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TABLE of CONTENTS

Voice of Academia
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Mohamed Sabli et al. / Voice of Academia 14(1) 2019, 53 - 63

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THE AWARENESS OF LIFE CYCLE COSTING AMONG ARCHITECTS

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ABSTRACT

Life cycle costing (LCC) is a method of accessing the total cost of facility ownership and has been used in foreign countries for the last few decades. Even though it has been used widely in the foreign countries, our country still far behind as the application of the LCC is not been used wide enough. In fact of that, in order to increase the usage of LCC technique in Malaysia, each party that involved in the industry should have their own awareness to implement the technique in our industry. The implementation of LCC technique in Malaysia construction industry will lead to a greater success in the field and will brings good increasingly-competitive business environment, dwindling resources and an ever-increasing need to obtain value for money in all areas of corporate activity. It is essential to plan and monitor assets throughout their entire life cycle, from the development until the completion of the project. Therefore, the main aim of this paper is to measure the awareness of LCC among the architects since the implementation of LCC should start at the design stage. Feedbacks obtained from the questionnaire survey has shown that there are still lack of awareness among architects about LCC implementation during inception and briefing stage and this may lead into a few issues in light of the fact that LCC is one of the vital components in bringing the value for money to the construction projects. In-depth study of LCC is the crucial factor to be considered at the early stage of the project, in order to ensure the good returns and the best value for money to clients.

1. Introduction

Life Cycle Cost (LCC) can be defined as "the present value of the total cost of the project/ asset over its entire operating life and includes the initial capital and construction costs, operating and maintenance costs and the cost or the benefit of eventual disposal of the asset" (Rangelova & Traykova, 2014). Others described LCC as a method of expenditure evaluation in which recognizes the sum total of all costs that associated with the expenditure during the time that the building is constructed, as well as when it is being used (Akbar & Mokhtar, 2017). LCC is employed as a tool which synthesizes data and contributes to making a logical decision (Reynolds & Hills, 1976). In Malaysia, the Public Works Department (PWD) has developed a standard guideline of LCC called

'Garis Panduan Pengiraan Kitaran Hayat' (KKH) [Standard Guideline of Estimating Life Cycle Cost (LCC)]. This guideline was developed to provide appropriate methodology for the practice of LCC analysis for future public projects in the Malaysian construction industry (Ayob & Rashid, 2014).

Construction industry is one of the key industries that plays important role towards improved social well-being of a nation. It is a driver of economic growth especially in developing countries. According to Khan et al (2013), Malaysian construction industry has been contributing between 3-5% of the nation's aggregate economy Gross Domestic Product (GDP) for the past two decades. In terms of labour productivity, the construction sector has recorded a growth of 12.4% in 2016, which although is low compared to other sectors, stills plays an important role to the Malaysia's economy through its multiplier effect on other industries (CIDB, 2017). Thus, the industry plays a critical part in the advancement of the economy in Malaysia. The author believes that greater application of the Life Cycle Cost (LCC) method in the construction industry can further contribute to the development of the economy.

The main purpose in implementing LCC is to figure out and determine the best way to reduce building's ownership costs in order to achieve a financially viable investment (Highton, 2012). Apart from that, LCC can be used as a management tool in the sense that it could be used to estimate the costs that will incur during a building's life. Additionally, it acts as maintenances guide because it could be utilized to estimate the forecasted annual operation and maintenance cost as well as those that occur at regular intrevals through out the building's life, such as repair and replacement cost (Kirk & Dell'isola, 1995). LCC serves as a far more accurate analysis of the long-term cost effectiveness of a project as it concentrates on overall cost rather than initial cost only. With clients now demanding buildings that demonstrate value for money over the long term, LCC has become an essential tool for those involved in the design, construction, and operation of construction projects (Boussabaine & Kirkham, 2006). LCC approach can be applied throughout the project entire life (Ashworth & Hogg, 2000), but LCC will be most effective if it is used in the early development phase of a project, such as in the design phase (Che Mat 2002; Clift 2003). The reason is that most of the operating costs which accumulate during a lifetime of a building are determined at a design phase (Bogenstätter, 2000). During this stage, factors and maintenance costs of a project are accounted to obtain a more accurate LCC projection (Akashah & Rum, 2011). Optimal benefits will be obtained on larger and more complex projects (Rangelova & Traykova, 2014). If properly carried out, LCC will deliver benefits such as (a) transparency of future cost of operations, (b) improve ability to plan future expenditure, (c) increase awareness of total cost, (d) improve ability to manipulate and optimise future costs at the design stage, (e) higher chance to achieve and obtain better value for money (VFM) in project, (f) provide competitive alternatives evaluation and (g) better performance trade-offs against cost (Langdon & Everest, 2004; Akinrata, 2017). Additionally, LCC can be utilize in promoting and achieving sustainable construction (Rahim et al, 2014).

