PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 19 ISSUE 2 (2021), Page 27 – 38

KEY APPROACHES OF LIFE-CYCLE COST IN GREEN GOVERNMENT PROCUREMENT (GGP) FOR GREEN PROJECTS

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Abstract

Sustainability has emerged as a critical concern in any viable physical planning and development. Hence, the Malaysian government has promoted the concept of green procurement also known as Government Green Procurement (GGP) that aims to minimize environmental degradation. In GGP, life cycle perspective thinking is introduced where life-cycle cost (LCC) tools act as decision-making in controlling the initial and future value of building ownership. Despite the increasing importance of green procurement and LCC in the planning phase of green projects, the viability and implementation of LCC is still lacking. Many have stated the benefits of LCC in green procurement for green building projects, however the criteria of LCC are not clearly determined. The study aims to determine the important level of LCC components relating to the green project planning phase. Questionnaire survey was distributed to 50 respondents composed of project team members that were involved in the selected green government projects. 32 respondents returned their responses to the survey. The results revealed that the highest rank of LCC components in green procurement is energy consumption cost, greenhouse gas (GHG) savings cost, acquisition cost, energy simulation cost and utilities cost. These results would elevate the use of LCC in the green procurement adoption and viability of green projects.

Keywords: Life cycle cost, government green procurement, planning phase, green projects

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INTRODUCTION

Over the last decades, sustainability has emerged as a critical concern that must be addressed in any viable building planning and development strategy, including in achieving green buildings. In Malaysia, sustainability and green growth in the building project's planning has been addressed in the Construction Industry Transformation Plan (CITP) 2016-2020 and 11th Malaysia Plan (2016-2020). To cater the sustainability agenda, the Malaysian government has promoted the awareness of green growth and the concept of government green procurement (GGP) as a method to maintain and minimize the environmental effects (Adham et al., 2015; Buniamin et al., 2016; Kahlenborn et al., 2014). This plan refers to the purchase of products, services and related works in the public sector that take into account environmental criteria to conserve the environment and natural resources, and minimize and mitigate the negative impacts of human activities (Bohari et al., 201; Musa et al., 2013).

Furthermore, Malaysia as a member of the global community is working toward the reduction of carbon under the Low Carbon City Framework (LCCF) (as shown in Figure 1), that sets a target for carbon reduction in the country by 40% in the year 2030. Align to the government's commitment towards reduction in carbon footprint, the LCCF makes a difference partners in cities and townships to define their needs and create activity plans to diminish the carbon outflows as it centers specifically on methodologies and measures towards carbon lessening (KeTTHA, 2011). It is also aligned to the National Planning Policy and Green Neighbourhood Policy sets in the PLANMalaysia (Department of Town and Country Planning) under the Ministry of Housing and Local Governance Malaysia. With the framework and strategic direction in place, the construction industry will need to evaluate its current position and gear its effort in line with the national master plans and agenda.

Due to the importance of public green purchasing and procurement, Malaysia had already established a government green procurement (GGP) guideline for products and services in 2014 and 2018. The guideline was introduced for government procurers through the Ministry of Energy, Green Technology and Water (KeTTHA) (or currently known as KASA) with Malaysia Green Technology Corporation. The GGP guideline was improvised through its latest issuance in the year 2018, where 20 products and services were incorporated instead of 6 products and services in 2014. By adopting a policy and guidelines through GGP establishment, the public sector can also strongly influence the strategies and behaviour of private sectors and organisations, pushing them towards cleaner and more feasible generation designs (Bohari et al., 2020; Razali et al., 2021; Giacomo et al., 2019; Testa et al., 2016).

