

INTEGRATION OF WHOLE LIFE CYCLE COSTING WITH SUSTAINABLE
FACILITIES MANAGEMENT FOR PRIVATIZED BUILDING PROJECTS IN
MALAYSIA

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DEDICATION

Specially dedicated to myself, for the struggles, sleepless nights, additional 10kgs and 6 years of boring life.

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ABSTRACT

Privatized building projects are escalating in Malaysia and render the importance of Whole Life Cycle Costing (WLCC) and Sustainable Facilities Management (SFM) as these are the two main features of the projects. However, in Malaysia, the guideline for these projects focuses only on WLCC but not on SFM, thus jeopardizing the maintenance culture. Additionally, Malaysia lacks standardized procedures for implementing WLCC and SFM. Therefore, this research examined the barriers and drivers of WLCC and SFM for privatized building projects in Malaysia, investigated the parameters of WLCC and SFM relevant to these projects, proposed a framework of WLCC of SFM for these projects and validated the proposed framework. In order to achieve the intended objectives of the research, the quantitative method was adopted, whereby self-administered questionnaires were utilized. Since the population of the respondents of the research is relatively small, hence, no sampling was required. The questionnaires were distributed to all the members of Malaysian Association of Facility Management (MAFM). The results revealed that the main barrier that hindered the WLCC implementation in the projects was the inconsistency in underlying philosophy and methodology whereas for SFM, there was a lack of guidance in the documentation. In order to drive the implementation of both WLCC and SFM, the findings showed that it is essential to define WLCC parameters and assumptions, besides reducing the life cycle costing for SFM. Additionally, the findings disclosed significant parameters of WLCC and SFM, which led to the development of a framework of WLCC of SFM for the projects. The framework was validated by means of a Delphi survey that revealed the satisfaction of all the panel of experts. In conclusion, the research contributes by means of developing a framework of WLCC and SFM, adjudged to have the potential to systematically guide the facility managers in implementing WLCC of SFM for privatized building projects in Malaysia to enable them to succeed in terms of monetary as well as sustainability.

ABSTRAK

Projek-projek bangunan yang diswastakan semakin meningkat di Malaysia dan menjadikan kos kitaran hayat (WLCC) dan penyelenggaraan fasiliti yang mampan (SFM) satu kepentingan kerana ia adalah dua ciri utama projek tersebut. Walau bagaimanapun, di Malaysia garis panduan bagi projek-projek ini hanya tertumpu kepada WLCC dan tidak kepada SFM, sekaligus menjejaskan budaya penyelenggaraan. Di samping itu, Malaysia tidak mempunyai prosedur piawai untuk melaksanakan WLCC dan SFM. Oleh itu, kajian ini bertujuan untuk mengkaji halangan dan cadangan WLCC dan SFM untuk projek bangunan yang diswastakan di Malaysia, mengkaji parameter WLCC dan SFM yang berkaitan dengan projek ini, mencadangkan rangka kerja WLCC dan SFM untuk projek ini dan mengesahkan rangka kerja yang telah dicadangkan. Untuk mencapai tujuan kajian ini, kaedah kuantitatif telah digunakan di mana borang soal selidik digunakan. Oleh kerana populasi responden bagi kajian ini agak kecil, maka, tiada pensampelan yang diperlukan. Soal selidik diedarkan kepada semua ahli *Malaysian Association of Facility Management (MAFM)*. Hasil kajian menunjukkan bahawa halangan utama yang menghalang pelaksanaan WLCC dalam projek adalah ketidakkonsistenan dalam falsafah dan kaedah manakala bagi SFM, terdapat kekurangan panduan dalam dokumen rujukan. Bagi memacu pelaksanaan kedua-dua WLCC dan SFM, dapatan menunjukkan bahawa adalah penting untuk menentukan parameter dan anggapan WLCC, selain mengurangkan kos kitaran hayat bagi SFM. Di samping itu, hasil kajian juga menjelaskan parameter penting WLCC dan SFM yang membawa kepada pembangunan rangka kerja WLCC dan SFM untuk projek tersebut. Rangka kerja ini telah disahkan menggunakan kaji selidik Delphi yang menunjukkan kepuasan semua ahli panel yang pakar. Sebagai kesimpulan, kajian ini menyumbang dengan cara membangunkan rangka kerja WLCC dan SFM, yang diakui berpotensi untuk membimbing pengurus-pengurus fasiliti dalam melaksanakan WLCC dan SFM untuk projek-projek bangunan yang diswastakan di Malaysia untuk membolehkan mereka berjaya dari segi kewangan dan kemampuan.

