



INVESTIGATION OF LIFE CYCLE COST (LCC)
ANALYSIS PRACTICE OF UNIVERSITY
MOSQUE MAINTENANCE DURING THE IN
USE PHASES

BY

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ABSTRACT

Mosque is a remarkable place for Muslims, where Muslims perform 5 prayers and worship Allah every day. The maintenance of the mosque during the in use phases need to be accomplished effectively with sufficient budgetary planning. Mosque maintenance during the in use phases is essential to extend mosque life cycle. However, mosque maintenance during the in use phases is being actualized ineptly in an aimless path and without adequate economical system to identify maintenance cost. Life cycle cost LCC is a procedure that can be applied to quantify and evaluate the economic performance of mosque during the in use phases over it is life cycle. The aim of this research is to investigate LCC practice of university mosque maintenance during the in use phases (operation phases, maintenance phases, and selvage phases) of Mahallah Ruqayyah Mosque (MUSOLLA AR-RAHMAN). The research seeks to achieve the following objectives; (i). to review the practice of LCC of university mosque maintenance during the in use phases of MUSOLLA AR-RAHMAN (, (ii). to identify the required data that can be used as inputs for LCC practice of university mosque maintenance during the in use phases of MUSOLLA AR-RAHMAN, (iii). to identify the appropriate strategies that can be used to enhance LCC practice of university mosque maintenance during the in use phases of MUSOLLA AR-RAHMAN. The methodology utilized involves literature review, interview questionnaire and case study. Previous studies in related to this area have shown there is limited practice of LCC of university mosque maintenance during the in use phases. In addition, the literature study has identified the main types of data that can be used as inputs of LCC practice of university mosque maintenance during the in use phases. The findings of the interview questionnaire demonstrate that all respondents share the same opinion and judgment that there is limited practice of LCC of mosque maintenance during the in use phases. Furthermore, the interview questionnaire has established unanimity in related to the types of data that can be used as inputs of LCC practice of university mosque maintenance during the in use phases. The case study has found the main facilities that used in the university mosque, and the appropriate maintenance types that can be used to maintain university mosque facilities. In addition, the case study shows the main types of data that can be used in LCC practice of university mosque maintenance during the in use phases. Based on the outcomes of data collected by primary approaches (interview questionnaire and case study) and secondary approach (literature review) many appropriate strategies have been found; which can be applied to enhance the practice LCC of university mosque maintenance during the in use phases, among the appropriate strategies 3 strategies have been highlighted with higher mean score, which are; construct a database to save the historical data of maintenance works, establish a training program to improve the skills of maintenance technician, and establish a system to write and to save the annual reports.

