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Life Cycle Costing (LCC) in Nigerian construction industry: Barrier and Drivers facing its Implementation

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ABSTRACTS

Life cycle cost in construction projects is a process of economic decision analysis, which helps taking decisions on investments in new construction. These decisions on investments are analyzed for the payback over the life of the investment. Life-cycle costing makes it possible for the whole life performance of buildings and other structures to be optimized. This paper introduces the concept of life-cycle costing in the Nigerian construction industry. It briefly explains monitoring cost performance over the economic life span, controlling the design development within the capital & running cost budgets and others as its benefits to the industry. Drivers and barriers to its implementation in Nigeria were not left out. Based on extensive literature review this paper shown that the life cycle costing techniques has not been implemented and greatly used in Nigeria. Unstable economic situation, government policy, separation of capital and running cost of most project and others are the barrier facing its implementation. This paper also attempts to provide some recommendations that should facilitate the implementation of LCC in the Nigeria.

Keywords: life-cycle costing (LCC); Barrier; Whole Life Cost (WLC); Nigerian construction industry; Implementation; Benefit

1. INTRODUCTION

Life Cycle Costing LCC can be describes the modelling techniques aimed at coping with the mixture of capital and running cost of buildings and the effect on ownership of the building. This technique does not only analyze the effect of using different materials, finishes and equipment over time, but also investigates running cost in term of running water, energy, maintain electricity, heating, air conditioning etc. It also take the future value of money into account. Opoku (2013) suggested that such long term involvement with a building, together with a clear desire on behalf of the client to optimize ownership costs over the whole life of the asset can be seen as the primary drivers for commissioning life-cycle cost studies. Kelly and Hunter (2009) suggest that the use of LCC has the ability to enhance a proposed building project's sustainability credentials by considering issues related to energy use and maintenance costs of different design alternatives. It is asserted generally that the use of such an early stage project evaluation tool would allow more informed cost advice to be generated than the early stage project cost advice currently generated that is based on a conventional initial capital cost basis.

In this paper, many literatures reviewed captured the range of conflicting benefit, understandings and barriers about the theories LCC in Nigeria and other developing countries construction industries. One of the benefits of using LCC are now appreciated by the stakeholders involved in the procurement of construction projects. Life Cycle Costing LCC is a technique that seeks to evaluate the total design life costs of components or materials that are proposed to be part of a building project's design (Ashworth, 2010). It is asserted that the use of this approach to the formulation of early stage building project price advice would enable better financial decisions to be made in relation to the long term design life of the proposed asset. As stated by Treasury Guidance (2011), the value for money assessments of public projects to be executed through the use of LCC so as to ensure that the finished built environment project met the requirements of the projects' end-users. The use of LCC is advantageous for client organizations who intend to have a long term involvement with their built environment asset. Kirkham *et al* (2004) suggested the nature of risk and the long-term financial implications of design decisions made by contractors as part of private finance initiatives and public-private partnerships mean the application of life cycle costing is becoming increasingly popular.

Despite the fact that there are various benefit in Life Cycle Costing, Nigerian constructing industry has not implement it. Kishk *et al* (2006) and Wu *et al* (2006) emphasized on the quality of the data available to execute the analysis of a potential building project's initial costs, future operating and maintenance costs, life cycles and discount and inflation rates as a critical issue affecting the use of LCC in practice. This one of the problem of implementing LCC in Nigerian construction industry. Indeed the techniques usefulness in this regard is further espoused in the work of Swaffield and McDonald (2008) and Meng and Harshaw (2013) who acknowledge that despite the practical difficulties associated with implementation, life costing continues to be an important tool for ensuring the long term financial success of such schemes. Lack of quality data available to execute the analysis due to unstable economic bring about bring a big blow on LCC implementation on Nigeria industry. Likewise unstable economic situation in Nigeria and Separation of capital / acquisition and running cost of most project contribute to it.

This paper used literature review to achieve its aim. Which is to emphasis on the benefit Nigerian construction industry gain from implementing LCC. Highlighting some barriers facing the implementation of LCC by practitioners in the construction industry. So there is need to point out any barriers to its use in Nigeria practice. This paper is structured to consider the introduction of LCC from previous work related to this topic so as to frame the barriers, benefit and drivers in its context and then to determine an appropriate literature review research approach towards them.