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LIST OF ABBREVIATIONS

AIRR	-	Adjusted Investments Rate of Return
AS/NZS	-	Australia/New Zealand
ASTM	-	American Society for Testing and Materials
BIFM	-	British Institute of Facilities Management
BS ISO	-	British Standard International Organisation for
BSI	-	British Standard Institution
BVPP	-	Best Value Performance Plan
CBS	-	Cost Breakdown Structure
CEN	-	European Committee for Standardization
CSFs	-	Critical Success Factors
FM	-	Facilities Management
GABS	-	Global Alliance of Building Charter
HKIFM	-	Hong Kong Institute of Facilities Management
IFMA	-	International Facilities Management Association Initiatives
JFMA	-	Japan Facilities Management Association
KPIs	-	Key Performance Indicators
LCA	-	Life Cycle Assessment
MAFM	-	Malaysian Association of Facility Management
NB	-	Net Benefits
NIST	-	National Institute of Standards and Technology
NPC	-	Net Present Cost
NPV	-	Net Present Value
NS	-	Net Savings
OGC	-	Office of Government Commerce
PB	-	Payback
PCDA	-	Plan, Do, Check, Act
PWD	-	Public Works Department
RII	-	Relative Importance Index
SCQS	-	Society of Construction Quantity Surveyors

SFM	-	Sustainable Facilities Management
SI	-	Severity Index
SIR	-	Savings to Investment Ratio
SMART	-	Specific, Measurable, Attainable, Realistic, Timely Standardization
SWOT	-	Strengths, Weaknesses, Opportunities and Threats
UK	-	United Kingdom
US	-	United States of America
WLCC	-	Whole Life Cycle Costing

LIST OF SYMBOLS

\notin	-	does not belong to set
Σ	-	sum
a	-	constant weightage given to each response
A	-	the highest response integer
e	-	grade alternative
f	-	basic criteria/factor
f_i	-	frequency of each response
M	-	membership function of each parameter
M_j	-	mean rating of a particular quantitative parameter
n	-	frequency of the responses
N	-	total number of responses
r_{ij}	-	degree to which alternative satisfies
S	-	significance value
s_i	-	weight assigned to each response
U	-	fuzzy set
u	-	fuzzy subset
W	-	weightage given to each response
X_Y	-	membership function

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CHAPTER 1

INTRODUCTION

1.1 Background of Research

Privatisation has been introduced in Malaysia for more than two decades due to the economic recession. Under privatisation, private sector are needed by the government for economic activities and development (Ismail and Rashid, 2007). Since then, many privatisation policies are introduced until, in 2009, Public Private Partnerships (PPP) and Private Finance Initiatives (PFI) are introduced in order to enhance the implementation of privatisation in Malaysia (Tenth Malaysia Plan, 2010). PPP and PFI involves funding of public projects by means of private financial resources and typically, the contract is awarded to a concessionaire (or also known as special purpose vehicle) based on long term concession period which is up to 30 years. PFI is a subset of PPP and both are regarded as privatisation. Privatisation projects include buildings, highways, infrastructure and many others. However, this research is limited to only buildings. As the term PPP and PFI are used interchangeably, general term of privatisation will be used throughout this research.

In Malaysia, the implementation of privatized building projects is escalating which render the significance of Whole Life Cycle Costing (WLCC) and facility management (FM). This is due to two of the key principles of privatized building projects in Malaysia are WLCC whereby typically, projects are awarded based on lowest cost over the concession period which is usually in between twenty (20) to thirty (30) years and augment operation and maintenance culture as the concessionaire will be accountable to maintain the assets over the concession period (UKAS, 2009). 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 represents 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; Wang and Horner, 2007). In term of FM, currently, facility managers are involved in privatized building projects in Malaysia in order to provide better facilities and services to the consumers or occupants of the projects (Hariati et al., 2016). FM is also viewed as a good mechanism to incorporate sustainability (or also known as sustainable facilities management (SFM)) into the projects as the nature of the projects, which are long term, is considered appropriate for incorporation of sustainability. The idea of sustainability will impose additional costs to the privatized building 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.

