LIFE CYCLE COSTING OF ENGINEERING PROJECTS IN NIGERIA

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ABSTRACT

Costing of projects is carried out employing different methods. Most of the methods take into consideration the initial cost of the material or equipment only. This paper examines the use of life cycle technique (LCT) for costing engineering projects. It focuses on different stages of life cycle costing to estimate total project cost. It was highlighted that life cycle costing, though new in Nigeria, be used for project cost estimation for optimal results. Limitations of the technique were discussed. Merits of this method of evaluating projects were also captured.

Keywords: Life cycle, Costing, Phases, Engineering projects.

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1. INTRODUCTION

The cost of ownership of civil engineering infrastructure is becoming an increasingly worrying problem with which clients (both private and public) are struggling to get to grips. This is often attributed to the appalling state of infrastructure works and associated cost of maintenance. To some, this is the price the industry is paying for awarding contracts based on the lowest cost principle (Bttigole, 1990). Industries have been called to adopt strategies that will address the problem. One such strategy is the use of financial analyses of estimates, using the life cycle costing analysis technique.

Escalating costs of recurring energy shortages are increasing the need for the design and construction of buildings with low operating and energy costs. Laws and regulations aimed at abating pollution and improving the environment have further complicated planning and design of both new construction and rehabilitation. The impact of these and other economic and social phenomena on the construction industry is attracting attention to the technique of life cycle costing.

Life cycle costing is a systematic evaluation of alternative building designs and the comparison of their projected total ownership, operating and maintenance costs over the economic life of the proposed building. The intent is to identify that design which would be the most economical over the useful life of the proposed building. Utilization of the life cycle costing technique holds a promise of improving decision making while simulating competition. Although its use by both public and private sector is rapidly increasing, life cycle costing is in the early stages of application in construction industry.

Life cycle costing is a valuable management tool for the comparison and analysis of alternative means of satisfying space requirements- should the owner lease, build, or rehabilitate existing space. It shifts attention from initial

acquisition costs to total life-cycle costs, and if accomplished during the development and design phases, the owner achieves even greater performance and cost effectiveness than previously realized. Everyday decisions made by a layman involved life-cycle costing. For instance, the value of life-cycle costing (LCC) is illustrated by comparing the acquisition and operating costs of a car to that of a building. A person can purchase an inexpensive car that runs perfectly well for a period of time. After awhile, it develops problems that make the operating cost to be high, thereby drawing his resources throughout its lifespan. An owner is faced with the same problem in the acquisition of buildings or building systems. Unless future operating, maintenance, repair, and alterations costs are given more than casual consideration, apparent savings generated by low initial procurement costs soon disappear because of abnormal future ownership costs. Life-cycle costing provides cost information that is valuable in choosing from among those alternative building designs and systems that meet established baseline performance requirements. Life cycle costing is a meaningful management tool that is used to obtain the best building for the money expended. Usage of this tool is indispensable in view of the fact that it gives total future ownership cost as against the initial acquisition cost.

2. LIFE CYCLE COSTS (LCC)

Life cycle costs are the total acquisition, ownership, and disposal costs of an item throughout its life. The most economical building is one that is designed for the lowest life-cycle cost, not just the lowest initial cost.

2.1 Phases of Life Cycle Costing

The life cycle costing of equipment, material or building is spread out in the following stages/phases of cost:

1. Conception
2. Feasibility

3. Design
4. Construction
5. Operating and Maintenance (O&M)
6. Disposal cost (if applicable)

The total life cycle cost of a building /equipment is the summation of all above costs.

This is explained in a bar chart shown in figure 1 below.