2.0 Problem Statement

The utilization of LCC in the construction industry remains limited (Heralove, 2017). Many literatures have suggested various reasons for this. According to Lindholm & Suomala (2004), unfamiliarity of LCC and uncertainty of the benefits gained by its implementation were seen to be the general problems. Lack of incentives to use LCC (Flanagan et al, 1987) also remains as one of the contributing factors (Cole & Sterner, 2000; Akinrata, 2016; Zuoa 2017). Kishk et al (2006), Wu et al (2006) and Zuo (2017) emphasized that lack in the availability of quality data

needed to execute the analysis is one of the critical issue that affects the application of LCC. Akinrata (2016) sumps up the other barriers which include unstable economic situation, government policy, separation of capital and running cost, lack of standard method of LCC, unavailability of skills and many more. Zuo et al (2017) also added lack of understanding of methodological problems and limitations of LCC, among others, as issues that continue to arise when it comes to LCC application.

By understanding the concept of LCC and its long term benefits, all project teams that involved in the construction project would certainly applies the LCC technique. Furthermore, continuous promotion and support by institutions of higher learning, architectural offices and construction firms to managers who lack awareness on the importance of LCC are needed (Toor & Ofori, 2007). Government intervention in relation to LCC policy as well as training programmes on LCC techniques may also be a driver in greater use of LCC in the industry (Akinrata, 2016).

3.0 Aim and Objectives

This paper aims to measure the level of awareness of implementing LCC in the construction industry focusing at the design stage. The specific objectives of the study include;

i) To identify the scope of Life Cycle Costing application in construction industry;
ii) To measure the awareness of Life Cycle Costing among architects in construction field; and
iii) To suggest the ways to enhance the awareness of Life Cycle Costing among architects.

From the outcomes, the sourced information will be recommended as proposals to improve the Life Cycle Costing application for construction development in the future.

4.0 Life Cycle Costing (LCC)

There are several terms used such as “cost in use”, “life cycle cost”, “whole life costing” and “whole life appraisal” (Wan et al, 2014). Although the terms used are interchangeably, the life cycle cost is used equivalent to whole life costing or appraisal and the term life cycle cost is better known term used in the practice today (Levander et al, 2007). According to the Australian government document, “cost in use”, “life cycle cost”, “whole life costing” and “whole life appraisal” are the terms used interchangeably which brings the same meaning but in different period of time (Wan et al, 2014).

LCC analysis is one of the method for economic evaluation of alternatives that will cogitates all the appropriate costs that linked to the project for its life time. It is a method of expenditure evaluation which recognizes the sum total of all costs associated with the expenditure during the time it is in use (Okano, 2001). From LCC to Life Cycle Cost Management (LCCM), there are three perspectives that need to be considered which are production or producer’s perspective, the customer’s or user’s perspective and societal or environmental perspective (Haes, & Rooijen, 2005). Furthermore, LCC analysis also known as one of the method used to determine and allocate the given budget among competing projects in order to get the most out of the overall net return of the project (Ellingham & Fawcett, 2006). Life-cycle cost is determined by identifying the applicable functions in

each phase of the life-cycle, pricing these functions, applying the appropriate costs by function on a year to year schedule, and ultimately accumulating the costs for the entire span of the life cycle (Okano, 2001).

According to Hasan, (2007), LCC is the sum of the present value (PV) of investment and operating costs for the building and service systems, including those related to maintenance and replacement, over a specified life span. Experience has shown that a major portion of the projected life-cycle cost for a given product and system stems from the consequences of decisions made during early planning as part of the conceptual design (Okano, 2001). In other words, important fundamental aspects of LCC is that LCC analysis is undertaken across the entire phase of the building process.

In construction industry, LCC can serve as a valuable technique to predict and assess the cost performance of constructed assets, and thus aid in determining whether or not a project meets the client's performance requirements (Akasah, 2012). According to Shamsuddin et al (2015), life cycle costing consists of initial cost (design and construction), operating cost (energy, water/sewage, waste, recycling and other utilities), maintenance, repair and replacement cost and other environmental or social costs/benefits (impact on transportation, solid waste, water, energy, infrastructure, worker productivity, and outdoor air emissions, etc.). Thus, by implementing life cycle costing in any project development, all the inputs and outputs of acquiring, possessing and disposing of the building can be identified. This approach is particularly useful when project alternatives, which fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings (Hikmat & Saba, 2009; Sterner, 2000). Furthermore, LCC applied for instance in design stages will overall run into the required objectives of the building by compelling the initial capital costs, operation and repair costs, as well as the life of the building itself, which is vital in any development. In fact, all the cost performance over the economic life span of the building can be supervised and managed through its application during operation of the building constructed.