Compared to FM, SFM is regarded as an effort of integration of FM with sustainability (Elmualim et al., 2010). For instance, aspects including waste reduction, energy reduction, productivity increment and others are typically the aims of SFM. In regard to that, Baaki et al. (2016) emphasized that facility managers need to have better perspective of FM in order to incorporate sustainability as well as to equip themselves with related knowledge and skills. Conversely, in Malaysia, SFM has yet to gain attention from the facility managers and the government particularly for the privatized building projects in Malaysia. This is due to that privatized building projects in Malaysia are still very young and progressing (Ismail and Harris, 2014) and tend to focus more on the value for money rather than focusing on its environmental impacts although it has been pointed out by Abdullah et al. (2014) that the projects have the potential to enhance sustainability for Malaysian construction projects. Most of the researches on privatized building projects concentrate only on value for money, for

instance, Takim et al. (2009) proposed a framework of value for money assessment for the projects, which considers three main aspects including economy, efficient and effectiveness. Similarly, as mentioned earlier, the PPP guideline in Malaysia outlined that WLCC is one of the key principles of the projects but none of the sustainability concerns is highlighted in the guideline.

Facility managers play vital role in sustainability and there is a need for sustainability to be incorporated within facility management for privatized building projects in Malaysia (Sarpin et al., 2016). In other words, there is a growing concern on the need for sustainable facility management (SFM). The main reason for this is that facility managers have the capacity to define, analyse and examine sustainability concerns. In addition, they offer great influence over the whole life cycle of a building. Hodges (2005) specified that facility managers are in a critical position to view a project as an entire process. This is because facility managers are responsible to manage the operation and maintenance of a project and hence, they have various inputs that can be contributed in selecting the best available alternatives of building elements and services which will render efficient facility management in the later stage. Actually, United Kingdom (UK) and United States of America (US) have published robust guidelines of sustainability but in order for Malaysia to adopt the guidelines, there is a necessity to investigate and develop appropriate sustainability indicators (Ros et al., 2012) to be incorporated in the guidelines so that it will be more practical and suitable in meeting local needs.

Moreover, Wong et al. (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 in order 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. (2005) mentioned that it is critical to integrate sustainability into privatized building projects and they pointed out that it is beneficial to investigate WLCC of sustainability in relation to privatized building projects so that a sustainable Privatized building projects can be successfully achieved. However, in a recent research by Highton et al. (2012), WLCC implementation is actually hindered

and this is due to the lack of standardized method of WLCC. Similarly, Malaysia is also lack of a standardized method of WLCC. In relation to this, if SFM if to be integrated with WLCC for privatized building projects in Malaysia, there is definitely a necessity to first, standardising the WLCC approach among the facility managers in Malaysia. Subsequently, SFM parameters can then be integrated in order to develop an integrated approach of WLCC and SFM for privatized building projects in Malaysia.

Therefore, this research intends to address the concerns relating to WLCC and SFM for privatized building projects in Malaysia. It is appropriate to address the concerns for privatized building projects because the concession period of the projects is long which is in between 20 to 30 years. Hence, if facility managers are involved in the early stage of the projects to deal with WLCC and SFM concerns, the benefits of both economic and environmental aspects can be expected. Boussabaine and Kirkham (2008) emphasized that sustainability achievement is feasible only with the consideration of long term operational and maintenance costs as well as performance of building elements and services. In addition, it has been highlighted by Alnaser et al. (2008) that economic viability is considered to the most significant factor in decision making to select the best value for money sustainable alternatives in a building. It is obvious that WLCC and SFM have to be considered for privatized building projects in Malaysia in order to ensure that economic and environmental aspects of alternatives of building elements and services are considered before their selection.

The outcome of this research is essential in contributing to the overall improvement of implementation of WLCC and SFM by facility managers in privatized building projects in Malaysia by means of a comprehensive framework that can act as a basis of guidance. With reference to the framework, the facility managers will be able to choose optimum design alternative for building elements and services, which will contribute to overall costs savings as well as sustainable privatized building projects in Malaysia. If the optimum alternative of building elements and services is chosen at the early stage when the decision is still open, the long term whole life costs and performance of the project can be optimised. Apparently, this research is significant and it is crucial that this research focus on facility managers because

according to Sarpin et al. (2016) and Hodges (2005), if they are equipped with appropriate knowledge and tools, they can bring lost lasting values to the projects.

In summary, this research develops a framework of WLCC of SFM for privatized building projects in Malaysia. This can positively guide the facility managers in enhancing their implementation of WLCC of SFM for privatized building projects in Malaysia so that they can make informed decision at the early stage of the projects about alternatives of building elements and services with consideration of WLCC and sustainability. These considerations will ensure that privatized building projects are cost effective and sustainable throughout the long concession period. Hence, the successful implementation of Privatized building projects in Malaysia can be enhanced not only in context of WLCC but also in context of sustainability.