2. LIFE CYCLE COSTING (LCC) IN NIGERIAN CONSTRUCTION INDUSTRY

Life cycle cost in construction projects is a process of economic decision analysis, which helps taking decisions on investments in new construction. These decisions on investments are analyzed for the payback over the life of the investment. This life cycle costing technique in construction industry according to ANAO (2001) is the sum of acquisition cost and ownership cost for an asset over its life-cycle from design stage, manufacturing, usage, maintenance and disposal. For this reason it is most important to make accurate decisions at the design stage, as such decisions will inevitably impact on the life cycle costs of the building (Flanagan & Jewell, 2005; Ellingham & Fawcett, 2006). LCC evaluates various cost elements, in particular materials and components used, energy, water consumption and the asset's overall performance (Kelly & Male, 1993; Ashworth & Hogg, 2007).

The main aim of LCC is to determine how to best reduce a building's ownership costs to achieve a financially viable investment. This can be done by initially considering what the fundamental costs are that will notably impact on the cost of ownership, i.e. operation, maintenance, and refurbishment and/or replacement (Ashworth & Hogg, 2007). Often the purchase price or initial cost does not reflect the real cost, either to the decision maker or cost bearer. This is due to the life-cycle stages, up and downstream from purchasing to production, contributing to the cost of ownership (Hunkeler et al., 2008). Life cycle costing is an economic estimation method that evaluates the entire cost of a building over its operating life, including initial capital costs, maintenance costs, operating costs and the ultimate disposal of the asset at the end of its life (Flanagan et al., 1989). Kirk and Dell'Isola (1995) referred to LCC as a management tool and a decision making tool; a management tool because it can be used to forecast the total costs that will be incurred during a building's life and a decision making technique because it can be used to pick amongst alternate projects. Unfortunately LCC has not been practice in Nigeria construction industry, not to talk of fully implementation.

2. 1. Difference between Whole Life Cost and Life Cycle Cost

The terms Whole Life Cost (WLC) and Life Cycle Cost (LCC) have been used interchangeably – and their meanings have become confused. Furthermore, the components of a whole life cost calculation have varied from client to client, consultant to consultant and among contractors. With no common ground, clients could not be sure what they were asking for, comparisons were impossible and it was difficult to work out whether actual costs had matched up to the estimates. According to the international standard, BS/ ISO 15686-5 Buildings & Constructed Assets, made a clear definitions for the two terms:

2. 1. 1. Whole Life Costing (WLC)

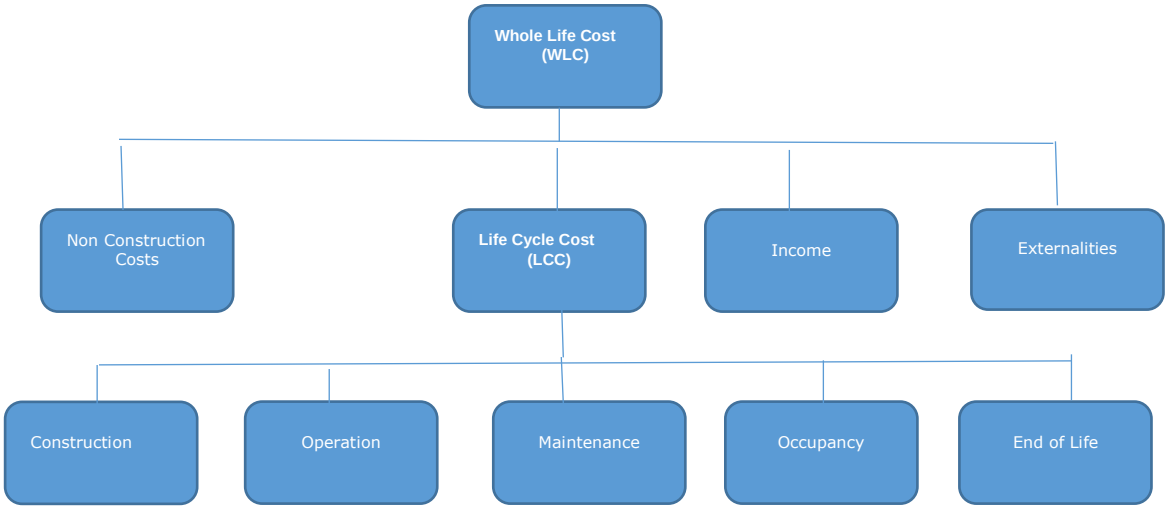
This is a methodology for the systematic economic consideration of all whole life costs and benefits over a period of analysis, as defined in the agreed scope. Another definition is "an economic assessment considering all agreed projected significant and relevant cost flows over a period of analysis expressed in monetary value. The projected costs are those needed to achieve defined levels of performance, including reliability, safety and availability".

