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Barriers and Drivers of Whole Life Cycle Costing of Sustainable Facility Management for PPP/PFI Projects in Malaysia

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Whole Life Cycle Costing (WLCC) and Sustainable Facility Management (SFM) are two key principles of Public Private Partnerships and Private Finance Initiatives (PPP/PFI) projects in Malaysia as the projects are usually awarded for a concession period of up to thirty years. However, these principles are at the infant stage which render complications in its implementation. The research seeks to examine the barriers and drivers of implementation of WLCC of SFM for PPP/PFI projects in Malaysia. Quantitative approach is adopted for the research where questionnaires are distributed to all members of Malaysian Association of Facility Management (MAFM). In order to achieve the objectives of the research, collected data is analysed and presented in the form of Severity Index (SI) and Relative Importance Index (RII). The findings reveal that inconsistency in underlying philosophy and methodology, lack of incentive, lack of motivation and lack of well-established standard and method are the main barriers of implementation of WLCC of SFM for PPP/PFI projects in Malaysia. In order to overcome the barriers, there is a need to define the parameters and assumptions of WLCC, to provide incentive for its implementation, to develop WLCC framework and to establish standard and guideline of WLCC. The research recommends that further research is significant in defining the parameters and assumptions of WLCC so that a standardized methodology can be made available to members of MAFM for effective implementation of WLCC of SFM for PPP/PFI projects in Malaysia.

1. Introduction

Buildings are long term investment and they are linked with environmental concerns over its life span (Ristimäki et al., 2013). Therefore, it is essential to appreciate the significance of environmental concerns and its impacts towards early design decisions over a life span of a building. In order to address the issues surrounding long term investment and environmental, nowadays, more projects have been procured using Public Private Partnership and Private Finance Initiatives (PPP/PFI) scheme (Cartlidge, 2006). Similarly, in Malaysia, the implementation of PPP/PFI projects is escalating since years ago which render the significance of Whole Life Cycle Costing (WLCC) and facility management. This is because two of the key principles of PPP/PFI projects in Malaysia are WLCC whereby projects are usually awarded based on lowest total cost over the concession period which is usually in between twenty to thirty years and augment 'maintenance culture' as the concessionaires will be accountable to maintain the assets over the concession period. It has been accentuated by Sarpin et al. (2016) and Hodges (2005) that operation and maintenance are crucial because of its impacts towards WLCC of a building. Apparently, initial costs of a building represent only a minor proportion of its WLCC and most of the proportion is essentially contributed by its operation and maintenance costs. There is a solid relationship between WLCC and operation and maintenance because it is noticeable that decision making without the consideration of WLCC for alternatives in a building will cause issues in the operation and maintenance of the building (Wang, 2011). The most appropriate time for WLCC is fundamentally at the early stage when decisions are still open so as to ensure that optimum decision is made (Cotgrave and Riley, 2012). Also, at this stage, sustainability concerns can be addressed and incorporated.

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The idea of sustainability will impose additional costs to the PPP/PFI projects in Malaysia have to be diminished and the only approach to overcome this typical view is by incorporating sustainability in the early stage of the projects so that it can be quantified in monetary terms over the whole life cycle of the projects. Wong (2010) conducted a research about WLCC for various types of sustainable alternatives of a building. However, the research requires further development and he recommended in his research that an approach of WLCC needs to be developed to assess various types of sustainable alternatives of a building so that to assist decision making in relation to which sustainable alternatives are best value for money. While, Zhou et al. (2006) mentioned that it is critical to integrate sustainability into PPP/PFI projects and also, they pointed out that it is beneficial to investigate WLCC of sustainability in relation to PPP/PFI projects so that a sustainable PPP/PFI projects can be successfully achieved. However, in a recent research by (Highton, 2012), WLCC implementation is hindered and this is due to the lack of standardized method of WLCC. Similar research is significant in Malaysia in order to ensure that WLCC of SFM for PPP/PFI projects in Malaysia can be successfully implemented. Hence, this research seeks to examine the barriers and drivers of implementation of WLCC of SFM for PPP/PFI projects in Malaysia.