1.2 Problem Statement

As discussed earlier, although privatisation has been introduced since the past two decades in Malaysia, but, there is no matured projects (Sarpin et al., 2016) that could be used as case studies or examples. Khaderi and Aziz (2010) pointed out that privatized building projects in Malaysia are associated with various issues in context of cost effectiveness and innovation. Due to the lack of transparency in bidding, it is challenging to obtain a competitive bid for the projects and the approach of procuring cost effective projects are in doubt. Furthermore, the FM that is one of the requirements of the projects need to be innovated but this element is missing. Compared to other countries, for instance, UK and Australia, the privatisation in Malaysia is lagging and Ismail and Harris (2014) and Khaderi and Aziz (2010) believed that this might be due to the absence of a guideline or framework for its implementation. Hence, this is affecting its ultimate aim of value for money and efficient FM. Furthermore, Hasan and Salleh (2018) accentuated on the need of establishment of KPIs and implementation of privatisation must be ensured to be able to achieve the established KPIs.

In order to achieve efficient delivery of FM of privatized building projects in Malaysia, two important aspects have to be considered which are economic and environmental. Apparently, in Malaysia, as discussed earlier, the PPP guideline concentrates only on the economic aspect but not environmental. Concerning that, Abdul Rashid et al. (2016) highlighted that privatized building projects in Malaysia are lacking of sustainable element. This is extremely unsatisfactory because the nature of the projects, which are long-term contract, render it to be very suitable to be incorporated with sustainability. It is agreed by Mohd Farmi et al. (2011) that the projects are lack of sustainability due to the fact that sustainability knowledge and skills are still lacking among the facility managers. However, Elyna Myeda and Pitt (2014) pointed out in their research that since privatized building projects in Malaysia is still a new subject, there is a flexibility for various approaches of facility management for the projects.

The issue of innovation as highlighted by Khaderi and Aziz (2010) is closely related to FM. It is believed that innovation of FM can facilitate value for money for the projects (Ismail and Abdul Rashid, 2007). In line with this, the General Director of UKAS, Jabatan Perdana Menteri in 2017 emphasized that privatized building projects in Malaysia require innovation including the incorporation of sustainability and energy efficient design. The incorporation will allow for improved operation and maintenance whilst providing comfort and better environment for the occupants of the buildings. Though, Sarpin et al. (2016) indicated in their research that SFM is still new in Malaysia and its implementation is hindered among the facility managers. Hence, there is a need to enhance SFM to focus not only on the initial costs but also to consider the total impact over the whole life cycle of a building (Elmualim et al., 2010).

Concerning the total impact over the whole life cycle of a building, as stated earlier, WLCC provides the provision to oversee the total impact of economic and environmental over the whole life cycle of a building (Highton, 2012) but its implementation is affected due to the lack of a standardized approach. In a research conducted by Steen (2005), he pointed out that it may be tricky to allocate costs to the environment account but it seems reasonable to improve the methodology. Moreover, it has been emphasized by Ristimaki et al. (2013) that economic and environmental

aspects depend on each other and thus, in order to enhance selection of buildings elements or assets, a methodological life cycle framework should be developed. There is a gap in their research that need to be filled which is to focus on the possibilities to optimize facility management by taking a life cycle perspective from both the economic and environmental aspects. Predominantly, a framework of enhanced WLCC and SFM is required in order to guide the facility managers in evaluating the potential economic and environmental benefits of a privatized building projects in Malaysia.

Similarly, Rahim et al. (2014) highlighted in their research that there is a necessity to explore on how WLCC can assist the sustainability in a building project. If this can be explored, it will definitely be beneficial in enhancing the economic and environmental performances of the building project. More recently, it is also specified by Gundes (2016) in his research that the need for a systematic and standardised methodology of integrating economic and environmental aspects still remains unfulfilled. Therefore, this research seeks to integrate WLCC and SFM for privatized building projects in Malaysia in order to guide the facility managers to implement WLCC and SFM for the projects which can contribute positively to the total impact over the whole life cycle of the projects. This is aligned with the hope of Meng and Harshaw (2013) in their research whereby they emphasized that it is significant to ensure the successful implementation of privatized building projects.

The development of an integrated WLCC approach is important because it offers the potential for the assessment of costs and benefits (Dixon et al., 2005) over the concession period of privatized building projects. The true value of the projects can then be assessed and opportunities can be identified to drive sustainability policies over the long-term contract. However, Malaysia is a lack of standardised method of WLCC and SFM particularly for Privatized building projects in Malaysia. According to Takim et al. (2009), Privatized building projects in Malaysia are yet to mature, hence, it is great if an appropriate sets of guidelines in implementing Privatized building projects in Malaysia can be developed. It is worth mentioned that there is a little research that has been carried out in WLCC and SFM in Malaysia. Hence, this research focuses on developing a framework of WLCC of SFM for Privatized building

projects in Malaysia as the basis for improved decision making among the facility managers in selecting the best available alternative of building elements and services.