خلاصة البحث

المسجد هو مكان رائع للمسلمين، حيث يقوم المسلمون بأداء خمس صلوات وعبادة الله كل يوم. يجب صيانة المسجد خلال مراحل الاستخدام بشكل فعال مع التخطيط الكافي للميزانية. إن صيانة المسجد خلال مراحل الاستخدام أمر ضروري لتوسيع دورة حياة المسجد. ومع ذلك، فإن صيانة المسجد خلال مراحل الاستخدام يتم تحقيقها بشكل غير دقيق في مسار لا هدف له وبدون نظام اقتصادي ملائم لتحديد تكاليف الصيانة. كانت تكلفة دورة الحياة LCC هي عملية إجرائية يمكن تطبيقها لقياس وتقييم الأداء الاقتصادي للمسجد خلال مراحل الاستخدام على مدى دورة الحياة. الهدف من هذا البحث هو التحقق من ممارسة LCC لصيانة مسجدي الجامعة خلال مراحل الاستخدام (مراحل التشغيل، مراحل الصيانة، ومراحل الحزام) لمسجد محلة الرقية (مصلى الرحمن). ويسعى البحث إلى تحقيق الأهداف التالية؛ (أنا). مراجعة ممارسة LCC لصيانة المسجدين خلال مراحل الاستخدام في مصلى الرحمن، (ii)). لتحديد البيانات المطلوبة التي يمكن استخدامها كمدخلات لممارسة LCC لصيانة المساجد الجامعية خلال مراحل الاستخدام لمصلى الرحمن، (iii)) لتحديد الاستراتيجيات المناسبة التي يمكن استخدامها لتعزيز ممارسة LCC لصيانة المساجد الجامعية خلال مراحل الاستخدام في مصلى الرحمن. تتضمن المنهجية المستخدمة مراجعة الأدبيات، واستبيان المقابلة ودراسة الحالة. وقد أظهرت الدراسات السابقة في هذا المجال أن ممارسة LCC لصيانة جامعة خلال مراحل الاستخدام محدودة. بالإضافة إلى ذلك، حددت الدراسات السابقة الأنواع الرئيسية للبيانات التي يمكن استخدامها كمدخلات في ممارسة LCC من المسجد الجامعي. وكانت الصيانة أثناء مراحل الاستخدام - توضح نتائج استبيان المقابلة أن جميع المستجيبين يشتركون في نفس الرأي والحكم بأن هناك ممارسة محدودة لـ LCC في صيانة المسجد خلال مراحل الاستخدام. علاوة على ذلك، فإن استبيان المقابلة أقام إجماعاً فيما يتعلق بأنواع البيانات التي يمكن استخدامها كمدخلات في ممارسة LCC لصيانة المساجد الجامعية خلال مراحل الاستخدام. وقد وجدت دراسة الحالة التسهيلات الرئيسية المستخدمة في المسجد الجامعي، وأنواع الصيانة المناسبة التي يمكن استخدامها للحفاظ على مرافق مسجد الجامعة. بالإضافة إلى ذلك، تُظهر دراسة الحالة الأنواع الرئيسية للبيانات التي يمكن استخدامها في ممارسة LCC لصيانة المساجد الجامعية خلال مراحل الاستخدام. استناداً إلى نتائج البيانات التي تم جمعها من خلال المناهج الأولية (استبيان المقابلة ودراسة الحالة) والنهج الثانوي (مراجعة الأدبيات)، لقد تم العثور على العديد من الاستراتيجيات المناسبة؛ التي يمكن تطبيقها لتعزيز ممارسة LCC لصيانة جامع الجامعة خلال مراحل الاستخدام. من بين الاستراتيجيات المناسبة، تم تسليط الضوء على 3 استراتيجيات مع درجة أعلى من المتوسط، وهي؛ بناء قاعدة بيانات لحفظ البيانات التاريخية لأعمال الصيانة، وإنشاء برنامج تدريبي لتحسين مهارات فنية الصيانة، وإنشاء نظام للكتابة ولحفظ التقارير السنوية.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion; it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Assets and Facilities Management).

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Salem M. A. Abuznaid

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PRACTICE OF UNIVERSITY MOSQUE MAINTENANCE
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CHAPTER ONE

RESEARCH INTRODUCTION

1.1 INTRODUCTION

This dissertation reports a study on investigation of the practice of Life Cycle Costing (LCC) analysis of university mosque maintenance during the in use phases. This chapter includes the prefatory items, as following:

1. Problem Statement of the Research
2. Aim and Objectives of the Research
3. Significance of the Research
4. Scope of the Research
5. Work schedule/timetable
6. Organization of the research

1.2 PROBLEM STATEMENT OF THE RESEARCH

Mosque is an exceptional place or building of worshipping to Islam followers. Muslims are meeting in mosque 5 times per day and pray together; standing before Allah, bowing and prostrating to Him. Mosques have a great importance to Muslims lives; for that, Muslims were order by Allah to take care and to maintain mosques (Omer, 2016).

Mosque can be seen as a building for worshipping, and it has a life cycle, which includes, i.e. predesign stage, design stage, construction stage, operation stage, maintenance stage, and disposition stage (Walden, Roedler, Forsberg, Hamelin, Shortell, 2015). Maintenance represents a main stage mosque life cycle, a stage where mosque

facilities need to be monitored and maintained well to keep mosque life cycle running until the end (Kaklauskas, 2016).

Mosque maintenance can be defined as any action that can be delivered to keep mosque and mosque facilities perform until the end of their life cycle (ADMMDR, 2013), all facilities in mosque should be performed effectively to serve the worshipper needs; for that previous studies of mosque maintenance field have identified the appropriate maintenance types that can be used in mosque maintenance, i.e. preventive maintenance, predictive maintenance, corrective maintenance, and scheduled maintenance (ADMMDR, 2013; BS8544:2013, 2013; Chen, Cowling, Polack, Remdea, Mourdjis, 2017; Krstić, Marenjak; 2012).

