

IMPORTANT OF LIFE CYCLE COST ON BUILDING PROJECTS

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Abstract- this paper clarifies the important of life cycle cost on building projects and explains the effect of accuracy estimate of the total life cycle cost on building projects. In addition, this paper aims to provide general concepts about the field of life-cycle costing. The purpose is to provide the essential backgrounds which will assist the stakeholders to understand the benefits of implementation of life cycle cost in the building projects.

Keywords- Life cycle cost, Building projects, estimation and accuracy.

I. INTRODUCTION

There are numerous ways to define the concept of cost. Generally, cost is the financial value of all goods and services consumed in order to achieve an organisation's goals [1]. Cost estimating is one of the most crucial functions in decision making at the early phase of a project life-cycle [2]. All decisions about cost estimating and the implications for the project at hand, requires a range of stakeholders including the owner, contractor, designer, and lending company, involving economic analysis of number of alternative project components, clarifying the feasibility of a project or identifying an initial cost of a project [3]. The next section identifies the importance of cost estimation for construction projects.

II. IMPORTANT OF COST ESTIMATION ON CONSTRUCTION PROJECTS

Estimation is an important financial issue to be taken into account as part of the project management exercise. It involves estimation of total costs and benefits of the project and alternatives. The project management team subsequently measures the return on investment or the payback period (the period of time that project will take to recoup the initial cost invested on project) to make an assessment about the desirability of the chosen alternative. This information also helps in shaping the opinion of financial and banking institutions that are associated with the project.

The significance and influence of construction cost estimating is supported by research. Carr [4], for example, has contended that cost estimation delivers substantial information for cost planning, resource controlling and decision making. Cost estimation is one of the most important factors to the success of project [5]. Alcabes [6] articulated that cost estimators duties include preparation of all estimates, check lists and pricing information; he also asserts that cost estimation is the heart of construction work as it

involves cost reporting, accurate cost classification and calculation of profit. Akintoye and Fitzgerald [7] surveyed 84 building companies in UK and found that cost estimation is a key method for construction contractors in terms of construction planning purposes rather than construction evaluation. Several surveys have been conducted by Hegazy and Moselhi [8] to identify the main elements of cost estimation and the kinds of methods used for estimation of these elements by building construction constructors in Canada and the USA; they found that the majority of contractors estimated direct and project overhead costs in a detailed manner. Assaf [9] studied the overhead cost of construction project in Saudi Arabia and found that the decision about the optimum level of overhead costs is difficult for construction companies to make it due to unstable construction market which enables them to win and carry out large projects.

Aibinu and Pasco [10] studied the importance and accuracy of cost estimation of building construction projects in Australia. Their study involved examining 56 building construction projects and surveying 102 companies. Their results indicate that size of project is the most influential factor in cost estimation of building construction project in Australia. Overestimated cost by a large amount often occurred in small projects rather than under-estimations. In order to improve cost estimation, they recommended several methods such as using probability estimation and simulation of past estimates; such methods are discussed further below.

III. THE EFFECT OF INACCURATE COST ESTIMATION ON CONSTRUCTION PROJECTS

Accurate cast estimation is a challenging task in the construction project, in which cost estimation is the determination of the total project cost and prepared based on limited information and under situations of high uncertainty [11]. There are three possible results

of cost estimation which are: accurate estimate overestimates and underestimate.

The relationships between these outcomes can be seen in the fig.1. This figure has been represented by Frank Freiman who developed fast cost estimation system for Radio Corporation of America (RCA). Overestimates may lead to higher cost out-run than projected due to under-utilisation of resources such as staff, acquiring excess capacity and the company becoming weak because it is unable to provide a suitable product for a reasonable price.

On the other hand, a cost under-estimate means the total cost of project is more than predicted. Poor estimation and planning are often the causes of under-estimate. The outcome of an under-estimated project may lead to increasing the cost of projects due to reorganisation and replanning resulting in delay [12]. In this case, Construction client has three options[13]:

1. A construction client will terminate the project and incur loss.
2. A construction client will carry out the project while seeking extra funding.
3. A construction client will decrease the quality of the project to avoid the additional funding.

Good cost estimation requiring realistic estimates and economical project cost-ings help achieve a project's goals as illustrated by [12] in fig.1 below. The methods to assist in this activity are discussed in the following section.