It starts with examining the barriers and drivers of WLCC and SFM for privatized building projects in Malaysia so that the facility managers are aware of the barriers that hindered the implementation of WLCC and SFM as well as the strategies that should be carried out in order to enhance the implementation. The examination of the barriers and drivers are essential because various researches have been carried out in examining the barriers and drivers of WLCC and SFM but over the time, different barriers and drivers are revealed. For instance, Meng and Harshaw (2013) revealed that WLCC is lacking of standard methodology but Park (2009) exposed that WLCC is lacking of data. Meanwhile, Elmualim et al. (2010) exposed that SFM implementation is hindered by the lack of senior level management commitment, but more recently, Asbollah et al. (2016) indicated that facility managers are lack of knowledge to implement SFM. As for the drivers, Hunter et al. (2005) proposed framework development for WLCC while Levander et al. (2009) suggested for uncertainties of WLCC to be addressed. In context of SFM, Ikediashi et al. (2012) pointed out that legislation and regulation are important to drive SFM implementation but Massoud et al. (2010) indicated corporate image as an important driver. Therefore, in order to confirm the mutual agreement among the facility managers regarding the barriers and drivers of WLCC and SFM for privatized building projects in Malaysia, there is an essential need to examine the barriers and drivers. This is to ensure that the proposal that is proposed in this research is aiming towards the practical direction.

Subsequently, this research continues with investigation of parameters of WLCC and SFM that are relevant for privatized building projects in Malaysia. This is as accordance as recommendation by Kshirsagar et al. (2010) and Frangopol et al. (2001) whereby there is a need for improved framework and methodologies of WLCC and as accordance as suggestion by Elyna Myeda and Pitt (2014) that SFM requires proper guideline and standards. These parameters are significant because they will be adopted in order to propose the framework of an integrated WLCC and SFM for the projects. If the facility managers are following the proposed framework accordingly, it is believed that they will then be guided to implement WLCC and SFM for the

projects. Hariati et al. (2016) proposed a useful step by step approach for implementing SFM for the projects but they insisted that there is an essential need to investigate the applicability of the proposed approach. Hence, this research proceeds with the development and validation of the framework so that it can be finalised in term of its appropriateness, practicality and relevancy.

It is expected that by conducting this research, a framework of WLCC of SFM for privatized building projects in Malaysia can be developed, validated and utilised by the facility managers in Malaysia so that they can contribute in resulting in efficient privatized building projects in Malaysia in context of economic and environmental. The framework is hoped to be able to acts as guidance for facility managers in implementing WLCC and SFM for privatized building projects in Malaysia so that the KPIs of the projects could be achieved successfully.

1.3 Research Questions

The research anticipates answering the following research questions:

- a) What are the barriers and drivers in implementing Whole Life Cycle Costing and Sustainable Facilities Management for privatized building projects in Malaysia?
- b) How can Sustainable Facilities Management be integrated into Whole Life Cycle Costing for privatized building projects in Malaysia?

1.4 Research Aim

The aim of the research is to develop a framework of Whole Life Cycle Costing of Sustainable Facilities Management for privatized building projects in Malaysia in order to guide the facility managers in implementing Whole Life Cycle Costing for Sustainable Facilities Management for the projects.

1.5 Research Objectives

In order to answer the research questions and to attain the aim of the research, the research seeks to achieve the following objectives:

- (a) To examine the barriers and drivers of Whole Life Cycle Costing and Sustainable Facilities Management for privatized building projects in Malaysia.
- (b) To investigate the parameters of Whole Life Cycle Costing and Sustainable Facilities Management that relevant for privatized building projects in Malaysia.
- (c) To propose a framework of Whole Life Cycle Costing of Sustainable Facilities Management for privatized building projects in Malaysia.
- (d) To validate the proposed framework of Whole Life Cycle Costing of Sustainable Facilities Management for privatized building projects in Malaysia.

1.6 Scope of Research

The research is limited to study about WLCC and SFM only for privatized building projects in Malaysia. In Malaysia, it is essential that facility managers to be involved in the early stage of the projects so that they can provide beneficial input for the projects holistically. This is because they will be the most important professionals in the later stage that will deal with the operation and maintenance of the projects over the long concession period. Therefore, they are selected as respondents for the research. Based on the updated list of members of Malaysian Association of Facility Management (MAFM) in Malaysia, there are 107 members in total but only 71 of them are practicing facility management. According to Fellow and Liu (2015), if the population of respondents is considerably small, hence, they are all be taken as sample size for the research. Hence, instrument for data collection is distributed to all members of MAFM in order to achieve the aim and objectives of the research.