2. 1. 2. Life Cycle Cost (LCC)

The initial capital outlay cost is, however, only a portion of the costs over an asset's life cycle that needs to be considered in making the right choice for asset investment. The process of identifying and documenting all the costs involved over the life of an asset is known as Life Cycle Costing (LCC). Life cycle costs are those associated directly with constructing and operating the building; while whole life costs include other costs such as land, income from the building and support costs associated with the activity within the building. The expertise of the construction industry is best placed to deliver life cycle costs, which its clients can then use to calculate whole life costs.

The life cycle cost of an asset can be expressed by the simple formula:

Life Cycle Cost = initial (projected) capital costs + projected life-time operating costs + projected life-time maintenance costs + projected capital rehabilitation costs + projected disposal costs - projected residual value.



BS/ ISO 15686-5 Buildings & Constructed Assets

2. 2. Consideration during LCC procedure

Michael (2003) stated that the time-dependent stages of the life of a facility that need to be considered during the decision and procurement processes are: acquisition (including pre-construction and construction); operation (maintenance, replacement or refurbishment); and

disposal (sale or demolition). At each stage consideration must be given to the basic elements of the facility – such as structure, envelope, mechanical and electrical services, finishes, and fixtures and fittings. The below Table explain further.

LCC considerations

Stage of building life	Considerations for life-cycle costing
1. Acquisition by construction (new or refurbishment) – Groundwork for new build	• land for the building, its clearance and related
Which would include costs of:	• Design, although this may often be included in the cost of Construction with use of design and build type
procurement	• Planning, regulatory and legal fees • Construction, commissioning, fitting out and handover • In-house administration • Interest or cost of money
Or Acquisition by purchase or rental –	• purchase price
Which would include costs of:	• planning, regulatory and legal fees • Adaptation to suit needs of the business • In-house administration • Interest or cost of money
2. Operation (use and maintenance) –	• maintenance, repairs, replacements of components and systems
Which would include costs of:	• cleaning • Utilities and energy • churn • Security and management • Rates • Income
3. Disposal – which would include costs of:	• demolition • site clean-up
Income from disposal	• sale of interest in asset • sale of land • sale of materials from demolition

Sources; based on Client's Construction Forum, *Whole Life Costing: A client's guide*, 2000

3. BENEFITS OF LIFE CYCLE COST IN NIGERIAN CONSTRUCTION INDUSTRY

As stated by Oduyemi (2015) Life cycle costing is an economic estimation method that evaluates the entire cost of a building over its operating life, including initial capital costs, maintenance costs, operating costs and the ultimate disposal of the asset at the end of its life.

So therefore, these are the benefits Nigerian construction industry would gained if life cycle costing is fully implemented:

3. 1. Evaluating economic aspects of a project

Life-cycle costing (LCC) plays a significant role in supporting economic and natural resource sustainability goals. Olubodun *et al.* (2010) found that the factors limiting the wider use of LCC were, a lack of understanding of the technique and its benefits as well as the need for a standardized method of application. LCC help in evaluating, at an early project stage, the economic aspects of a proposed building project design (Caplehorn, 2012). Whilst acknowledging that the majority of construction professionals are now actively promoting LCC as a decision tool for the evaluation of environmental sustainability.