5. 0 Life Cycle Cost Based On Design Decision

The conception and structure of buildings nearly always laid a rigid focus on delivering at the lowest capital cost, but now a greater consciousness and desire to look at costs over the whole life has persisted. According to Ashworth & Hogg (2000), value improvement in the building industry is imperative and will benefit all stakeholders in the industry such as the clients, contractors, advisers and the company as a whole. Nowadays, clients not only focus on the short term value for money but also entail the true value for money over the long term. This is due to the government initiative such as 'Rethinking Construction Best Value and Private Finance Initiative' that have underpinned the importance of Whole Life Cycle Costing which can be brought to the industry (Kirkham, 2002). The integration of LCC might facilitate collaboration between organisations throughout project design and construction, especially because it is considered as an influential technique in the construction industry (Rahim et al, 2014).

LCC can be applied at each stage during the life-cycle of the projects (Ofori-Darko, 1997; as cited by Mohamed et al, 2007) in which different costs are incurred in between (Cole and Sterner, 2000). However, LCC calculations are usually carried out in the design phase of projects where they are more functional since there is a great opportunity to explore and compare different options against each other (Sterner, 2000). Ashworth and Hogg (2000) found that

the usage of LCC is the most effective during pre-construction phase in terms of overall cost consequences of construction; particularly at conceptual and preliminary design stage whereby changes are able to be made easily and the resistance to making such changes are less likely to occur. This was supported by Che Mat (2002) and Clift (2003), where they suggested the implementation of LCC should be as early as possible to obtain the maximum effect. Hence, it is very crucial to ensure the decisions made at the design stage are precise because the decisions have deep impacts on the LCC of the building (Flanagan & Jewell, 2005; Ellingham & Fawcett, 2006; Ashworth, 2010).

6.0 Research Methodolgy

This research was conducted by distributing a set of questionnaire survey to respondents whom are architects by profession. The questionnaires developed include questions which have selective-based and rating-based as the type of answering methods. The selective-based questions required respondents to tick one or more answers as accordance to the instruction given, while the rating-based required respondents to choose the answer on a four-point scale (ranking). Methods used to conduct the survey were by mail, through interview sessions, as well as self-administered. A random sampling method was used to identify the respondents from architect firms located within the Klang Valley are. There were about 100 sets of questionnaire survey sent out to the architect firms to collect the data that needed for this research.

7. Results And Discussion

7.1 The Scope of Life Cycle Costing

In this part of questions, the respondents had been asked about the stages of the construction projects where the concept of LCC is typically implemented based from their previous projects they have undertaken. Table 1.0 below shows the data analysed from the respond gathered by using descriptive statistics.

Table 1.0 Implementation of Life Cycle Costing

Construction Phase	Mean	Std. Deviation
Appendix A. Inception process.	2.60	1.287
Appendix B. Design process.	2.60	1.333
Appendix C. Construction process.	2.72	1.272
Appendix D. Operation & maintenance process.	2.55	1.298
Appendix E. Demolition process.	2.28	1.341

The results from Table 1.0 above shows that the inception process has a mean of 2.60. This indicates that during this stage, the architects rarely implement LCC probably because at this phase, the architects will only get the initial details about the development required by the clients. The interaction between clients and architects will develop further during the design process. The implementation of LCC in the design stage is also low with an average mean of 2.60 which can be concluded that the respondents have low involvement in the implementation of LCC. At thi stage of the process, it incorporates all the thought or theoretical stage, arranging stage applying preliminary design, design phase implementing design and shop drawings, and acquirement stage including documentation. The result shows occasionally the implement of LCC in the design stage by the respondent because of the difficulty in obtaining quality data upon which to base the LCC calculation with. Table 1.0 also shows that the construction process, operation and maintenance together with demolition also have a low of mean with 2.72, 2.55 and 2.28 respectively. This further emphasized the conclusion that LCC in the construction project is uncommonly used. Overall, this situation occurs probably due to the difficulties in obtaining information by the respondents about the LCC, lack of awareness about the LCC, and the nearness of various parts of necessities coveted by customers.

7.2 The Awareness of Life Cycle Costing Among Architects in Construction Project

In order to measure the knowledge and understanding of the respondents on LCC, a set of questions that included the basic information about LCC were asked. This can be used in order to analyse the level of awareness among respondents related to the implementation of LCC in the construction industry.