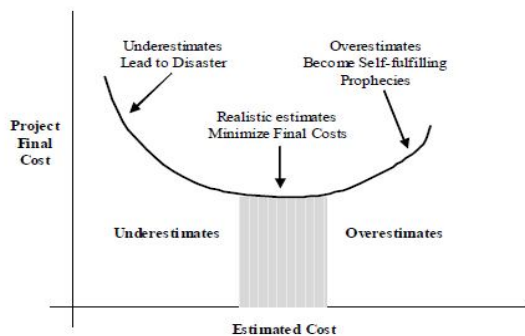


Fig. 1 the Freiman Curve

The next section illustrate the impact of making decision about the project based on capital costs instead of consider all total cost including capital costs, maintenance and operation and disposal cost.

IV. THE IMPORTANT OF TAKING INTO ACCOUNT ALL TOTAL COST INSTEAD OF THE INITIAL COST

In the past, decisions in the construction of many civil engineering systems and buildings throughout the design phase were made basically by comparing initial capital costs. The main motivation for utilising this

method was its simplicity [14]. Furthermore, construction clients always give a high priority to initial cost as the most visible one. They are unable to aware the inter-dependant relation between life cycle cost of the construction and the initial construction cost [15]. Previous studies indicate that often the total cost of ownership of engineering system exceed initial costs. According to several studies, the total cost of ownership of engineering system (i.e., maintenance and running cost) is about 10 to 100 times the original initial costs [14]. In civil engineering sector, the initial cost of building project represents only a small amount of its life cycle cost. It has been predicted that the initial cost of building projects is about five times less than their life cycle cost [16]. For example, National Building Research Institute of South Africa reported that the initial cost of hospital building is only between 6 to 10 % of the total life cycle cost. In addition, they found that from 2 to 3 years after the project construction completing, the operation costs exceed the initial cost[17]. Moreover, Roger, George, Justin and Graham [18] studied the life cycle cost of different types of building such as Primary schools, home for elderly and Secondary schools and indicated that the initial cost of these projects is less than half of the total life cycle cost as in fig. 2-4. The same result has been found by O'Rourke [19] in UK as in fig. 5.