3. 2. Monitoring the cost performance

Another benefit construction industries in developing country can gain in Life Cycle Costing is that its helps in monitoring the cost performance over the economic life span of a building Langdon (2005). Therefore, the implementation of LCC in the construction industry is significantly important to construct the structures, infrastructure projects that will meet all the principal of future value and, sustainability (Akasah and Rum, 2011). LCC is a tool for assessing the total cost performance of an asset over time including the acquisition, operating, maintenance and disposal cost (Barringer, 2003). It is one of several methodologies that can be used to account and provide cost in a more comprehensive way by involving the systematic consideration of all relevant costs and revenues associated with acquisition and ownership of an asset or a project (Cole and Sterner, 2000).

3. 3. Determine best way to reduce building ownership costs

As stated by Rahimto *et. al* (2014) implementing LCC will determine the best way to reduce building's ownership costs in order to achieve a financially viable investment as in (Highton, 2012). Che Mat (2002) describes that LCC approach is effective in the decision making process in four main ways. Firstly, it identifies the total cost undertaken in asset acquisition. Secondly, it facilitates an effective choice between alternative methods by taking into consideration various alternatives which display different capital and running costs. Subsequently, LCC is a management tool that details out all costs associated with capital, running and replacement costs of the building or components within that building. All of these can be summarized as the decision to invest should be made on the total LCC of an asset and not on the basis of initial capital cost alone, because the future is as important as those incurred in the capital acquisition (Rahimto *et. al* 2014). According Akasah and Rum (2011), life cycle costing adds to all the costs of different options over their life period and enables an evaluation on a common basis for the period of interest, thus enabling decisions to be made in the path full of cost implications.

3. 4. Control design development

LCC help in controlling the design development within the running cost and the capital cost budgets. Life cycle costing is to present client with maximum benefit when all the costs are accounted for by analyzing the alternative designs and components. In this process, the

costs are analyzed with the benefit in the future. For example, how the cost of extra expenditure on a particular component can benefit in the project owner now or the investment shall be carried out only in future for that component. What will be the best alternative for that component now or in the future? Life cycle costing provides framework for making analysis of costs and benefits based on time value of money. This helps the analysts to compare and select from alternatives that have different spans and diverse cost and benefit profiles.

3. 5. Costing of projects.

This should include full life-cycle costs of the facility, as well as more immediate construction and project costs. The quality of both design and construction has the potential to greatly reduce life-cycle costs, including costs-in-use and eventual disposal of the built facility. Decisions made early in the design process can have a considerable influence on life-cycle costs. Building orientation will influence the amount of solar heat gain and level of cooling required and the degree of shading; floor plate depth will influence the decision on whether the building needs to be air-conditioned as opposed to naturally ventilated; levels of insulation and air tightness will affect heat loss and energy costs; the number of floors will impact on costs of access for cleaning and maintenance; the number of entrances influences levels of security (Michael (2003)).

Other benefits are;

The life cycle costing helps to reduce the overall cost of a project by selecting best alternative designs and components to minimize the cost not only at the time of construction, but also the over the full life of the project.; As part of a business case evaluation, to work out if you can afford to build the structure; To provide a set of instructions and a budget for the facilities manager; To work out if you can afford to run it.; As part of an option appraisal exercise to decide on the most economically advantageous solution over the life of a building.

4. BARRIER OF LIFE CYCLE COST IN NIGERIAN CONSTRUCTION INDUSTRY

Over the years, the construction industry operates in an increasingly uncertain business environment, characterized by increasing competitiveness, resource scarcity, sustainability requirements, and demand for current and future value for money by its stakeholders in Nigeria. Despite the fact that there is need for life cycle costing in the industry, these are the barriers facing its implementation in Nigeria:

4. 1. Lack of quality data

Kishk (2004), Kishk *et al.* (2006) and Wu *et al.* (2006) identifies the quality of the data available to execute the analysis of a potential building project's initial costs, future operating and maintenance costs, life cycles and discount and inflation rates as a critical issue affecting the use of LCC in practice. This one of the problem of implementing LCC in Nigerian construction industry. Lack of quality data available to execute the analysis due to unstable economic bring about bring a big blow on LCC implementation on Nigeria industry.