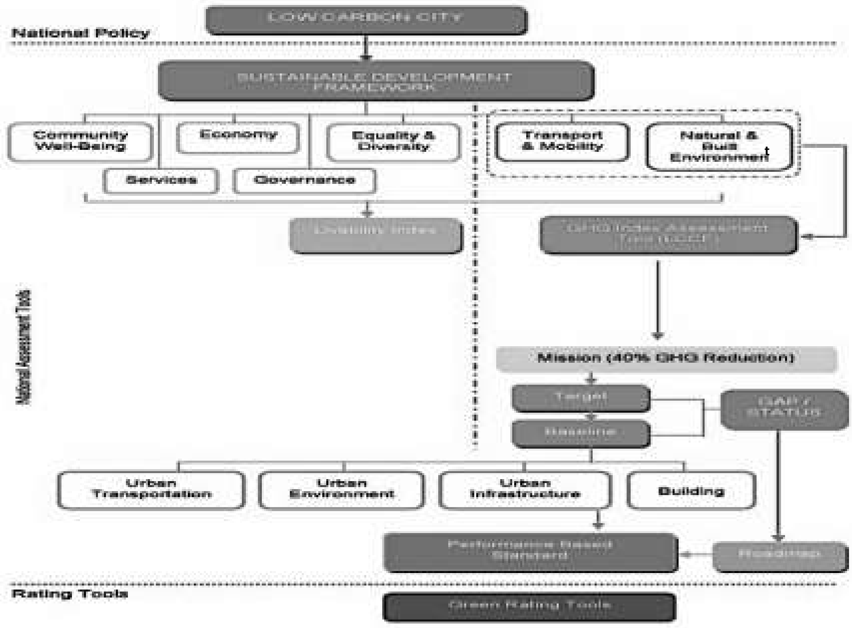

Figure 1: Sustainable Framework for Low Carbon
Source: KeTTHA (2011)

One of the key approaches introduced in green procurement is life cycle perspectives thinking (Giacomo et al., 2019). According to UNEP (2013), life cycle thinking relates to green procurement policy. It represents a holistic approach that allocates life cycle management tools to assist in decision making at development and project stages; including green and sustainable product development, production, green procurement, and final disposal. One of the tools in life cycle management is known as Life Cycle Cost (LCC). According to Oduyemi et al. (2018), LCC is beneficial in allowing owners and clients to make an informed decision about the facility of products before it is used. LCC is a financial assessment towards a decision-making approach that determines the cost of ownership of a facility. It is a useful tool that facilitates controlling the initial and future value of building ownership. In LCC exercise, procurement decisions based on the lowest price risk the systematic exclusion of environmentally friendly options (Giacomo et al., 2019).

Ideally, the concept of sustainability is composed of environmental protection, economic growth, and social equality. In today's critical economy, expectations have gone beyond the design and construction of sustainable and green buildings. As stated by Kshirsagar et al. (2010), owners have broadened their perspective to include operations, maintenance, repair, replacement, and disposal costs. Therefore, a full implementation of the LCC approach in procurement procedures and all costs brought about amid the lifetime of the green ventures ought to be taken into consideration (Giacomo et al., 2019; Marchi & Zanoni, 2017; Pombo et al., 2016). LCC helps public authorities to consider all costs-in-use including the maintenance and salvage cost that are not preliminarily allocated during the product's acquisition (European Commission, 2016). As supported by Dwaikata and Ali (2018), the stakeholders undertook a holistic approach in achieving high efficiency in the procurement process by acknowledging the whole life cycle costs during the planning phase of green projects.

The incorporation of LCC in the decision-making process encourages public administrations to proficiently select between competing items as the purchase costs, maintenance, refurbishing and operating costs are all taken into account, and are expressed in comparable amounts (Heralova, 2014). As mentioned by Giacomo et al. (2019), green procurement and LCC are the catalyst and leads to both environmental public policies and sustainable supply chain management strategies that should be adopted by the government. The relationship of green procurement, life cycle cost and total cost of ownership is depicted in Figure 2.

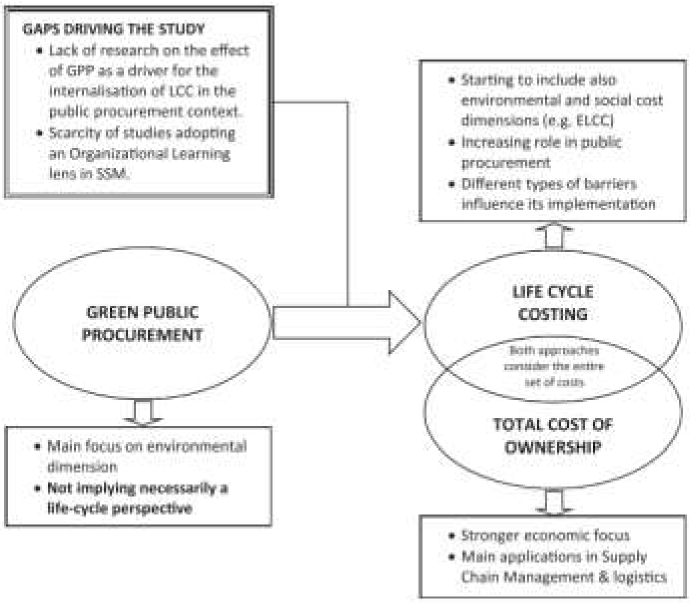

Figure 2: Relationships between green procurement, life cycle cost and total cost of ownership
Source: Giacomo et al. (2019)