Table 2.0 Importance of Life Cycle Costing

	Mean	Std. Deviation
Appendix A. LCC comprises of research and development cost, production and construction cost, operation and support cost, retirement and disposal cost.	3.67	.697
Appendix B. LCC analysis is undertaken across the entire phase of the building process which are from inception process, design process, construction process, operation & maintenance process and demolition process.	3.65	.845
Appendix C. LCC will involve of all the producer, supplier, design team, customer and all related cost from inception until demolition	3.60	.778
Appendix D. The primary objective of LCC is to provide a technique which has the potential for the correct financial evaluation of buildings and replace the traditional methods based on the initial costs of the building project.	3.54	.797
Appendix E. By enforcing the concept of life cycle costing, it can furnish useful data to clients and suppliers and directly can be one approach to probe the price effects of outsourcing from both the customer's and supplier's point of opinion.	3.48	.858

From the analysis carried out, it clearly indicates that the respondents understand the application of LCC can be done in five stages of the buildings life which are inception, design, construction, operation & maintenance, and demolition stage. In overall, the respondents has the understanding that LCC is entirely about the cost components that are taken for the whole life cycle of a building with a mean of 3.65 and 3.67 with standard deviation 0.697 and 0.845.

The respondents also agreed that LCC will involve of all the producer, supplier, design team, customer and all related cost from inception until demolition. With the mean of 3.60 it shows that the respondents understand the importance of LCC to all parties involve in the construction process and all those cost related cost to the buildings life can be reduced and be monitor efficiency with the implementation of LCC. The respondents also aware with 3.54 mean, the main primary objective of LCC consists of identifying the total cost commitment rather than concentrating on the initial, facilitating an effective choice between alternative methods of achieving a stated objective, detailing the current operating costs of assets such as individual building elements or complete building systems, identifying those areas in which operating costs might be reduced, determining the factors of maintenance costs in order to lessen it. The result also shows the level of understanding regarding the effect of LCC to the among Architect to the construction projects are still moderate with the mean of 3.48. Without a full understanding about the outcome from the application of LCC from the architect, it make the application of LCC in construction project become harder to be implemented.

7.3 Ways To Enhance The Awareness Of Life Cycle Costing Among Architects

In this part of the survey, the respondents were asked about the approaches that can be taken in order to raise the awareness level on LCC among the architects.

Table 3.0 Approaches that can be taken in order to raise the awareness of LCC

	Mean	Std. Deviation
Appendix A. Introduced LCC in education system.	4.37	.691
Appendix B. Government start introduce LCC concept in government project.	4.35	.687
Appendix C. Board of Architects Malaysia (BAM) give information about LCC.	4.32	.723
Appendix D. Conference or workshop about LCC	4.26	.705

In light of the outcome, the respondents suggested that the presentation of LCC in education system is the primary element that should be considered important with the most elevated rate of mean which is 4.37. It is believed that the architects would be more aware about LCC if they obtained such knowledge at earlier point of their studies before the embark on their carreer. Government initiative is also important in order to promote LCC concept in the construction industry.

The result shows that government intiatives has the second highest mean with 4.35. This show that most of the respondent agrees with the government roles in the utilization of LCC concept in the construction projects. In fact, the government should start implementing LCC concept in public projects so that all the parties involved would be exposed, thus enhancing the awareness level amonh the architects especially, particularly concerning what and why LCC is needed in that particular project. Government may also arrange for enforcement of LCC implemention in every project. In line

with the Government roles in promoting LCC, PAM also need to play their part in introducing LCC to the architects since PAM is the nation's professional institute representing architects in Malaysia.

Lastly, conference or workshop to raise the awareness on LCC among the architects has the lowest mean with 4.26 but fairly important as the other approaches. The need for architects to attend conferences and workshop annually to enhance their knowledge and maintain their network with the industry players, would ensure that this approach is vital in promoting LCC awareness among them.

8. Conclusions

The outcomes from this research had been developed through several phases in order to understand the importance of life cycle costing to be implemented in construction projects. All parties who are involved in a development, should be involved in the application of LCC, especially the architect since LCC would be at its best when it is utilized at the early stage of the project, and of course until the end of the buildings' life span. The Government and Board of Architect Malaysia have to play an effective roles in order to create awareness among architects regarding the importance of life cycle costing and its benefits. Hopefully the implementation of LCC will give the industry the best value for money and a good return on investment for the clients.

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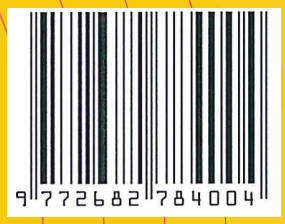

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