maintenance is a system that ensures that the building infrastructure in any built environment remains in their healthy conditions structurally, functionally and aesthetically throughout its expected life span. They explained further that building maintenance in most developing countries like Nigeria, is described as a major aspect of construction management and it is often ignored, accounting for the vast number of dilapidated buildings around our cities and towns in Nigeria.

In reality, it is highly desirable but not feasible to design and construct buildings that are maintenance-free but much can be done at the design stage to reduce the amount of maintenance work to be carried out.

LITERATURE REVIEW

BUILDING MAINTENANCE

According to Ayo Bamisile (2004), Maintenance can be defined as the degree to which ease of maintenance has been designed into a proposed building. From the definition above, maintenance must be taken into consideration during the design and planning stage of the building. This will be done by taking into consideration the initial cost of the building and the operating and maintenance cost, comparing cost and nature of materials, construction methods and taking decisions. Maintenance is a process that begins from the ‘beginning’, the design stage and requires effective communication amongst stakeholders. Buildings, in order to fulfill its intended life span, ensure optimal performance for its users and the maximum return during its disposal, they must be maintained.

According to British Standards (2017), maintenance is the combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in or restore it to a state in which it can perform the required function.

According to Ivor H. Seeley (1996), maintenance seeks to preserve a building in its initial state so that it continues to serve its purpose and is an essential component in the life cycle of a building. He further stated that the designer of the building will fail in his role if he does not understand the problems connected with maintenance and running costs of buildings and fails to apply this knowledge at the design stage.

But we must understand that effective building maintenance requires the correct diagnosis of defects and implementation of the correct remedial measures, based on sound technical knowledge, in order to avoid waste of materials, labour and money as the work will probably have to be repeated. Buildings are too valuable assets to be neglected in any way as their components deteriorate at a greater rate depending on materials used in construction and methods of construction, environmental conditions and the use of the building.

Building maintenance is work carried on an existing structure in order to keep or restore every component to its standard value. Maintenance work can be categorized into two; Predictable and Avoidable (Ivor H. Seeley 1996). He explained further that Predictable Maintenance is regular periodic work carried out that may be necessary to retain the performance characteristics of a building as well as that required to replace or repair the building after its useful life span. While avoidable maintenance is work carried out to rectify failures caused as a result of incorrect designs, faulty installation and the use of faulty or wrong materials.

Building maintenance is characterized with diverse interest long/short term to the stakeholders. The main aim should be to get good value for money. The standard of maintenance achieved has an important influence on the environment and the users of the building. Building maintenance is aimed at preserving a building in its initial state, as far as practical so as to effectively serve its purpose (Ivor H. Seeley, 1996). He further explained that building projects are maintained basically to retain the value of investment, retain good appearance and continue to function maximally and fulfill its intended purpose. The amount of maintenance work can be reduced by improved and efficient design methods, specification and construction.

There is the need to consider the implications of maintenance at the design stage of the building project in order to achieve an effective maintenance activity. It is at the design stage that the maintenance burden can be positively influenced as good maintenance begins on the drawing board. Every design should be attractive, functionally efficient and constructionally sound with minimum maintenance cost. Building maintenance can be planned or unplanned depending on the type of maintenance activity involved.

TYPES OF MAINTENANCE

The design life of most buildings require periodic maintenance. Repair and replacement of leaking roofing sheets, door handles, hinges, leaking water pipes, electrical connections and fittings, taps etc. In some cases, certain components are replaced such as windows and Doors, Roof members and coverings (sheets). This is to ensure that the building structure fulfills its intended life span and purpose. Different approaches have been developed to know how maintenance can be performed to ensure the building structure fulfills or exceeds its intended purpose and life span. Maintenance is carried out in some cases, when there is a failure or breakdown of any component or part of the building structure (reactive maintenance) and in other cases, as a preventive and predictive measures.