PROBLEM STATEMENT

It is noted that the significant barrier for growth in the green building market is the perception of higher initial costs associated with these buildings. It becomes evident that the position of sustainable and green buildings in strategies towards achieving a healthy and sustainable built environment cannot be overemphasized. One of the performance criteria stated in the *Urban Infrastructure* of Low Carbon Cities Framework (LCCF) is energy. The criteria is intended to optimise energy consumption through a design review, technology and innovation with a target of 10% to 40% reduction of electricity by the year of 2030. Among the recommendations stipulated in the key features of energy criteria of LCCF is to encourage the use of low-energy consumption bulbs and other alternative energy-efficient approaches for carbon emission reduction. This is also mentioned by Abu Bakar et al. (2020) that highlights purchasing energy-efficient products and appliances during the planning of physical development will enhance the environmental behavioural and awareness among stakeholders. However, the acquisition costs of energy-efficient devices and bulbs are higher than conventional appliances. This is where life cycle cost (LCC) can play a vital role in enabling the owners and stakeholders to take informed decisions upfront and thereby promote a higher level of sustainability at large (Weerasinghe & Ramachandra, 2018). Therefore, LCC is crucial for decision-makers to survey and evaluate recognizable esteem from introductory capital and operating costs. As supported by Heng et al. (2019), the perceptions of stakeholders are essential where decision making acts as a continuous process in order to satisfy the preferences and needs of decision makers.

Despite the increasing importance of green procurement and LCC in the planning phase of green projects, the viability and implementation of LCC is still lacking. Many have stated the benefits of LCC in green procurement for green building projects, however the criteria are not clearly determined. For example, studies have investigated the relationship between green procurement and life cycle cost (Giacomo et al., 2019), suitability of GGP in an economic crisis (Adham et al., 2015; Nikolaou & Loizou, 2015), stakeholder values and behavioural in green procurement (Bohari et al., 2017; Preuss & Walker, 2011; Testa et al., 2016). Few studies (for example: Antoniadou & Papadopoulos, 2017; Sun & Hong, 2017) are delineated to energy performance criteria rather than looking into the aspects of life-cycle costing. In Malaysia, even though GGP guidelines are introduced for government procurers, the application has yet to be fully implemented due to many issues including data scarce, lack of expertise in LCC techniques, ambiguous input parameters, the rehabilitation time, and the inclusion of the social factors cost (EPU, 2020). Several green project studies in the global context also showed that LCC is not utilised to its full potential data scarcity (Heralova, 2014), inconsistent data collection (Giaconomo et al., 2019) and insufficient collaboration between stakeholders (Higham et al., 2015).

According to Oduyemi et al. (2018), LCC provides more accurate precise evaluation and long-term cost effectiveness of sustainable buildings compared to conventional economic approaches that focus merely only on initial capital costs in the very short term. This is achievable by considering the criteria of life cycle cost (LCC) in the inception and planning stage of green building projects. Decision of green elements and green requirements should be determined in the inception phase of building, by prioritizing the active elements and passive building elements. Hence, a proper plan of these active and passive design elements leads to a sustained performance of green buildings.

METHODOLOGY

The study adopts a quantitative method where the questionnaire is used as the survey instrument. The questionnaire is distributed to 50 respondents, using a purposive sampling method. Purposive sampling is known as non-probability sampling that is a form of intentional selection of informants where researchers rely on their judgment when choosing members of the population to participate in the study (Chua, 2011). As the study is narrowed to the government green projects and the established GGP guidelines, hence the sampling is drawn to the stakeholders in the green government projects, consisting of enabler and user category (Table 1). User category comprises project team members that have been involved in the previous green government projects only, while enabler category comprises experts that are involved in the establishment of GGP guidelines for products and services. The survey was carried out from April to June 2020 via an online platform. The online survey has received 32 responses from the targeted sampling, where the response rate is 64%. According to Creswell (2012), data is valid to have more than 50% responses from the total sampling population. Hence, the data is sufficient and relevant to the purposive sampling concept.