1.7 Contribution to Knowledge

The research proposed a framework of WLCC of SFM for privatized building projects in Malaysia with a view of introducing an integrated implementation of WLCC and SFM to facility managers of the projects in order to guide them in selecting alternatives of building elements and services at the early stage of the projects so that they are able to take into consideration not only costs aspect but also environmental aspect of their selected alternative. Essentially, the research is considered capable of enhancing the implementation of WLCC and SFM among facility managers for privatized building projects in Malaysia as it provides standardised procedures of WLCC and SFM that can be implemented for any building elements and services.

It is noticeable that Malaysia is currently lacking of a standardisation of WLCC and SFM implementation and hence, individual facility management organisation will have their own approach in implementing WLCC and SFM. Additionally, with the integration of SFM, facility managers will be able to provide sustainability input and advice to the client at the early stage of the projects. It is expected that the proposed framework will guide the facility managers in selecting the best available alternative of building elements and services for the projects so that client can have not only costs saving but also sustainable projects. The nature of the projects, which is usually contracted for a long period, will allow for the integration of WLCC and SFM so that the real benefit of the projects can be appreciated throughout the phases of the projects.

1.8 Research Methodology

Figure 1.1 shows the details of the research methodology.

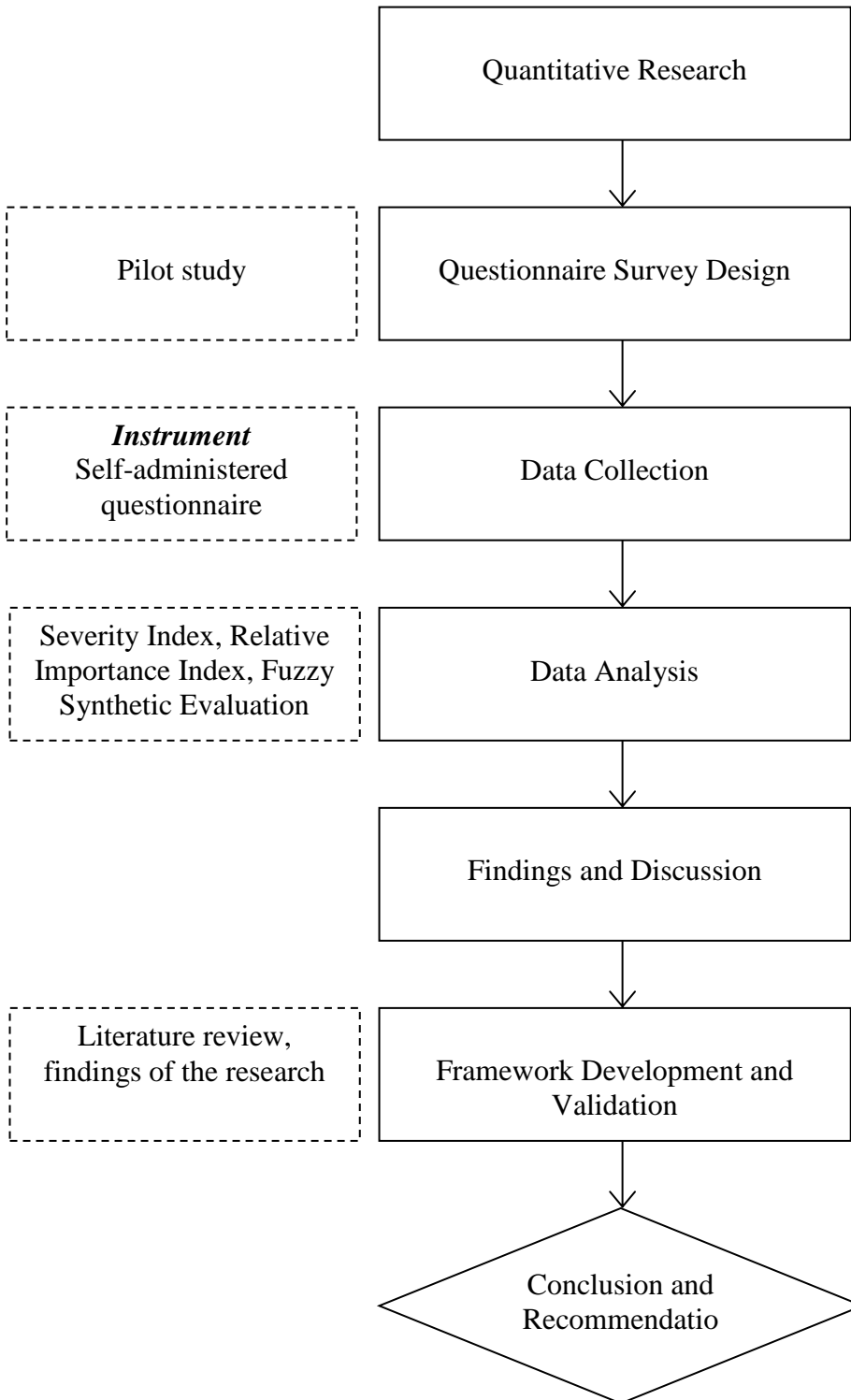


Figure 1.1 Research methodology flowchart

Based on Figure 1.1, the research adopted quantitative research approach. The approach is appropriate to achieve the aim and objectives of the research. According to Creswell and Clark (2017), in quantitative research, collected data can be quantified and subsequently statistically analysed to support or contradict “alternate knowledge claims”. Williams (2011) added that quantitative research can be used to response to the interpersonal questions of variables in a research. In order