THE APPLICATION OF LIFE CYCLE COSTING IN MALAYSIA CONSTRUCTION INDUSTRY-CLIENT PERSPECTIVE

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Abstract
The application of Life Cycle Costing (LCC) in Malaysia is still in its early stages compared to developed countries such as Australia, United Kingdom and Singapore. The practitioner and client are not seriously concerned about the value and cost of the building but only the exterior and aesthetics of the building. This paints a picture of the lack of application on life cycle costing by both practitioners and clients in the Malaysian construction industry. The main purpose of this research was to establish the impact of life cycle costing in the Malaysian construction industry, the objectives by which to achieve the aim of the study included, to identify the challenges encountered in the implementation of LCC in Malaysian construction industry; to identify the strategies to overcome the challenges in the implementation of LCC in Malaysia construction industry; and to analyze the impact of the application of LCC in Malaysian construction industry. The research used a questionnaire survey approach, with 215 questionnaires distributed to experienced developers in Kuala Lumpur and Selangor. Altogether, 66 valid returned questionnaires were analyzed using descriptive analysis. Based on the findings for research objective 1, the most challenges in implementing LCC is poor demand from the clients. For research objective 2, the appropriate strategies to overcome the barrier is to introduce the benefits of LCC towards clients. The findings for research objective 3, optimize the overall cost of the building was reported as the major impact in implementing LCC. Owing to the increasing importance of LCC in various settings, the study concludes by emphasizing the need to promote the adoption of LCC in the Malaysian construction industry.

Keywords: Construction industry, challenges, costing, adoption, life cycle costing, Malaysia

1. INTRODUCTION
In general, lack of understanding of life cycle costing among the practitioner in the construction industry has led to the poor perception of Life Cycle Costing (LCC) benefits (Hassan et al., 2014). According to Chiurugwi et al., 2010, the lack of the application of LCC stems from poor demand from construction clients, which in turn is as a result of no promotion of the life cycle costing approach. The application of LCC in Malaysia is still in its early stages compared to developed countries such as Australia, United Kingdom and Singapore (Noor, Aizuddin, & Eves, 2010). According to Hassan et al., 2014, the practitioner and client are not seriously concerned about the value and cost of the building but only the exterior and aesthetics of the building. Most of the clients focus only on initial costs but very rarely they consider future costs. Other than that, techniques including life cycle costing (Ayob; Ayob & Rashid; Chiurugwi et al.; Gluch & Baumann; Kawauchi & Rausand; Rashid & Ayob) are rarely applied in Malaysian construction industry (Ayob & Rashid, 2011). According to Hassan et al., 2014, one of the challenges to implementing life cycle costing is lack of awareness and understanding among practitioners in Malaysian construction industry. The situation described above paint a picture of the lack of application on life cycle costing by both practitioners and clients in the Malaysia construction industry on motivating the LCC concept and practice. According to Hassan et al., 2014, LCC is a concept that seem ambiguously understood in the construction industry in Malaysia.

Therefore, the aim of this paper is to establish the impact of Life Cycle Costing in Malaysian construction industry. This aim is achieved through the following objectives; to identify the challenges encountered in the implementation of Life Cycle Costing in Malaysian construction industry; to identify the strategies to overcome the challenges in the implementation of Life Cycle Costing in Malaysian construction industry; and to analyze the impact of the application of Life Cycle Costing in Malaysian construction industry.

2. LIFE CYCLE COSTING
Life Cycle Costing was first developed in the mid-1960s in the United States Department of Defense for all types of procurement and purchases. LCC involves the systematic consideration of all related costs and revenues related to the ownership and acquisition of an asset (Cole & Sterner, 2000; Flanagan & Jewell, 2008). It minimizes total expenditure through proper evaluation of costs that will be incurred through the life
of the asset (Flanagan & Jewell, 2008). Compared to developed nations, LCC use in the construction industry in Malaysia is still in its infancy (Noor et al., 2010). Besides that, LCC concepts and practices seemed to be unrecognized and there is lack of knowledge among practitioners in the construction industry (Rum & Akasah, 2012). Other than that, they only concentrate on the initial cost but very seldom take into consideration the future cost for example operations, maintenance, replacement of building facilities (Ayob & Rashid, 2011). It has long been recognized that to evaluate the costs of buildings on the basis of their initial cost alone is unsatisfactory, cost in use must also be considered (Ashworth & Hogg, 2014). Moreover, LCC has been applied to facilitate the agencies to identify excessive costs, maximize cost saving in the building and optimize the overall life cycle costing to obtain standard qualities demanded (Noor et al., 2010). However, in Malaysia there is no evidence that large number of people have knowledge of life cycle cost and practice life cycle costing technique to evaluate total ownership cost of a building project (Ayob & Rashid, 2011). Therefore, in order to improve this issue, it is crucial to understand why there is lack of application of LCC in Malaysian construction industry and how to improve it.