CORRECTIVE MAINTENANCE

MD Azree Othuman Mydin (2015) described corrective maintenance as work carried as a result of breakdown, aimed at reinstating the item to a state in which it can perform its intended purpose. In this case, maintenance is carried when there is a failure or breakdown of a component of the building structure or the entire of the building. Little or no efforts are taken to maintain the building. This is predominantly the type of maintenance widely used today, particularly in the public buildings in Nigeria. According to Adenuga and Iyagba (2005); in Nigeria public buildings are in much deteriorated condition, lacking maintenance. Though no cost is incurred periodically, it is not cost effective as more resources will be expended than in preventive. Corrective maintenance is only carried out when there is a component failure or breakdown or entire failure of the structure, thereby resulting in the reduction of the life span of the building and in the fulfillment of its purpose. There will be an increase in cost of maintenance as there will be more replacement of the damaged components of the building. During the maintenance activity, the building occupants are usually relocated from the building to enable maintenance work to be carried out. In cases of commercial/ industrial buildings, loss of working hours will result in loss of revenue. The maintenance activity in this type of maintenance is usually extensive and requires more time and money.

PREVENTIVE MAINTENANCE

This is the type of maintenance that must be done regularly with a prearranged plan at regular, fixed intervals which may be based on certain standards, such as time, in order to minimize the possibility of a component of the building or the entire building from breaking down unexpectedly thereby attracting high cost of repairs (MD Azree Othuman Mydin, 2015). It is an action performed on a time schedule that prevents or mitigates degradation or deterioration of the building component or the entire structure. It is planned activity aimed at sustaining or extending the useful life of the building. It is a means of increasing the functionality and the intended life span of the building.

Preventive maintenance is always much cheaper and easier than reactive maintenance, it is a cost saving type of maintenance. There is the saying that “prevention is better than cure”. Defects in buildings make the building unsafe for habitation as they are become deteriorated, dilapidated, and unhealthy for the occupants. Defects in building can be detected through various means of detection, and if not promptly attended to, minor defects can develop to serious or major defects, causing failure or sudden collapse of the building component or the entire structure. Preventive maintenance is a more efficient type of maintenance, reduces failure rate in buildings, cost effective, energy saving, increases the life span of the building and can be planned and carried out in phases. Also it includes the maintenance of components or building parts that do not need maintenance at the scheduled time, it is labour intensive and consumes more time. Preventive maintenance is time based, it is based on schedule of maintenance prepared at the inception stage of the building and cost planned captured.

LIFE – CYCLE COSTING

Today building designers, engineers and construction professionals are under pressure from building clients/owners to design and build magnificent structures and to minimize total project cost. Unfortunately, only but a few understand the concept of total project cost. Most of the building owners see project cost as the cost of acquisition of the building (initial cost) but in real situation, the initial cost of the building is not the total project cost. The operating and maintenance cost is part of the total project cost. The total cost of the project is the acquisition cost and the operating and maintenance cost. Effective project management ensures that total project cost is minimized rather than the acquisition cost (initial cost).

According to El-Haram et al (2002), total project cost is the cost of the project throughout its life span. It is a combination of the acquisition cost, maintenance cost and disposal cost.

Life – cycle costing is a technique of cost by which the initial construction and associated cost, operating and maintenance cost of a building or part of a building can be reduced to a common measure, (Ivor H. Seley 2010). He explained further that the actual cost or total cost of a building (project) is the initial acquisition cost and operating and maintenance cost of the building throughout it's effective life, including refurbishment cost. Life-cycle costing is a design tool for the comparison of the costs of different designs, materials, components and construction techniques. It is a guide to the building designer in obtaining value for money for the building client. It can be used by property developers to compare cost against value from property rents.

Life –Cycle costing is to provide a basis for choice in circumstance where there are alternative means for achieving a given goal or project, where the alternatives differ not only in their initial costs but also in their operational and maintenance costs. According to Ivor H. Seley, total building cost refers to all costs and expenses incurred throughout the life span of the building, irrespective of who pays them. It is cost of acquiring the building, operating and maintaining the building.

Byron A. Ellis (2007), views Life- Cycle costing from the concept of total project cost (operating and maintenance cost) and not total acquisition cost (Capital cost). He further explained that poor design creates serious challenges for users and in maintenance, making it difficult and costly to maintain. He recommended that stakeholders should review designs to ensure that adequate consideration is given to operating and maintenance cost.

Life-Cycle costing is a model for the estimation of the cost of a project over its useful life. It covers its initial cost, operating cost, maintenance cost and disposal cost. Life-Cycle costing helps in taking decisions on the available alternatives during project acquisition. It helps in tracking the actual costs and revenues attributable to the project from the inception to the disposal.