Mosque maintenance is being implemented incapably in an indiscriminate way and without sufficient budgetary planning (ADMMDR, 2013). Efficient maintenance of mosque is important to improve mosque life cycle by retardant disintegration, rot and disappointment in this way improving service conveyance. (Aizat Abdullah, Ariff, Ismail, a Kaliwon, 2017). The erratic and ineffectual frameworks as of now being connected combined with low budgetary portions infer that maintenance objectives cannot be met coming about to genuine imperfections build-up. The results for regularly expanding deserts excess incorporate interruption of conveyance of facilities service through gear breakdowns or mosque components failures (Krstić and Marenjak, 2012).

Life cycle costing (LCC) analysis is an economic optimal technicality system, that helps the facility manager to choose the appropriate decision of mosque maintenance in related to budget (cost) (BS8544:2013, 2013). Since life LCC can be applied at each stage of building life cycle; that means LCC can be practiced in mosque maintenance works

during the in use phases. In any case, performing reasonable cost investigation for a facility to be utilized as a part of mosque facilities, represents a test, because of the absence of learning, background, inquire about and distributed information and data (Ayob and Abdul Rashid, 2016).

In addition, an effective LCC analysis will need large number of data inputs particularly when it is applied to maintenance stage. Also, this large number of data can be ambiguous and incorrect (Ayob and Abdul Rashid, 2013). Furthermore, the application of LCC analysis could tell the Facility Manager about future expectations of maintenance budget and facility performance during it is life cycle (Kayrbekova, 2011).

Several researchers like (Nor Zaimah, Nik Elyna, Azlan, 2014; Mustafa, Johar, Ahmad, Zulkarnain, Rahman, Che Ani, 2011; claimed that maintenance budget is playing a great part in decision making about the appropriate type of maintenance that can be used to maintain the facilities in buildings and mosques. They have identified several factors that may affect maintenance cost, i.e. poor workmanship, improper utilization of the property, complete inability to report issues, and selection of problematic support technique (Che-Ghani, Myeda, Shah Ali, 2014).

Several guidelines were published in different countries, to explain maintenance policy and principles, like United Arab Emirates (Abu Dhabi Mosque Development Regulations, and the Australian guideline (Policy for Maintenance of Queensland Government Buildings) (ADMMDR, 2013; MMF, 2017). United Arab Emirates guideline has identified the main components of mosque maintenance policy, i.e. quality policy, operations policy, maintenance policy, cleaning policy. Documentation policy and community support policy (ADMMDR, 2013). The Australian guideline has divided

maintenance policy into three stages, i.e. maintenance planning and development, maintenance implementation, and maintenance information and systems (MMF, 2017).

Many researchers like Ayob and Abdul Rashid, 2013; have identified the key of quality data that can be used as inputs LCC practice, to produce accurate output, i.e. availability, accessibility, cash of cost information, and reliability of data. In addition, the same researchers in (2011) have identified the main sources of data that can be used as inputs of LCC practice, as following:

1. Contractors, manufacturers, testing specialists, and suppliers.
2. Data from modelling techniques
3. Historical data.

The research has accomplished a comprehensive study of previous studies in related to this field. However, there has been limited studies and guidelines that have discussed about LCC practice of mosque maintenance during the in use phases, because of this, the study has reviewed previous studies and guidelines in related to the practice of LCC of building maintenance during the in use phases.

For further explanation of the research problem statement, the following questions are used:

1. What is the current state of practice of LCC of university mosque maintenance in International Islamic University Malaysia (IIUM) during the in use phases?
2. What are the data that can be used as inputs of LCC practice of university mosque maintenance of International Islamic University Malaysia (IIUM) during the in use phases?

3. What should be done to improve LCC practice of university mosque maintenance in International Islamic University Malaysia (IIUM) during the in use phases?

Research background has been developed to investigate life cycle costing (LCC) analysis practice of university mosque maintenance during the in use phases.

1.3 AIM AND OBJECTIVES OF THE RESEARCH

The aim of this research is to investigate the practice of LCC of university mosque maintenance in International Islamic University Malaysia (IIUM) during the in use phases,

The study has chosen Mahallah Ruqayyah Mosque (MUSOLLA AR-RAHMAN) as the subject of the case study. The in use phases of mosque include the following; operation phase, maintenance phase, and selvage phase. (ADMMDR, 2013)

In order to accomplish the aim of this research, the following objectives are delivered to answer the research questions:

1. To review the practice of LCC analysis of university mosque maintenance during the in use phases of MUSOLLA AR-RAHMAN
2. To identify the required data that can be used as inputs for the practice of LCC analysis university mosque maintenance of MUSOLLA AR-RAHMAN.
3. To identify the appropriate strategies that can be used to enhance the practice of LCC analysis of university mosque maintenance during the in use phases of MUSOLLA AR-RAHMAN.