2. Literature review

As mentioned earlier, since PPP/PFI projects in Malaysia are usually awarded for a concession period of up to thirty years, there is a need to shift the conventional focus of lowest costs to better value projects. This can be achieved with the implementation of WLCC. WLCC is an approach that is implemented at the early stage of a project in order to evaluate the total costs of the project which include not only the initial costs but also other associated costs including operation and maintenance costs throughout the entire life of the project (Dell'Isola and Kirk, 2003). However, regardless of the benefits of WLCC, still, its implementation is hindered among the professionals in the construction industry (Meng and Harshaw, 2013)

2.1 Barriers of WLCC implementation

Based on the researches that have been carried out in the area of WLCC, many barriers of its implementation have been indicated. Firstly, there is lack of motivation from the client for WLCC implementation (Chiurugwi et al., 2010). This is because although WLCC offers long term benefits and financial gains, but usually, the benefits will not flow back to the decision maker. Also, the future aspects that are taken into consideration in WLCC implementation are beyond the scope of responsibility of the decision maker. Hence, the decision maker or the client has limited interest in WLCC which render the lack of motivation towards its implementation. In relation to this, there is also a lack of incentive from the decision maker or the client for WLCC implementation (Cole and Sterner, 2000). Additionally, there is a lack of well-established standard and guideline of WLCC that can act as reference for the professionals in implementing WLCC (Olubodun et al., 2010). Moreover, most of the professionals have low understanding towards WLCC principles (Mat Noor et al., 2012) because it is too future oriented.

3. Methods

Research methodology can be divided into two main approaches. Qualitative approach is a naturalistic approach that aims to understand a phenomenon in context-specific settings. While, quantitative approach tests hypothetical generalization by means of deductive methods. In this research, quantitative approach is adopted and questionnaires are used as tool for data collection. The questionnaires comprise of three sections which include demographic background of the respondents, barriers of WLCC of SFM for PPP/PFI projects in Malaysia and drivers of WLCC of SFM for PPP/PFI projects in Malaysia. The respondents for the research are all members of MAFM. Collected data is analysed statistically by means of Severity Index (SI) by using the following formula:

$$\mathrm{SI} = \sum \frac{\mathrm{a}\left(\frac{\mathrm{n}}{\mathrm{N}}\mathrm{x}100\right)}{5} \quad (1)$$

where a is a constant weight given to each response (ranges from 1 to 5), n is the frequency of the responses, N is the total number of responses (Assaf and Al-Hejji, 2006). The Relative Importance Index (RII) is determined using:

$$\mathrm{RII} = \sum \frac{\mathrm{W}}{\mathrm{A} * \mathrm{N}} \quad (2)$$

where W is the weight given to each response (ranges from 1 to 5), A is the highest response integer (5), N is the total number of responses (Sambasivan and Soon, 2007)

4. Results and findings

In total, 61 % response rate has been received from the respondents. According to Yong and Mustaffa (2011), 20 to 30 % response rate is considerable in construction research. Table 1 shows the demographic background of the respondents for the research. They are categorized based on their years of experience in FM, categories of their organization, their involvement in PPP/PFI projects in Malaysia as well as their involvement in WLCC for PPP/PFI projects in Malaysia. Obviously from table 1, majority of the respondents have 6 to 10 years of experience in FM (39.5 %), they are from consulting organization (79.1 %), and they are involved in both PPP/PFI projects in Malaysia (93 %) and WLCC for PPP/PFI projects in Malaysia (90.7 %).

Table 1: Demographic background of respondents

Demographic Background	Frequency	Percentage (%)
Years of experience in FM		
1 – 5 years	11	25.6
6 – 10 years	17	39.5
11 – 15 years	6	14.0
16 – 20 years	9	20.9
Categories of organisation		
Client	2	4.7
Consulting	34	79.1
Contracting	1	2.3
Multidisciplinary	1	2.3
Academic	1	2.3
Other	4	9.3
Involvement in PPP/PFI projects		
Yes	40	93.0
No	3	7.0
Involvement in WLCC for PPP/PFI projects		
Yes	39	90.7
No	4	9.3

4.1 Normality of data

It is essential to begin data analysis by checking the normality distribution of data. Hence, skewness, kurtosis and Shapiro-Wilk test have been used to explore the normality of the data collected. Since Likert-scale questions were used to examine the barriers and drivers, it is therefore important to compute the variables before they are tested with normality tests. Computation of data into means was conducted and subsequently, normality tests were conducted to check the normality of the data. Table 2 below reveals that the data collected is normally distributed as the skewness and kurtosis values are in between -1.96 and 1.96 (Chua, 2013) and p-value (sig.) of Shapiro-Wilk test is more than 0.05 (Chua, 2013).