Table 1: Questionnaire's distribution to the respondents using purposive sampling

No.	Respondents' category	Engagement	Total purposive samples (N)
1	Enabler	GGP Core Team (government agencies)	10
2	Enabler	Enabler for green government projects	18
3	User	Consultants for green government projects (architects, engineers, surveyors)	22
Total Number of Respondents			50 (distributed)

The questionnaire consists of 22 components of LCC. The LCC criteria was initially retrieved and compiled from *Garis Panduan Kos Kitaran Hayat*

(JKR, 2012) and also from precedent studies on the LCC to green buildings and energy efficiency. The focus phase is narrowed to the key approach of LCC in the inception and planning phase, as referred to the project stage in the *Garis Panduan dan Peraturan Bagi Perancangan Bangunan* (EPU, 2008). The respondents were asked to rate their agreement level on the importance of the LCC criteria in the inception and planning phase of green projects. Five (5) numerical Likert-scale is used to measure their agreement level, i.e., strongly disagree (scale 1) to strongly agree (scale 5). The questionnaire covers the respondents' agreement level on the LCC components and criteria related to LCC for green government projects.

RESULTS

In examining the completeness of the returned questionnaires, all the raw data was entered into the Statistical Package Software System (SPSS) Version 24. The Cronbach alpha test was performed to ensure the instrument consistently measures the variables. Based on the test, the alpha values are at 0.864. The scale items have an acceptable level of reliability or internal consistency, and no serious problem of multicollinearity exists if the value exceeds 0.70. Hair et al. (2006) further mentioned that an alpha value of 0.60 is also acceptable in exploratory study. The analysis is presented in descriptive statistics using frequency, percentage, mean score, and standard deviation. Figure 3 shows the industry sectors represented by the respondents. The result showed that 65% or the highest respondents represent government officers (n=21), followed by 22% from private organisations (n=7) and 13% from government link companies (n=4). The result of mean score and standard deviation on the costing components is shown in Table 2. The results are arranged in the order of top rank (most important) to the lowest rank (least important).

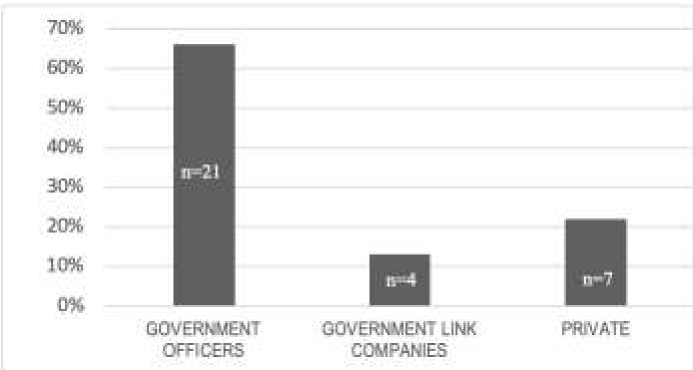

Figure 3: The industry sectors represented by the respondents (n=32)

Table 2: Result on the mean rank of the LCC components

No.	Components and Criteria of Life-Cycle Cost in the Planning Phase of Green Projects	Mean Score	Standard Deviation (*sd*)
1.	Energy consumption cost	4.69	0.535
2.	Green House Gas (GHG) savings cost	4.62	0.554
3	Acquisition cost of green materials	4.59	0.622
4.	Green and energy simulation cost	4.56	0.675
5.	Utilities cost	4.56	0.848
6.	Green buildings certification cost	4.53	0.677
7.	Servicing, repairing and replacement cost	4.53	0.626
8.	Initial Construction Cost (awarded contract sum)	4.53	0.621
9.	Eco-label certification cost	4.50	0.855
10.	Residual cost / salvage cost	4.44	0.675
11	Disposal cost	4.41	0.761
12	Wastage cost	4.41	0.667
13	Discounted cost	4.38	0.877
14	Facility Management Cost	4.38	0.805
15	Inspection Cost	4.38	0.608
16	Development Cost	4.31	0.938
17	Feasibility Studies Cost	4.31	0.783
18	Environmental Management Cost	4.31	0.807
19	Preventive and Schedule Maintenance Cost	4.28	0.779
20	Document preparation cost	4.19	0.842
21	Advertisement Cost	3.72	0.677
22	Value Management Cost	3.66	0.938

DISCUSSION OF RESULTS

Table 2 shows that the mean value ranges from the highest mean score (4.69) to the least score (3.66). The standard deviation (*sd*) value depicts a smaller scattering on the data dispersal, and the obtained *sd* score is less than the mean, ranging from 0.535 to 0.938. The standard deviation shows that the ratings are constant among all respondents; hence, the data are reflected as valid and reliable. By referring to the mean value, it also depicted that the respondents' agreement level on the importance of the LCC components is perceived as moderately agreed to very agreed.