to achieve the aim and objectives of the research, self-administered questionnaire survey is adopted as instrument for data collection because it is an effective method of collecting data compared to the other methods, for instance, interview and case studies. In addition, it is comparatively less expensive and less time consuming as the advancement of technology nowadays allow for questionnaire survey to be distributed electronically through email.

The population for the research are members of MAFM that are practicing as facility managers and it is considerably small, thus, they are all taken as sample size (Fellow and Liu, 2015). In order to collect data from the members of MAFM, as mentioned earlier, self-administered questionnaire is adopted as instrument. Additionally, since the research is integrating two main concepts of WLCC and SFM, two sets of different questionnaires are distributed to the respondents. Each set of the questionnaire is developed based on the aim and objectives of the research and comprised of questions related to demographic background of the respondents, drivers and barriers of WLCC and SFM as well as parameters of WLCC and SFM. Details of the two sets of questionnaires are further explained in Chapter 3 and it is worth mentioned that the questionnaires have been piloted among 10 selected respondents before they are distributed to the other respondents.

A total of 71 questionnaires for each set of questionnaires have been distributed to the respondents and 61% and 63% of response rates have been received for the first and second sets of questionnaire. These responses are then analysed accordingly. Appropriate analysis is conducted including mean scores, Severity Index, Relative Importance Index and Fuzzy Synthetic Evaluation. Subsequently, based on the findings and discussion of the research and reference to literature review, a framework is developed. In order to finalise the appropriateness and relevancy of the framework,

it is validated by means of Delphi survey of selected experts. Details of the research methodology is explained in Chapter 3 of the research.

1.9 Research Structure

The research structure can be presented into two basic phases, which are pre-phase activities and post-phase activities.