Table 2: Normality of data

		Statistic	Std. Error
Barriers	Skewness	0.447	0.361
	Kurtosis	0.020	0.709
	Shapiro-Wilk	0.953	
Drivers	Skewness	0.327	0.361
	Kurtosis	-0.335	0.709
	Shapiro-Wilk	0.950	

4.2 Barriers of WLCC of SFM for PPP/PFI projects in Malaysia

To examine the barriers of WLCC of SFM for PPP/PFI projects in Malaysia, severity index (SI) is calculated for each of the barriers that have been ranked by the respondents. The barriers include lack of motivation lack of incentive, poor communication of benefits, weak collaboration among stakeholders, insufficient and unavailability of data, complicated and time consuming, lack of well-established standard and method, variety of uncertain parameters and assumptions, inconsistency in underlying philosophy and methodology and Low understanding towards its principles. Figure 1 reveals the SI for each of the barriers. The highest rank barrier

with SI value of 82.33 % is inconsistency in WLCC underlying philosophy and methodology. The main reason for this is because WLCC is a process that requires vast amount of data and comprise of parameters and assumptions. It is a forecasting technique and requires appropriate guidance throughout the process. However, Malaysia is lack of established standard of WLCC compared to other countries mentioned before. Hence, facility managers for PPP/PFI projects use their own approaches in implementing the WLCC to suit the needs of the client or government. Diverse approaches have render the implementation to be inconsistent and unstandardized. Lack of motivation has been ranked by the respondents as the third highest with SI value of 80.93 %. Limited interest from the government towards WLCC implementation consequently lead to their lack of motivation for the facility managers to implement WLCC. As discussed earlier, the major concern of the government is on the initial costs rather than the overall long-term costs savings. This should not be happening as for PPP/PFI projects, the main concentration should be given to the long-term operation and maintenance of the projects as well as the consumers' satisfaction. Wolstenholme (2009) agreed that rather than lowest price, there is a need for greater appreciation of better value projects and this should be the main focus at the early stage of the projects.

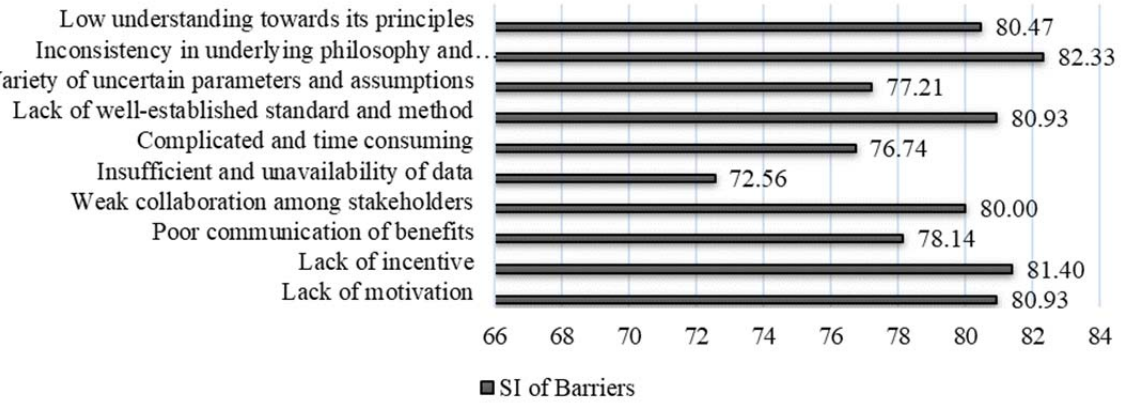

Figure 1: Barriers of WLCC of SFM for PPP/PFI projects in Malaysia

Also, from Figure 1, unpredictably, insufficient and unavailability of data is the least ranked barrier with SI value of 72.56 %. This is unpredictable because most of the researches that have been carried out in context of WLCC indicated that data is one of the main barriers for WLCC implementation (Meng and Harshaw, 2013). However, this is reasonable because majority of the respondents for this research have more than 6 years' experience in facility management. Hence, they are well established consulting organization with proper policies and systems in place. Having more than 6 years' experience in facility management, the respondents absolutely have their own database of data and information from their past and historical records of projects. This will render less difficulties in getting the necessary data to be used for WLCC implementation. Apart from that, complicated and time consuming have been valued with only 76.74 % SI value by the respondents. This is due to the advancement of technology and the availability of various software and support tools which can assist to expedite the WLCC implementation. Traditionally, the WLCC implementation is time consuming and tedious but using the software and support tools, the implementation can be implemented easily and with less efforts.