2.1 Challenges to Implementing LCC
Life cycle costing provide benefits to the owner and clients such as value for money, optimize the overall cost and minimize the operational and maintenance cost of the building. However, the application of life cycle costing is still not widely adopted in the construction industry, especially in Malaysia. There are many problems and barriers in the implementation of life cycle costing. Life cycle costing is not widely adopted in the construction industry. In the United Kingdom, lack of understanding of LCC was ranked as the most limiting factor to usage of LCC (Olubodun et al., 2010). One of the challenges in implementing LCC in Malaysian construction industry is lack of the awareness of the application of life cycle cost among building owners and design teams (Cole & Sterner, 2000; Rum & Akasah, 2012). This process involves long-term investment associated with large impact over a long duration of time. In addition estimating costs into the future may result in an LCC calculation that is faulty (Ashworth & Hogg, 2014). According to Cole & Sterner (2000), one of the key reasons for limited acceptance and implementation of LCC relates to methodological limitations, that is, the lack of a standard format of LCC methodology.

One of the challenges in implementing LCC is perceived inaccuracy of the results of LCC analyses. This would be difficult to concur with, however, as it is unlikely that one would go back and compare how accurate forecast of whole life costs really was (Olubodun et al., 2010). According to Chiurugwi et al. (2010). Main sources of data used in LCC analysis are usually not strong and due to lack of reliable data. Client requirement has also been recognized as a key motivation for implementing LCC. Educating clients about the practice and benefits of LCC one of the options to increase the usage of LCC (Olubodun et al., 2010). Lack of motivation to use LCC among clients is due to lack of understanding of LCC. Besides that, clients give low priority to LCC due to their perception that LCC offer little or limited benefits (Cole & Sterner, 2000). This is also true to the Malaysian construction industry as Hassan et al. (2014) reports poor demand from the construction clients in regarding the use of life cycle costing in their projects.

2.2 Strategies to overcome the challenges to adopting LCC
Life cycle costing is still not widely used in the construction industry, especially in Malaysia. Several factors have been identified in the earlier as challenges to implementing LCC. There are, however, strategies to overcome the barriers, which will be discussed below. The uncertainty towards the benefits gained with LCC is seen to be the general problem to LCC (Lindholm & Suomala, 2004). Clients are not aware of the benefits of the implementation of life cycle costing in their projects, thus the introduction of public awareness programs on the benefits of LCC can be done by highlighting the consequences of a long-term ownership through better understanding of the initial costs and recurring costs. For designers to perform a life cycle cost analysis, the owner must provide the practitioner with sufficient information such as financing costs, facility’s economic life and return on investment (Kirk & Dell’Isola, 1995). A life cycle costing analysis involves the uncertain and unfamiliar, which is symbolized in the assumptions about future costs, future inflation rates and life of the component and asset. The uncertainty surrounding the variables used in any LCC model should be eliminated to improve the accuracy of the estimation (Aouad et al., 2001). The use of sensitivity analysis has provided a medium to test any suspected variables against various alternatives for any differences or changes to the results. Many researchers (e.g. Aouad, 2001; Flanagan, 2008) recommended utilizing either the sensitivity analysis or probabilistic risk assessment technique. Based on the research,
there is no encouragement and specific requirement in procurement for LCC. In Malaysia, the relevant authorities (e.g. JKR, CIDB) should encourage and make mandatory requirement for LCC research in public buildings. One of the strategies to overcome the challenges in implementing LCC in the construction industry is to develop appropriate software for performing LCC. The lack of a universal method and useful software are often cited as one of the reasons for limited performance and use of LCC (Cole & Sterner, 2000).