The result shows that the top three (3) important LCC cost to be considered during inception and planning phase is energy consumption cost (mean=4.69, *sd*=0.535), followed by greenhouse gas (GHG) savings cost (mean=4.62, *sd*=0.554) and acquisition cost of green materials (mean=4.59, *sd*=0.622). Energy efficiency and savings on GHG has been the core concern for the green projects. This is parallel to Kale et al. (2016) that mentioned energy consumption cost as the key component in reducing the LCC and the significant annual expenditure. Environmental-friendly or green construction materials utilised less energy and resource consumption during their usage, which leads to reduction in the operational costs. As one of the most widely adopted environmental management practices, these findings support evidence from previous studies (Asmone and Chew, 2018; Chew et al., 2017; Conejos et al., 2019; Khan et al., 2018; Mostavi et al., 2017; Oduyemi et al., 2018). The studies are rationalized by considering opportunities and reducing energy consumption to make savings for green projects.

Acquisition costs of green materials are also one of the top three important component costs to be considered for green projects. Wimala et al. (2016) revealed in their study that over than 30% respondents voted higher costs for green building options than conventional ones as barriers to green projects movement. However, Shamsuddin et al. (2017) argued that even though the initial cost of green materials are higher than conventional materials, the cost savings can be achieved by considering weightings on the cost of ownership or LCC. Hence, understanding the LCC concept is very crucial for green project stakeholders.

The next important LCC costs to be considered during the planning phase are green and energy simulation cost, utilities cost, green buildings certification cost, replacement cost, initial construction cost, eco-label certification cost, salvage cost, disposal cost, wastage cost, and discounted cost. These components are ranked at 4^{th} to 13^{th} rank as the important components of LCC, respectively. Ideally, the components are the general items needed for LCC application. However, for green building certification cost and eco-labelling cost, focus should be made on the incentives or solutions that can reduce the cost. As the components are also important, Wimala et al. (2016) suggested that a reduction of certification fee should be considered to raise interest from the stakeholders to label their green products and buildings.

Next, the LCC components are facility management cost, inspection cost, development cost, feasibility studies cost, environmental management cost, preventive and schedule maintenance cost. Even though these components are ranked at 14^{th} to 19^{th} rank important components, the components are parallel to the study by Kshirsagar et al. (2010); Mostavi et al. (2017) and Shamsuddin et al. (2017). All phases of building life cycle including material extraction and production, maintenance and replacement and demolition should be included in LCC. The least important of LCC components in the planning phase of green projects is document preparation cost, advertisement cost and value management cost. Ideally, all of these three components are similar items needed for all kinds of project, including for conventional projects (Abdul Lateef et al., 2013). It is not merely for green projects. For government projects, value management is mandatory for public projects exceeding RM50 million which is subject to the authorisation of Value Management (VM) Circular 3/2009 by the Economic Planning Unit (EPU) (Maznan et al., 2012). Therefore, value management cost is not only for green projects.

The above results are able to help project stakeholders in determining the viability of green projects through LCC application. Consequently, it is justified to summarise that the LCC analysis can provide a method of determining the entire cost of a structure over its expected life and operational and maintenance cost for green buildings.

CONCLUSION

The life cycle cost (LCC) constitutes a significant aspect of the considerations. Understanding the crucial aspects of green requirements will lead to a better capacity to select appropriate goals and benchmarks over asset, design, project and building life cycles. The significance of LCC to building development stems from long-term speculation for all costs and benefits all through the length of proprietorship. It is hoped that this study will strengthen the LCC adoption and is systematically implemented in the green procurement process.

ACKNOWLEDGEMENT

This project is part of the research consultancy works under the Economic Planning Unit (EPU) for SCP-GGP 2020. The authors also would like to express gratitude to all the invited respondents who took part in the survey.

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Received: 17th May 2021. Accepted: 9th July 2021