4. 2. Government policy

Government policy affect the implementation of LCC in the industry. In Nigeria, government is the main client of construction industry, government is indeed not taking the issue of LCC seriously to ensure future generations are provided with an acceptable standard of living and quality of life Ellingham &Fawcett, (2006). Until there is an efficient policy and implementation of LCC on construction, and new buildings are procured on a value for money basis for present and future, the government can use its forces to reverse the current practice. Flanagan & Jewell, (2005).

4. 3. Fragmented nature of the construction industry

According to Bull (1993) which identified that the fragmented nature of the construction industry would be a key inhibitor to an increase in the uptake of LCC. The argument put forward implies that a lack of joined up thinking regarding the overall construction process would restrict its application. Each component of the construction process, whether planning, building or maintaining, is considered separately and this approach offers a complete contrast to the philosophy of LCC. In addition Cole and Sterner (2000) explain that bureaucratic structures affecting public sector client organizations have also severely restricted the use LCC analysis on their projects.

4. 4. Separation of capital and running cost of project

Separation of capital/acquisition and running cost of most project, the divorce between capital cost and running cost really affect application of LCC in Nigerian construction industry. The practice of accepting the cheapest tender and then the subsequent handover without any interest in its future beyond the defects liability period. The lack of clear definition of the responsibilities of the buyer and seller are thought to be the reason for this (Liapis, *et al.* 2014). Cole and Sterner (2000) assert that the way public funds are divided between capital spend and ongoing revenue budgets ensure that decisions are made in isolation from each other and not in accordance with the suggested LCC framework. These sentiments are further alluded to by both Perera *et al.* (2009) and Williamson *et al.* (2010) who assert widespread reforms of public expenditure are required to allow LCC to be better incorporated within public procurement budgeting.

4. 5. Type of investor/user

Most developers are concerned with the initial costs as they do not manage the buildings when completed. This result in a lack of long-term interest in the building operating and maintenance costs and similarly, the lack of capital and the high financial costs and prevailing interest rates can limit investors on advanced investment to cut the operating costs (Oduyemi *et. al*,(2014)).

4. 6. Unreliable data

Difficult of obtaining the appropriate, relevant and reliable information and data. The trouble of getting the correct level of information to calculate LCC is one of the main problem in Nigeria. This is as a result of the absence of suitable, applicable and consistent historical figures and statistics (Kishk, *et al.*, 2003). It is true that life cycle costing (LCC) plays an

increasingly significant aspect in assessing the procurement of constructions in Nigeria, but the absence of consistent and reliable data for precise LCC examination remains the problem as stated by Bouachera, *et al*., (2007).

4. 7. Client unwillingness

Clients do not request for LCC during execution of project, this is because most Clients in Nigeria are ill informed about the benefits of a life cycle approach which can lead to subjective decision-making (Memon, 2013).

4. 8. Unstable economic situation

Unstable economic situation is one of the major barrier facing LCC implementation in Nigerian construction industry. The construction industry in the Nigeria is facing unprecedented and demanding uncertainty, rising inflation with poor economic trends, reduction in purchasing power, budget limitation. This really affect LCC implementation in Nigeria.

4. 9. Lack of common and standard method

According to Oduyemi *et. al.* (2014) lack of a common method as the major limitation of LCC and one of the key problems that exist in LCC is the lack of an acknowledged methodology for carrying out an LCC procedure. The journey towards a standardised method has been muted by practitioners since 1970. However, the construction industry is yet to develop a framework for LCC that is not only universally acceptable, but more importantly dynamic in use as most clients now want buildings that demonstrate value for money over a long term. Subsequently, several researchers have sought to use different methods to deliver effective solutions to the problems of uncertainty quantification (Kelly and Hunter, 2009; Kirkham, 2002; Choong, *et al*, 2002; Kirkham, Boussabaine and Kirkham, 2002). However, there is still no real credible user friendly method in place as the existing frameworks do not enable researchers to forecast future operational and maintenance costs before integrating quantitative risk assessment measures (Creedy, 2006).

4. 10. Risk and uncertainty

It has been widely noted that concerns about using a LCC approach are based mainly on the risky nature of the assumptions on which the forecasts are modelled (Boussabaine and Kirkham, 2008). Whilst forecasting of future costs is to some extent not an inexact science, this should not dissuade analysts and managers from attempting to apply LCC principles (Kishk, Al-Hajj and Pollock, 2001).