2.3 Impact of application of LCC in the construction industry
Many studies have identified the impact of implementing LCC in the construction industry. One of those is that maintenance costs can be minimized (Hassan et al., 2014; Noor et al., 2010). Life cycle costing is a method of economic analyzing of all costs related to constructing, operating and maintaining a construction project over a defined period of time (Heralova, 2014). Life cycle costing is an instrument for optimizing buildings with a long-term perspective (Pelzeter, 2007). According to researchers, productivity can also be maximized indirectly (Noor, 2010). Some organization have preventative and strategic maintenance policy, however, among many the budget for these is generally insufficient to meet anything like total need. For example, lift breakdown in the building will affect the productivity of the building. According to Higham et al. (2015), using LCC for value for money tool for public projects to ensure the project meets the requirements of the project’s end users. According to Flanagan & Jewell, 2008, every decision should drive best value not best price. In the short run, best price may be attractive however will not deliver the best facility based on long-term value. A higher investment may offer greater long-term benefits and advantages with reduced operating and maintenance costs (Flanagan & Jewell, 2008). The service life is the period of time after installation during which a building and its elements meet or exceed performance requirements (ISO 15686-1-2000). The lifetime of services of any building is governed by several different factors. Some of the factors are sufficiency of the design, constructional details and the method used for its construction (Ashworth & Hogg, 2014). LCC is useful for developers who intend to have long term involvement with their asset. This will optimize ownership costs over the whole life of the asset (Higham et al., 2015).

3. RESEARCH METHODOLOGY
The scope of this research covers LCC use by developers in the Malaysian construction industry, focusing primarily on Kuala Lumpur and Selangor, the two most developed and economically advanced states in Malaysia. A questionnaire survey was considered appropriate to gather information from developers regarding LCC use, challenges to implementing LCC, strategies for improving implementation and impact of LCC application to construction projects. First, a piloting of the questionnaire involving thirty (30) construction practitioners was carried out. A pilot study provides a trial run for the questions, which involves testing the wording of the question, identifying ambiguous questions, testing the technique that is used to collect data. The practitioners were required to give comments and suggestion which were used to improve the questionnaire. Secondly, the improved questionnaire was distributed to experienced developers in Kuala Lumpur and Selangor. Generally, the questionnaire designed in five sections that consist of 24 questions, presented in three pages of A4 size paper. The questions used combination scale of measurement such as ranking, multiple-choices, rating and open-ended questions. For the respondent’s particulars, multiple-choice questions were used for the respondents to select one of the answers provided in a question. In total, 215 questionnaires were distributed to developers who were identified from the Real Estate and Housing Developers Association, Malaysia. The questionnaires were distributed to the targeted respondents in Kuala Lumpur and Selangor by post and via the Internet and were instructed to complete the questionnaire based on their experience in handling any construction project. Sixty-six (66) returned questionnaire was sorted out and deemed valid for data analysis. Data analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 20.0. Selected appropriate statistical tests were employed using the software, based on the types of data. The descriptive statistical test was used for the data presentation and analysis. Mean score and standard deviation were used to determine ranking of the variables in the study.

4. RESULTS AND DISCUSSION
As described earlier, 215 questionnaires were distributed and 66 returned questionnaires were found to be valid for analysis, resulting in a 30.7% response rate. The respondents have to evaluate by giving answers on a Likert scale of 1 to 5 (1 – strongly disagree; 5 – strongly agree). The ranking of the degree of agreement
for the application of life cycle costing in the Malaysian construction industry used the mean score to rank the results.

### 4.1 Challenges to implementing LCC in the Malaysian construction industry

Table 1 shows the results regarding the challenges of LCC implementation in the Malaysian construction industry. As shown in Table 1, ‘poor demand from the clients to use LCC’ ranked as the number 1 challenge to implementing LCC with mean score 4.42. This was followed by ‘lack of motivation to use LCC among clients’ with mean score 4.29, ‘difficulty in obtaining reliable data’ with mean score 4.24, ‘practitioners not aware of LCC concept’ with mean score 4.21, and lack of understanding LCC concept among practitioners with mean scores 4.03. All the indicators in the challenges of LCC in the Malaysian construction industry have a mean value of more than 4 which indicating that all are important challenges. The results show that all the aforementioned are main challenges of LCC implementation in the Malaysian construction industry. The findings related to the poor demand of LCC by clients supports (Hassan, 2014). As Hingham (2015) mentioned, the practitioners do not promote LCC to the clients, which leads to poor demand for LCC from clients. According to Cole and Sterner (2000), lack of motivation to use LCC among clients is due to lack of understanding of LCC. Besides that, clients give low priority to LCC as they perceived it to have limited benefits. The third major challenge was difficulty in obtaining reliable data. This supports findings from Ayob & Rashid, 2011; El-Haram, Marenjak, & Horner, 2002; Flanagan & Jewell, 2008; Kishk et al., 2003) that one of the major challenges in implementing LCC analysis is lack of reliable data on costs and performance. In addition, the slow development of LCC in Malaysia is due to the lack of knowledge and understanding regarding LCC concept and its importance towards construction projects (Rahim et al., 2016).