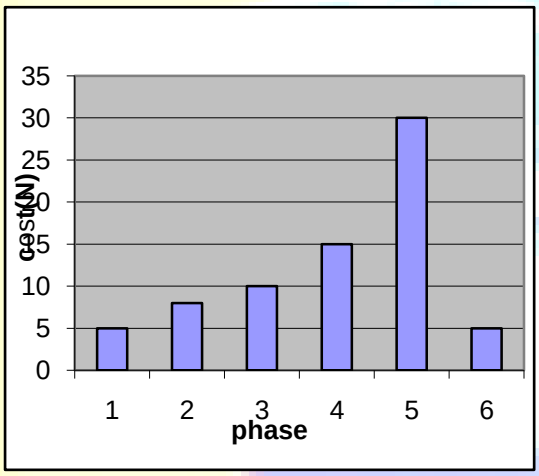

Fig 1: Bar chart showing costs of life cycle phases.

Analyzing figure 1, O&M phase has the highest cost. This is obtainable for most facilities. This explains why it is not realistic to evaluate project alternatives using initial ownership costs only.

Conception Phase

The need for a facility is identified and defined during this phase. Then, alternatives to satisfy the need are generated, defined and analyzed, and the appropriate course of action is determined.

Feasibility phase

Here the different alternatives are analyzed on their individual merits to determine whether they are possible and likely to be achieved. They are examined to determine whether they are practicable. For instance, if the decision is to build, site requirements are defined, and action is initiated to acquire the site. Project management and implementation plans are prepared and approved. Approval is granted and sufficient funds are provided to proceed with t5he next phase.

Design Phase

The defined need is translated into drawings (plans, sections, elevations, etc, specifications and other contract documents. More definite estimates are prepared. Funds are allocated for the next phase. The main use of whole life-cycle costing is potentially very useful at the design stage where a lot of alternative are normally encountered. Additionally, the cost and resistance to making changes to t5he design is much less at this stage (Arditi and Messiha, 1996).

The drawings and specifications are converted into a finished product that satisfies the defined need. If it is a construction work is commenced and completed. If an equipment, or material like a vehicle, the construction works is commenced and finished at the end of this phase the owner occupies or starts using the facility. In situations where the decision to use the technique was not part of the design process, the contractor may use a method of construction which would comply with the specifications but can affect the overall life cycle cost(Ashworth, 1993).

Operation and maintenance (O&M) phase

O&M is the predominant and normally the longest phase of the buildings life cycle. It is the phase during which the owner uses the building. This phase begins at beneficial occupancy and ends when the building passes out of the hands of the owner. During maintenance of project infrastructure, LCC can be used to

evaluate difference maintenance options available. This will include not only the type of maintenance but also the type of different material to be used, since different materials have different service lives. At present, this is one area where the technique is widely used (Lead Beater, 1995). When a structure has undergone cycles of maintenance, there comes a time that a decision has to be made regarding further repair, rehabilitation reconstruction or replacement (4R's). This is because it is generally acknowledged that the cost of maintenance of infrastructure increases as years go by.

Disposal phase

This is carried out, if necessary, at the end of the useful life of the facility. For instance, industrial machinery is disposed of at the end of its useful life.

In Nigeria, like many countries of the world, it is usual practice to compare project design alternatives by their initial capital costs and considering other costs t in LCC. This is misleading in view of the fact that a project alternative may have high initial capital costs and low O&M cost while it is the reverse for anot5her alternative. Moreover, design alternatives are most of the time analyzed using their initial capital costs. The lifecycle cost analysis (LCC) brings all the costs in focus to enable choosing the alternative that is most cost effective. The least LCC is chosen as the best alternative on ground of cost optimization.

Life cycle costing of project could also be illustrated by considering a business man that wants to acquire land and develop it for a residential apartment. One alternative is a land that is located outside the center of the town where the buyer trades and where his children school. The cost of the property is seven hundred thousand naira (#700,000) only for a plot of land. The second alternative is a land at the town center where his business, market and school for his children are located within walking distance. The cost of this particular property is three

million naira (#3,000,000.00) only. Assuming that the same type and quality of building is to be built, the prospective buyer is now faced with the choice of the property to procure from the two alternatives, it will definitely have much higher life cycle cost. In the first alternative, after building the house, the owner will spend more money on transportation, for children schooling and going to business center for various activities. Though acquisition cost is lower in the first alternative, the operating and maintenance costs for this will be higher by many folds.