4. 11. Dealing with intangible factors

Dealing with intangible factors is also a very important barrier as the design or component selection decisions can often be taken based on factors other than financial criteria (Oduyemi *et. al.* (2014). Most of these factors cannot be assessed in a strict LCC framework. This is mainly because either they are in conflict with the main LCC objective or because they are mostly ‘non-financial’ (Kishk, Al-Hajj and Pollock, 2001).

Others barriers are:

Lack of procurement and contract award incentive to the use of LCC; Lack of fiscal measure that encourage client's uses of LCC; Lack of standard method of LCC; LCC skills are unavailable; The result are difficult to interpret and directly useful; There is insufficient time to carry it out; Client are unwilling to pay for it; Not compatible with client intangible for non-financial objective and need..

5. DRIVERS OF LIFE CYCLE COST IN NIGERIAN CONSTRUCTION INDUSTRY

These are the main drivers to implementation and great use of life cycle costing in Nigeria;

5. 1. Government intervention:

Nigerian construction industry has all this while depends on Government on most it activities example in about three decade ago came the introduction of structural adjustment programme (SAP), maybe because the Government has a crucial role in determining demand for the construction industry's output and its growth prospects. Life cycle costing on construction project will not be an exception. Government involvement through the introduction of LCC policy, regulations, guidelines and enforcement of LCC will make the practice one the important activities carried out when estimating and project construction.

5. 2. Training and education of LCC:

In Nigeria LCC is not yet a concept well known and practiced by all the practitioners involved in the building industry. Training and educating the professionals in the industry in LCC techniques and practices hopes to prove that it is truly beneficial and a worthwhile practice to enhance the value of any building project presently and future sustainability. It is important for Nigerian built professionals especially quantity surveyors to become aware of and familiarize themselves with LCC. The professional bodies like NIQS, QSBN, NITP, should organize seminars and educational awareness to the members. We are a few steps behind with LCC compared to some of the developed countries like Britain, Australia, North America and China.

5. 3. Client commitment and involvement:

The involvement of the clients and the consultants were important drivers in implementation and great use of LCC since they are the key players who play an active involvement in order to produce the specified sustainability buildings and other facilities during the construction process. Therefore, client input must be considered through a thorough understanding of the outcome of the specified construction project. By analyzing the information gathered from the various literatures from this perspectives, this would be able to enhance the implementation of LCC techniques in Nigeria construction industry in procuring the projects. The Client commitment will be very important due to their contribution to the development and growth of Nigeria construction industry. Others drivers are: Societal awareness and Incorporate LCC in procurement and contract award.

6. CONCLUSIONS

As reviewed and discussed above, the benefits of LCC are well cited as to determine how to best reduce a building's ownership costs to achieve a financially viable investment. This can be done by initially considering what the fundamental costs are that will notably impact on the cost of ownership, i.e. operation, maintenance, and refurbishment and replacement. Evidence showed that LCC helps to reduce the overall cost of a project by selecting best alternative designs and components to minimize the cost not only at the time of construction, but also the over the full life of the project. It is hoped that the Nigerian construction industry will make constructive strides towards implementation of LCC as a mechanism for change.

This paper also gave an overview on the barriers of LCC implementation in the Nigerian construction industry with drivers on how its implementation can be established. This has led to the identification of the most relevant barriers hindering its implementation. Lack of quality data available to execute the analysis due to unstable economic bring about bring a big blow on LCC implementation on Nigeria industry. Fluctuation and unstable price of materials is not an exemption.

Moreover, main drivers to implementation and great use of life cycle costing in Nigeria are Government intervention toward LCC policy and training of LCC techniques. Recognized professional bodies within the construction industry like NIQS, QSBN, NITP, NIA, COREN these professional bodies could encourage increased LCC education for their members. Failure to do this would result in not reaping the benefits of the LCC implementation. Likewise government involvement through the introduction of LCC policy, regulations, guidelines and enforcement of LCC will make the implementation ride on a smooth path.

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