<table>
<thead>
<tr>
<th>Challenges encountered the implementation of LCC in the Malaysian construction industry</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of understanding LCC concept among practitioners</td>
<td>4.0303</td>
<td>.65562</td>
<td>5</td>
</tr>
<tr>
<td>Practitioners not aware of LCC concept</td>
<td>4.2121</td>
<td>.69093</td>
<td>4</td>
</tr>
<tr>
<td>The process of LCC is complex</td>
<td>3.3636</td>
<td>.77730</td>
<td>8</td>
</tr>
<tr>
<td>Absence of standard methodology</td>
<td>3.6212</td>
<td>.85512</td>
<td>6</td>
</tr>
<tr>
<td>Perceived inaccuracy of results</td>
<td>3.4545</td>
<td>.66058</td>
<td>7</td>
</tr>
<tr>
<td>Difficulty in obtaining reliable data</td>
<td>4.2424</td>
<td>.74546</td>
<td>3</td>
</tr>
<tr>
<td>Lack of motivation to use LCC among clients</td>
<td>4.2879</td>
<td>.62672</td>
<td>2</td>
</tr>
<tr>
<td>Poor demand from the clients to use LCC</td>
<td>4.4242</td>
<td>.65775</td>
<td>1</td>
</tr>
</tbody>
</table>

### 4.2 Strategies to overcome LCC implementation Challenges

Table 2 shows the results regarding the most appropriate strategies to overcome the challenges of LCC in Malaysian construction industry. As shown in Table 2, ‘introduce life cycle cost benefits to the clients’ obtained the highest mean score of 4.36. This was followed by ‘provide sufficient information’ with mean score of 4.33 and ‘mandatory requirement’ with mean score of 4.00. All these three strategies had a mean value of 4 and above, which indicating that they were the most appropriate strategies to overcoming the problems of LCC implementation in Malaysian construction industry. The results show that all items are the strategies to overcome the challenges of LCC in Malaysia construction industry. The results support arguments by Chiurugwi et al. (2010), that lack of appreciation of LCC translates to poor demand for LCC from construction clients because no one promote it to the clients. Clients are not aware of the benefits that they can get from the implementation of life cycle costing in their projects. In conjunction with limited consideration of the concept, the clients are not aware that conducting life cycle costing analysis is not a waste of money. The introduction of public awareness programs on the benefits of LCC by highlighting the consequences of long-term ownership through better understanding of the initial costs and recurring costs. LCC will bring more advantages than disadvantages to the property manager, thus, ways to enhance LCC implementation in the Malaysian property development sector is make it mandatory for public buildings (Noor et al., 2012). Introducing to the client benefits of LCC give more benefits towards government and other parties. Mandatory requirement is one of best strategies to overcome the problems of implementing LCC. Regarding this, the government must take into consideration and at the same time introduce and promote the benefits of LCC. These results also support the arguments by Dunk (2004); Lindholm &
Suomala (2004); and Rebitzer et al. (2004) that uncertainty towards the benefits gained with LCC are general problems to LCC implementation.

Table 2: Strategies to overcome the challenges in the implementation of LCC

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduce life cycle cost benefits to the clients</td>
<td>4.3636</td>
<td>.71546</td>
<td>1</td>
</tr>
<tr>
<td>Provide sufficient information</td>
<td>4.3333</td>
<td>.68687</td>
<td>2</td>
</tr>
<tr>
<td>Conduct risk analysis to reduce uncertainty</td>
<td>3.8485</td>
<td>.84567</td>
<td>5</td>
</tr>
<tr>
<td>Mandatory requirement</td>
<td>4.0000</td>
<td>.89443</td>
<td>3</td>
</tr>
<tr>
<td>Developed appropriate software</td>
<td>3.9091</td>
<td>.83624</td>
<td>4</td>
</tr>
</tbody>
</table>