1.4 SIGNIFICANCE OF THE RESEARCH

The study is important as it will fill the hiatus of knowledge of the current state of the practice LCC analysis of university mosque maintenance during the in use phases. This research will improve the knowledge of data types that can be used as inputs of LCC practice of mosque maintenance during the in use phases.

Furthermore, the research will build a unanimity of experts opinion and judgment of the appropriate strategies that can be used to enhance LCC practice of mosque maintenance during the in use phases. In addition, this research will describe the mosque facilities and the appropriate types of maintenance that can be used to maintain mosque facilities.

1.5 SCOPE OF THE RESEARCH

The objective of the research scope is to chain the research field. The research scope can be acted as conceptual limits that can simplify the researcher to cramped down the research topic and identify the area of study of the research. The following is a description of the research scope:

1. The research only focuses on the current state of LCC practice of university mosque maintenance during the in use phases.
2. Mahallah Ruqayyah mosque (MUSOLLA AR-RAHMAN) has been chosen as the subject of the case study in this research.
3. The research investigates the quality and sources of data that can be used as inputs of LCC practice of university mosque maintenance during the in use phases only.

1.6 ORGANIZATION OF THE RESEARCH

This dissertation contains 7 chapters. Figure 1.1 shows the interconnection between the dissertation chapters in related to the dissertation aim and objectives. The following is a short discretions of the chapters:

1. **Chapter 1:** introduces the dissertation.
2. **Chapter 2:** presents the definition mosques maintenance, maintenance policy, mosques maintenance guidelines during the in use phases
3. **Chapter 3:** reviews the LCC practice of mosques maintenance during the in-use phases, which includes, LCC definition, guideline of LCC practice of mosque maintenance during the in use phases.
4. **Chapter 4:** presents the methodology of the research, which includes, research strategy, research model, reliability and validity of the chosen research approaches.
5. **Chapter 5:** reports the findings of data analysis, which consists of two parts to analyze the collected data from the questionnaire interview and the case study.
6. **Chapter 6:** discusses the findings of the data analysis, this chapter contains only one section; to discuss the findings of data collection analysis
7. **Chapter 7:** presents the conclusion, recommendations, and limitations of the research