4.3 Drivers of WLCC of SFM for PPP/PFI projects in Malaysia

To overcome the barriers of WLCC of SFM for PPP/PFI projects in Malaysia, as shown in Figure 2, with RII value of 0.8093, majority of the respondents agreed that there is a need to define the parameters and assumptions of WLCC. As discussed earlier, WLCC is a process that comprises of six main parameters which include identification of objectives, alternatives and constraints, formation of basic parameters, compilation of data, implementation of WLCC, consideration of risks and uncertainties and reporting of WLCC (Khiyon and Mohamed, 2015). Each of these parameters need to be defined in the context of PPP/PFI projects in Malaysia so that a standard approach of its implementation can be achieved by the facility managers. Secondly, with RII value of 0.8047 the respondents confirmed that it is significant if incentive can be provided for the WLCC implementation. This is to ease the whole process of WLCC including the compilation of data from suppliers, consultants' payment and fees and support systems. Additionally, with RII value of 0.7907, majority of the respondents agreed that there is a need to establish standard and guideline of WLCC as looking at other

countries for instance, UK, US, Australia and New Zealand, they have their own standard of WLCC that can be used as guideline for the WLCC implementation. Hence, Malaysia need to have its own standard of WLCC so that facility managers can be guided throughout the WLCC implementation process. The standard should comprise of detailed step by step procedures of how to implement WLCC and should define all the parameters that are significant for WLCC implementation. As said earlier, WLCC implementation is guided by BS ISO 15686-5 in the UK, by ASTM E917 in the US and by AS/NZS 4536:1999 in Australia and New Zealand. Moreover, with RII value of 0.7907, development of a framework of WLCC is agreed by the respondents as one of the important drivers of WLCC implementation. This is because this framework could act as the basis of the WLCC implementation with a proper flow of steps that the facility managers can follow. Somehow, before the establishment of standard and guideline can be done, this framework can be very beneficial for the facility managers. Although the framework might not be as thorough as a standard but it could be a guiding principle for the WLCC implementation so that facility managers can have a standardized approach in WLCC implementation.

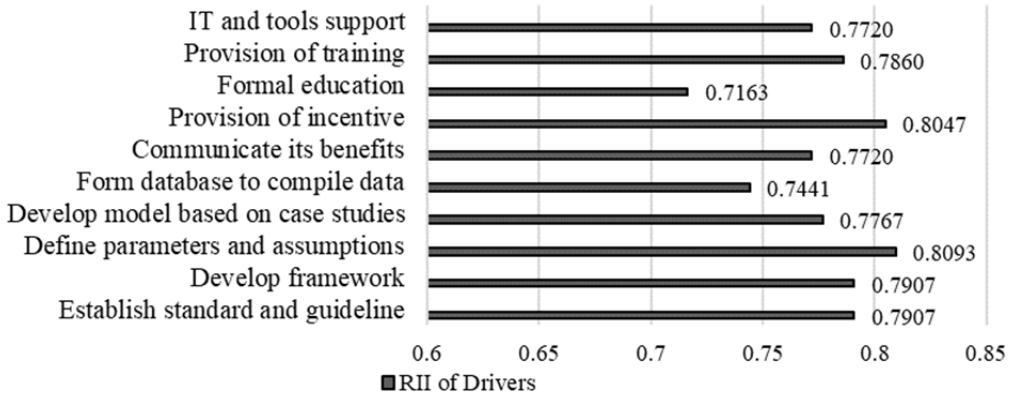

Figure 2: Drivers of WLCC of SFM for PPP/PFI projects in Malaysia

Figure 2 also exposes that with RII value of 0.7163, formal education is the least ranked driver of WLCC of SFM for PPP/PFI projects in Malaysia. This confirms that facility managers do have the knowledge and skill of WLCC, hence, formal education of WLCC is not significant for them to enhance their WLCC implementation. Secondly, with RII value of 0.7441, form database to compile data is the second least ranked driver of WLCC of SFM for PPP/PFI projects in Malaysia.

5. Conclusion

In conclusion, despite of the benefits of WLCC, WLCC of SFM for PPP/PFI projects in Malaysia is presently hindered. This is because of the inconsistency of its underlying philosophy and methodology, lack of incentive and lack of motivation from the client or government for its implementation. To overcome the barriers, there is a need to define the various parameters and assumptions of WLCC, there is a need for provision of incentive, to establish standard and guideline as well as to develop framework of WLCC. As this research focuses only on the barriers and drivers WLCC, it is recommended that further research to be carried out in relation to the parameters of WLCC as well as in the area of SFM. In context of SFM, WLCC is able to evaluate both the economic and environmental aspects of projects at the very early stage. Inevitably, WLCC and SFM are two key principles that need to be focused on for PPP/PFI projects. However, since both of the principles are still at the infant stage in Malaysia, further research in the area of SFM to look at its barriers and drivers are significant before further investigation is carried out towards its parameters so that it can be integrated with the parameters of WLCC.

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