4.3 Impact of LCC implementation in the Malaysian construction industry

Table 3 shows the results regarding the impact of LCC implementation in the Malaysian construction industry. As shown in Table 3, ‘optimizing the overall cost of the building’ was the highest ranked impact of LCC implementation in the Malaysian construction industry. Pelzeter (2007) notes that life cycle costing is an instrument for optimizing buildings with a long-term perspective. Even though it is ranked the lowest, the mean scores show that this variable is highly integrated. This analysis shows that the ‘improve the lifetime performance of the building’ and ‘optimise lifetime cost of ownership’ have same mean scores with 4.09. The results support Woodward (1997), that LCC is a concept to optimise the total costs of asset ownership. This can be realized by identifying all the significant net expenditure arising during the ownership of an asset. The lowest ranked impact was ‘minimised the maintenance cost of the building’ with mean score of 3.97. During design development, the team in charge in life cycle costing need to identify the best choices of systems, elements and components of the building. The team will identify those alternative material that may reduce the maintenance costs and operational cost and the team will choose the best design and material to optimize the overall costs of the building. Life cycle costing bring more good impact towards Malaysian construction industry. This is supported by Roda & Garetti (2015) who notes that, cost of ownership is strictly related to the concept of life cycle costing.

Table 3: The impact from the application of LCC in Malaysian construction industry

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimise maintenance cost of the building</td>
<td>3.9697</td>
<td>.72260</td>
<td>7</td>
</tr>
<tr>
<td>Optimise the overall cost of the building</td>
<td>4.1818</td>
<td>.67730</td>
<td>1</td>
</tr>
<tr>
<td>Maximise the productivity of the building</td>
<td>4.0606</td>
<td>.69898</td>
<td>5</td>
</tr>
<tr>
<td>Best value for money</td>
<td>4.0758</td>
<td>.75060</td>
<td>4</td>
</tr>
<tr>
<td>Increase the value of investment</td>
<td>4.0152</td>
<td>.69043</td>
<td>6</td>
</tr>
<tr>
<td>Improve the lifetime performance of the building</td>
<td>4.0909</td>
<td>.67316</td>
<td>2</td>
</tr>
<tr>
<td>Optimise lifetime cost of ownership</td>
<td>4.0909</td>
<td>.71742</td>
<td>3</td>
</tr>
</tbody>
</table>

4.4 Perception of LCC in the Malaysian Construction Industry

Table 4 shows the perception of developers on the future benefits and trends of LCC in the Malaysian construction industry. As the results in Table 4 show, 100% of the respondents think LCC will give more benefits towards the Malaysian construction industry. Regarding the future trend of LCC, 68.2% of the respondents stated the trends of LCC will remain static whereas 18.2% predict the application of life cycle costing in Malaysian construction will decline. In fact, 13.6% of the respondents stated others which means the respondents stated the trend static growing with slow pace. It can concluded that, even though LCC appears to have good impact on the Malaysia construction industry, the respondents did not see it been widely implemented in the Malaysian construction industry in the near future as they considered its level of current implementation to be static over the foreseeable future. The argument can be made that, though the respondents consider the impact of LCC implementation in the Malaysian construction industry to be positive, the challenges and complexity associated with implementing LCC make them believe wide adoption of LCC in the forceable future is not likely.
Table 4: Respondents’ perception of LCC in the Malaysian construction industry

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you think life cycle costing will give more benefits to the Malaysian construction industry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>66</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>What do you think will be the further trend of life cycle costing in Malaysian construction industry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rapid declining</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Declining</td>
<td>12</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>Static</td>
<td>45</td>
<td>68.2</td>
</tr>
<tr>
<td></td>
<td>Rapid Growing</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>9</td>
<td>13.6</td>
</tr>
</tbody>
</table>

5. CONCLUSION

Life cycle costing is becoming an increasingly important issue in diverse settings including government, private practitioners and academicians. The present study has shown that the application of life cycle costing will optimize the overall cost of the building. Clients and design teams can benefit from the findings as well, where the impact for application of life cycle costing in construction industry will be made aware to them in future projects. The adoption of life cycle costing in Malaysian construction industry can be enhanced by identifying and implementing the strategies to overcome the challenges in the implementation of life cycle costing in the Malaysian construction industry, three of the major strategies, which include, introducing and promoting LCC benefits to clients, providing sufficient information about LCC, and mandatory requirements to implement LCC. This will encourage the practitioners especially quantity surveyors to be more aware and to deliver their services more efficiently and advice the client or developers. As for academics, emphasis should be given to the most suitable strategies to provide useful education on LCC. Professionals, especially quantity surveyors and clients need to analyze the impact of the application of life cycle costing. This will help in understanding the impact and benefits of adopting and applying life cycle costing. It will also create awareness of the importance of the impact of life cycle costing. Quantity surveyors would understand better the impact and benefits of life cycle costing to promote life cycle costing to clients effectively.

References