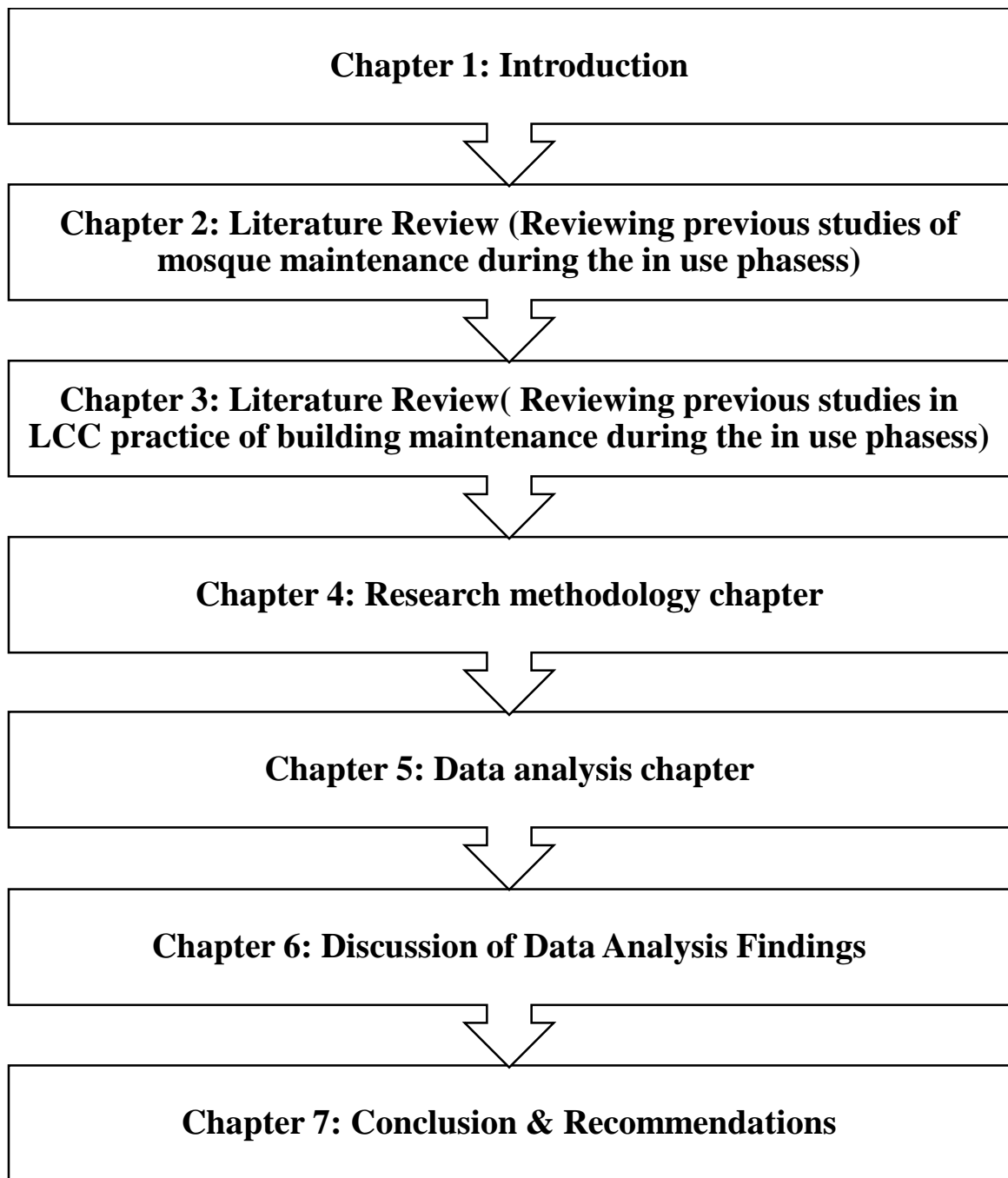


Figure 1.1: The interconnection between the dissertation chapters

CHAPTER TWO

MOSQUE MAINTENANCE

2.1 INTRODUCTION

Mosque is the first thing that Prophet Mohamed has established when He has arrived at the Radiant City; this is because the great importance of mosques in Muslims life. Allah ordered us as Muslims to build and to maintain mosques in several places of the Holy Quran, it was obvious in chapter 9 of Holy Quran Suraa AL-TAUBAH, Allah said:

"He alone can maintain the Mosques of Allah who believes in Allah, and the last day, and observes prayer and pays the Zakat and fears none but Allah; so these it is who may be rightly guided." (9:18).

This chapter will present mosque maintenance types, facilities inside mosque, factors that may affect mosque maintenance cost and LCC of mosque maintenance, and mosque maintenance process guidelines in different countries.

2.2 MOSQUE MAINTENANCE

The term of maintenance has been defined by British Standard Glossary of terms BS 8544:2013 (p. 7) as: "The combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function.". The definition has included both of administration and supervision works combined together: to keep the mosques or facilities working effectively; this will increase the value of management function. (EnCon, 2012)

To build a new strategy that make sure the stages of maintenance process will be controlled by the management of the organization, at the end of this a system of maintenance will be found (Omer, 2016). This system will combine both of maintenance and management which is called maintenance management system (Christen, Schreoder, Wallbaum, 2014).

Another important point can be explained from this definition, there are different elements of maintenance should be defined such as (maintenance reports, conditions standards, and maintenance cost, etc). In addition, there are different types of maintenance (i.e. planned maintenance and unplanned maintenance) which will be explained later in section 2.6 (Ab Muin, Sapri, Sipan, Adjei-Twum, 2016).

Mosque maintenance can be defined as any action that will be performed in order to keep mosque or mosque facilities work until the end of their life cycle. The main objective of mosque maintenance is to gain “Estidama”, (ADMMDR, 2013) it is an Arabic word which means sustainability in English. All of maintenance plans for mosque should be concentrated on Estidama necessity. Estidama necessity can be obtained by applying standards to maintain mosque facilities for example water use in the mosque it is one of the important parts in the mosque, water will be used in each day for five times for person and this is the minimum: because there should be standards to monitor the amount of water that are used and compare with the standards to see if it is acceptable or not (ADMMDR, 2013).

2.3 MAINTENANCE MANAGEMENT SYSTEM (MMS)

Maintenance Management System (MMS) is a database intended to upgrade the administration of conceded support and capital change exercises all through the Service