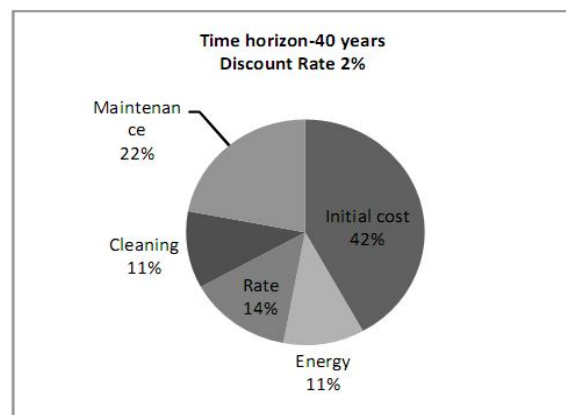


Fig. 2 Life cycle cost for homes for elderly

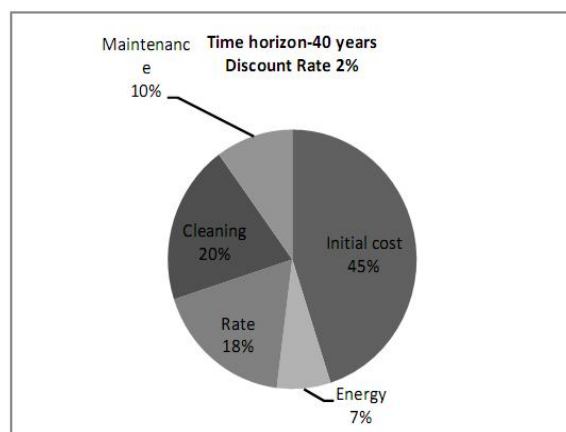


Fig. 3 Life cycle cost for Primary school

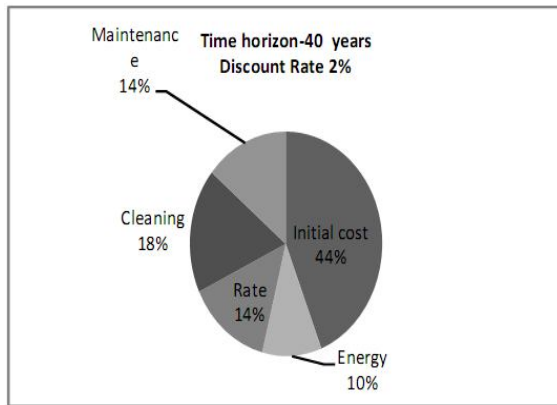


Fig.4 Life cycle cost for secondary school

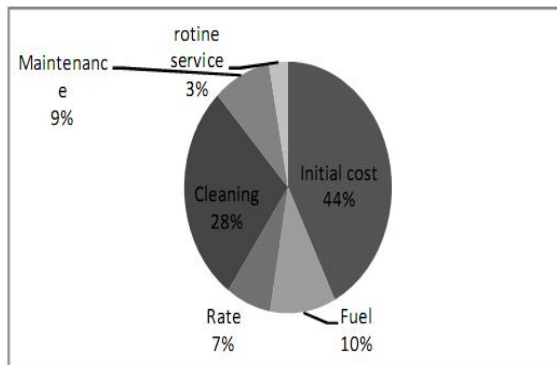


Fig. 5 Life cycle cost for National school

In order to successfully complete projects and make profit, the acquisition decisions of construction projects at the design stage should be made based on their life cycle costs rather on their initial costs. In addition, appropriate cost reduction measures can be easily taken when predict of the life cycle cost is available at an early design phase. However, when the construction project moves from early design stage to construction stage, possibilities to influence the total construction project cost are decreased quite significantly [20]. Fig. 6, shows that the ability to decrease cost of project during all stage of project's life cycle[21].

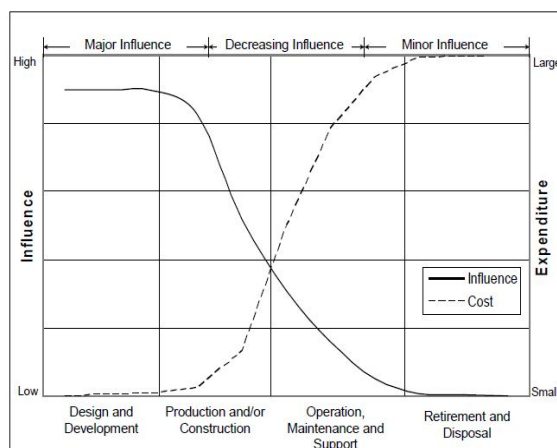


Fig. 6 the ability of decrease cost of project during all stage

The utilizing of life cycle cost approach may lead to increase the initial cost of building but in same time may decrease the amount of the overall cost over the life of this project. The purpose of life cycle cost approach is to inject the maximum information into the design phase, assisting to decrease waste and to improve efficiency of design and construction as well as operation and maintenance [16].

V. HISTORY AND DEFINITIONS OF LIFE CYCLE COST

The principle of Life –cycle Costing (LLC) is not new. The first extension of life cycle cost dates back to World War II when the U.S Department of Defence (DOF) used life cycle cost in the procurement of weapons and weapon support system[22].

In the early 1960s, the life cycle cost theory was developed by the DoD to increase the effectiveness of their procurement policies [23]. These policies were discussed by several researchers in the following references- Metzler[24], Gansler [25], Earles [26], Dixon & Anderson [27], Caver [28] and Dighton[29].

The Japanese is considered the first country used life cycle cost concepts widely to overcome the destruction of World War II, and to refresh their economy as the second objective by saving costs in the long term [30]. In the 1970s idea of integrate product design and economic modelling was narrowly applied. In the late 1970s, the life cycle cost was employed on construction projects in U.S with aim to discover the alternative energy design choices in construction projects [31].

Prior to the 1970, the procurement decisions were making based only on capital costs. During that time, Terotechnology School discussed that there were alternative and more effectiveness methods of making decisions than based only on capital costs [32]. The life cycle cost idea was widely beginning by the argument of spending more in initial cost would consequence in saving more in the long term when compared with cheaper options. While the concept of life cycle cost are created on long established philosophies of mathematics, economics, engineering and risk analysis, implementation of life cycle cost in construction engineering sector is still under improvement [33]. The main aim of any construction engineering activity has always to analyze and determine how they can design and arrange physical factors in order to create beneficial in a way that meets the need at the lowest possible cost. Therefore, a principle of life cycle cost was always included in engineering designs.