Life-Cycle costing is a technique that embraces a mixture of capital cost and running costs. It considers all relevant costs associated with the acquisition and ownership of an asset. (Constructing Excellence 2004)

RELEVANCE OF THE LIFE – CYCLE COSTING

- i.** Life –Cycle costing targets substantially at the total project cost and not initial of capital cost.
- ii.** Encourages communication between project stakeholders and leads to an improved project definition.
- iii.** Give rise to early assessment of risk
- iv.** Promotes good budgeting
- v.** Enables best value for money to be attained
- vi.** Provides information on expected future cost of the project.

LIFE-CYCLE COSTING CHALLENGES

Life- Cycle Costing model is not without challenges. Like other cost models, there are limitations in using it.

- i.** There is a great scarcity of cost information/data to use in predicting future cost of operating and maintaining the building structure. The difficulty of accurately assessing maintenance and running cost of different materials and systems is a major challenge.
- ii.** There are three different types of cost in the life of a building; initial cost, operating cost and maintenance cost. Some are paid at the initial stage, annually

- and periodically. This cost must be related to a common basis for effective comparison.
- iii. Inflation, which is a common challenge with the Nigerian economy may affect the cost in a uniform manner thereby affecting the Life-Cycle costing calculations.
 - iv. Suitable interest rate for calculation is difficult to predict particularly for periods over twenty to thirty years.
 - v. Future cost can be affected by changes of taste and fashion, and replacement of worn out components by superior items.

METHODOLOGY

Based on the objective of the study, the research data was collected from construction professionals/organizations and public/private agencies in Port Harcourt, Rivers state and analyzed.

Primary and secondary source of data collection for this study was through a well-structured questionnaires and personal interviews administered to relevant and appropriate professionals in the construction industry and public and private agencies.

Also secondary data collection was based mainly on the review of related past literature and write up on Building Maintenance management. Detailed references were made to the books, journals and other forms of published materials that were considered relevant to the research subject matter.

RESULTS AND DISCUSSION

Building maintenance is an important part of building construction/management to be left behind as constructing a building without maintenance will not fulfill the intended purpose of the building value for money.

Building designers will contribute significantly to the reduction in the cost of maintenance through the use of Life – Cycle Costing model as the model considers the overall cost of the building. It considers the initial cost (acquisition cost), operating cost, maintenance cost and disposal value.

From the concept of Life – Cycle Costing and its subsequent application in building design, the cost of maintenance can be reduced or controlled to a minimum or affordable level. Life – Cycle Costing takes into consideration present and future cost of the building project as the total cost of the building. It is a vital cost management tool for managing building maintenance cost through the use of Life –Cycle Costing Analysis, Life –Cycle Costing Management and Life –Cycle Costing planning techniques.

- i. Life-Cycle Costing Analysis collects and analyses historic data on the actual cost of maintaining comparable buildings with special reference to running cost and performance.
- ii. Life – Cycle Costing Management is derived from life cycle costing analysis and it identifies areas in which cost of maintaining the building can be reduced. This can assist clients to compare building costs in a meaningful manner and control maintenance cost through the life of a building to obtain value for the client.
- iii. Life –Cycle Cost Planning constitutes the prediction of total costs of a building, part of a building or individual element, taking into consideration the initial capital costs, running costs and residual cost.

CONCLUSION AND RECOMMENDATION

Building maintenance is very important in the life of every building structure, it will help in keeping the building in good condition and fulfilling its intended purpose and life span.

Maintaining a building is at a cost, most times far more than the cost of acquisition. It is very important to keep the maintenance cost as minimum as possible in order to fulfill the expected life span of the building, the intended purpose of the building and to get good value for money.

The cost of maintenance in building can be high, thereby affecting maintenance activity, leaving the building in a deteriorated and dilapidated form, as can be seen in our cities today. But with the use of Life-Cycle Costing as a model, during the design stage, the cost of maintenance during the life span of the building can be minimized.

Life-Cycle costing is an effective tool for managing the cost of maintenance in a building. The model considers both the present and future cost in its analysis. From Life-Cycle Costing, total Cost of a building project comprises of the acquisition cost, operating cost and maintenance cost throughout the life span of the building.

This study recommends a committed approach to the use of Life-Cycle Costing by building designers during the design stage of the building to minimize cost of maintenance.

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