You will discover that with just few years, if he chooses the first alternative; will spend money up to the cost of the land for the second alternative. In effect, if we consider total cost of ownership for the facility, one will discover that it is more economical to buy, develop and use the land that has higher initial cost but with minimal operating and maintenance (O&M) costs during the service or useful life of the building.

2.2 Generic Problems / Limitations

Many problems are associated with the technique of life-cycle costing. Irrespective of the style of application of the technique, the following are the general problems after associated with the use of the technique.

- Lack of reliable and credible historical database.
- Difficulties in forecasting or estimating costs associated with the Future e.g. operation, maintenance and the salvage cost.
- The reliability of the assumptions used for the analysis.
- Acceptability of the concept: - Due to the visibility of initial costs Versus the lack of visibility of future operating costs, it is difficult for Owners and designers to accept the concept that initial acquisition Costs are only a small fraction of the total ownership costs over the Life of the building/facility.

2.3 Life-Cycle Cost Analysis (LCCA)

The concept of life-cycle cost analysis is used to select from project alternatives a project that is most cost-effective.

Life cycle cost analysis is a method for assessing the total cost of facility ownership, taking into account all costs of acquiring, owning, and disposing of a building or building system.

The purpose of an LCCA is to estimate the overall costs of project alternatives and to select the design that ensures the faciliaty will provide the lowest overall costing ownership in consistence with its quality and function(http://ww.wbdg.org/design/func_opr.php). The LCCA should be performed early in the design process while there is still a chance to refine the design to ensure a reduction in life-cycle costs (LCC).

LCCA takes into account costs of acquiring, operating, maintaining and disposing of a building or building related costs usually fall into the categories:

- Initial costs- purchase, acquisition, construction costs
- Fuel costs
- Operation, maintenance, and repair costs
- Replacement costs
- Residential values- Resale or salvage values or Disposal cost.
- Finance charges – Loan interest payments
- Non-monetary Benefits or costs

In essence, life cycle costing (LCC) is the systematic evaluation of alternative building designs and comparison of their projected total ownership, operating and maintenance costs over the economic life of the proposed building. The intent is to identify that design which would be the most economical over the useful life of the proposed building.

The most economical building is one that is designed for the lowest life-cycle cost, not just the lowest initial cost.

Lowest life-cycle cost (LCC) is the most straightforward and easy to interpret measure of economic evaluation [Sieglinde Fuller (national Institute of standard and Technology (NIST)(http://www.nist.gov/index.html)]. Some other commonly used measures are Net savings or Net Benefits), savings to investment Ratio (or savings Benefit-to-cost Ratio), internal Rate of Return, and payback period. The approach to making cost effective choices for building related projects can be quite similar whether it is called cost estimating (http://www.wbdg.org/design/utilize_management.php), value engineering (http://www.wbdg.org/design/use_analysis.php), or economic analysis (http://www.wbdg.org/design/use_analysis.php).

3. DISCUSSION

Life cycle costing as a technique has helped in the choice of alternative designs, materials and procurement of some engineering projects, of these some notable examples in civil engineering are bridges, pavements and highways. In addition, life cycle costing full is aiding designers/engineers to be more proactive in terms of the structures they design and build. Average designers/engineers know that the structure designed and built will not collapse, however the same engineer may not be in the position to fully establish the effect of the design on the maintenance bill of that structure. With full use of LCC more can be achieved by the designers and the engineers in estimating life cycle cost of projects.

4. CONCLUSION

In the past, engineering infrastructure has been procured based on the lowest initial capital cost philosophy. This has resulted in infrastructures having a very

high maintenance bill, thus making the cost of its ownership somewhat difficult. This paper has tried to show that with a thorough and systematic implementation of life-cycle costing analysis in the procurement of engineering infrastructure, the problem can be reduced. Many of the phases of life cycle costing , for instance Operation and Maintenance, disposal stages, are not captured during life cycle costing of projects in Nigeria. Life cycle costing of projects should be employed to ensure most projects are not under estimated. It is recommended that this method of costing be used in Nigeria to achieve optimal cost estimate for engineering projects.

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