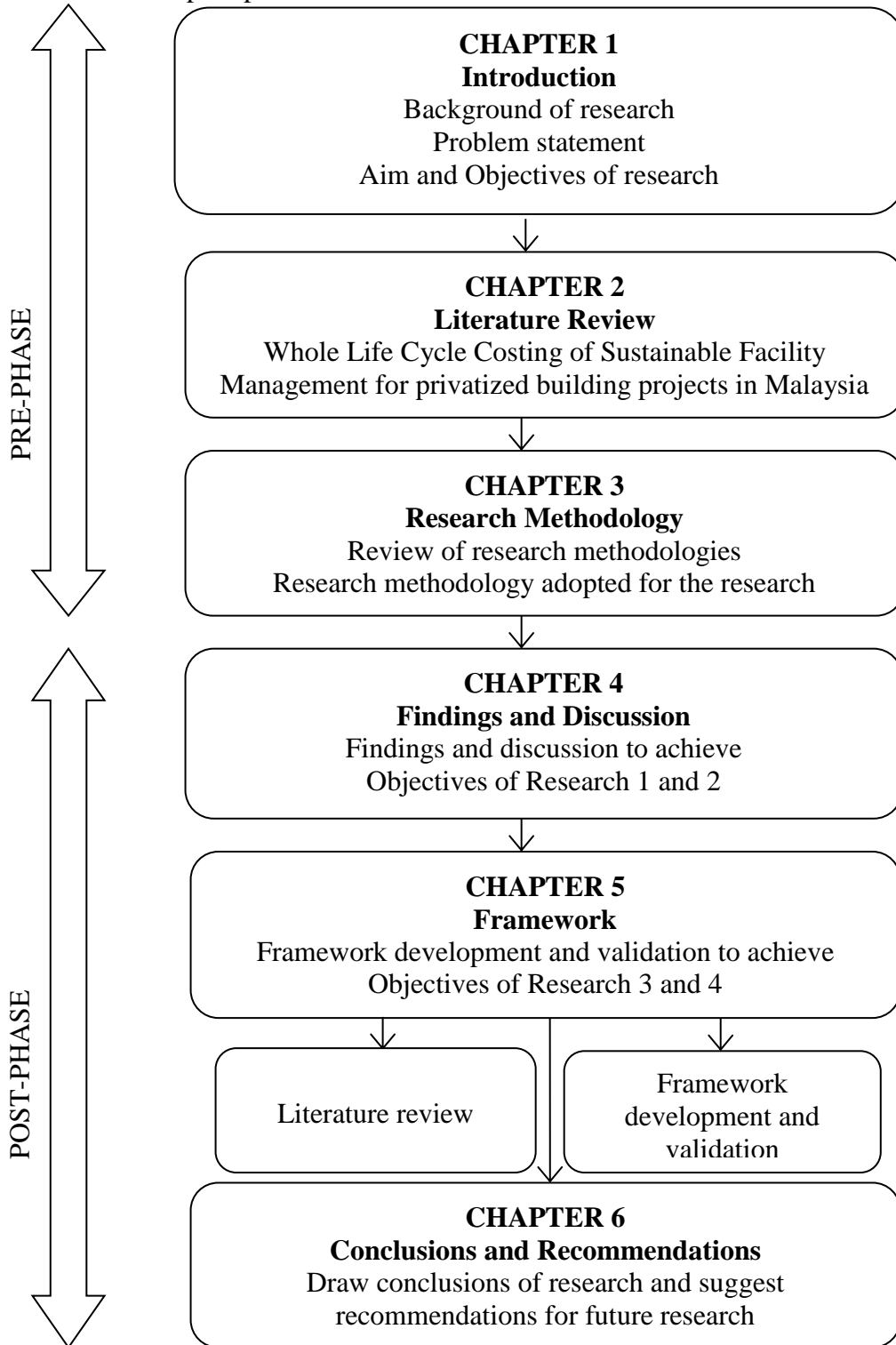


Figure 1.2 Research structure flowchart

As illustrated in Figure 1.2, the pre-phase activities are the activities, which are carried out before the collection of data. While, post-phase activities are the activities, which are carried out after the collection of data including analysis of data, discussion, framework development, validation and conclusions and recommendations.

(a) Chapter 1: Introduction

The chapter explains the fundamental principle of the research through passages of background of research and problem statement. In addition, it lists the research questions and to answer the questions, it justifies the aim and objectives of the research. Moreover, the chapter outlines the scope of the research and most essentially, it emphasized the contribution of the research to knowledge. The chapter is concluded with a brief explanation of research methodology and summary of research structure.

(b) Chapter 2: Whole Life Cycle Costing for Sustainable Facility Management of privatized building projects in Malaysia

The chapter presents the extensive literature review of WLCC of SFM for privatized building projects in Malaysia. The literature review includes the issues in relation to WLCC and SFM specifically associated to privatized building projects in context of its barriers and drivers. Furthermore, the parameters of WLCC and SFM are thoroughly reviewed. The main purpose of the literature review is to act as the basis of preparing tool for data collection for the research.

(c) Chapter 3: Research Methodology

The chapter discusses research methodologies for the research and explains the research methodology that is adopted for the research. Specifically, the chapter provides the procedures of achieving the aim and objectives of the research. It involves research approach, instrument for data collection, sampling technique, procedures of data collection as well as data analysis.

(d) Chapter 4: Findings and Discussion

The chapter entails post-phase activities of the research. It reveals the findings of the research and provides thorough discussion based on the findings. Appropriate analysis is conducted including mean score, Severity Index, Relative Importance Index and Fuzzy Synthetic Evaluation and analysis is presented numerically and graphically in order to achieve the first and second objectives of the research. In order to enhance the discussion of the findings, reference to previous studies are included in the discussion.

(e) Chapter 5: Framework Development

The chapter presents the framework that is deliberately developed to enhance the implementation of WLCC for SFM of privatized building projects in Malaysia. In order to develop the framework, findings and discussion in Chapter 4 and literature review are utilised to structure and subsequently, develop the framework systematically. Moreover, the chapter provides the validation of the framework. The chapter serves to achieve the third and fourth objectives of the research.

(f) Chapter 6: Conclusion and Recommendation

The chapter draws conclusion based on the findings and discussion as well as framework development and validation of the research and relates them to the achievement of the aim and objectives of the research. Additionally, the chapters provides essential recommendations for future research.

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