It was often thought that it can achieve economic competitiveness and strengthened through a life-cycle attitude in engineering. Although this philosophy deeply rooted engineering economic has been

confirmed by engineers at early stage of the project's life cycle, and focus primarily on the performance of early design with ignored generally the project life cycle performance, financial factors and consequences of operational and maintenance phases at the later phases of the project life-cycle [34].

The term cost-in-use refers to as operation costs of projects and was appeared in the literature in the early 1970s. However, The main weakness of this term model was its incapability to predict future costs [32]. Recognizing that prediction was a key element, the concept of the LLC appeared as a new methodology for assessing the costs through the late 1970s. The utilisation of life cycle cost in UK construction sector received a motivation with the publication by the Royal Institute of Chartered Surveyors of study by Flangan [35] on the concept and implementation of life cycle cost. In addition, the society of Chief Surveyors in Local government provided a report in the form of practice manual. Ashworth[36] has tried to focus more on the reasons behind the difficulties in application of life cycle cost.

Internationally, the application of life cycle cost has been gaining consideration. In 1985 there was conference held in New Zealand concerning about the impacts of decision making at early stages of asset's life cycle on the value of building assets. There was general agreement on the principle of total life cycle cost's importance; but no proof was existed of its normal employ as management tool by designers and project owners in New Zealand[37].

According to Ashworth [36] the life cycle cost has been widely applied in North America as recommended by Jelen and Black's [38], Ahuja and Walsh[39], and Lawl. Ruegg [37]carried out survey in U.S. and found that eight organisations had 14 life cycle cost documents guiding internal life cycle cost practise. Four documents were represented to investment in general, seven to energy investment, two to renovation decision and one to investment in hospitals.

Moreover, The Department of Energy has taken plan to expand the utilization of life cycle cost. The purpose of this program was to present practical and effective ways and process to Federal agencies for prediction life –cycle cost; to present saving of proposed and renewable energy [37].

In light of the above definitions, life cycle cost can be thought as a systematic assessment of total cost of asset from cradle to grave. It is a structured technique which assists in analysis alternatives, and therefore in reducing total expenditure over its anticipated life-span. This technique can be used from the simplest to the most complex projects. For example, when purchasing a new house, several factors may be considered such as maintenance, original cost, insurance, mortgage liability and so forth. This is an

example of the life cycle cost principle. The outcome of life cycle cost can be utilized to aid management in the decision making procedure when there is alternative option.

VI. THE OBJECTIVE OF LIFE CYCLE COST

Investment in the industry involves several of decisions for difference purposes. Some of these decisions are about budget and cost, some about benefits, some have immediate effect, and some have long term impact. Using life cycle cost as tools of making decision can be useful for shareholders of project (Client, Project team and contractor). The client may use life cycle cost to evaluate project viability, make a correct decision about the project (continuing or aborting a project), analysis all costs budget which are required for carry out the project and to measure the capability of pay for design facility. The project teams may use life cycle cost to choose best alternative among options and the most useful procurement approach, identify cost drivers and predict future budget requirements, create significant decisions policy and design trade-offs, control programmes and minimise total cost and clarify issues linked to the ultimate disposal of the asset. life cycle cost can be used to select contractor when the project is placed for tender. In addition, there are many number of recent trends have appeared as issue of worry for the design professional, involving: environmental sustainable, total quality management, value engineering, operation effectiveness, facility obsolescence. life cycle cost can be utilized to deal with these issues.

CONCLUSION

This paper illustrates the importance of construction projects, and estimation cost. There is generally agreement that construction projects must change the old method of investment which concern about initial cost with the concept of life cycle cost method which concern about all cost occurred during all stages of asset life cycle.

This paper also clarifies the historical development of the concept of life cycle cost from its early utilize in the military purposes to a broader approach. Life cycle cost is a systematic assessment of total cost of asset from cradle to grave. It can be used to estimate the total cost of an asset from early stage to disposal stage. In light of above one may conclude that life cycle costing can be utilized as management tool to support decision making process that may be incurred during all phases of construction project's life cycle (more details about construction project life cycle stages will be discussed in next chapter). Many researchers believe that making decision at early stage of construction project life cycle have the most important

effects on the running costs of construction project over their life span.

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