UNIVERSITI TEKNOLOGI MARA

# DEVELOPING FRAMEWORK LIFE CYCLE COST (LCC) COMPONENTS TO ENERGY PERFORMANCE IN GREEN OFFICE BUILDINGS

**NURUL AFIQAH BINTI YUNUS**

**MSc**

**July 2022**

# ABSTRACT

In today's critical economy, expectations have gone beyond design and construction of a green building. The major barrier for growth in the green building market is the perception of higher first costs associated with these buildings. It has long been acknowledged that it is unacceptable to appraise the costs of projects only on the basis of their initial costs. Hence, Life-Cycle Cost (LCC) is beneficial in allowing owners and clients to make an informed decision on the building materials. Through LCC, the total ownership of cost that includes operation and maintenance costs for a building items calculated in the design stage to get a more accurate projection for entire building life cycle. Ideally, the criteria or components of LCC should be determined before deciding to proceed with the project. However, the LCC components for green projects are fragmented and the items are not kept in a proper system. This situation can be challenging for the decision makers to adopt LCC exercise as there is no proper guidance on the LCC components for green projects. Hence, this research aims to develop the framework of LCC components to energy performance active design in green office buildings. The objectives of this research are to identify the life cycle cost (LCC) components to the energy performance for active design in green office buildings, to analyse the level of importance life cycle cost (LCC) component to energy performance active design in green office buildings and to develop the framework of life cycle cost (LCC) component of energy performance active design in green office buildings. A quantitative approach was used in this research by using questionnaire survey as the main instrument. Purposive sampling method is used to distribute the questionnaire to the respondents, comprises of 84 stakeholders' who involved in green office building construction projects in Kuala Lumpur. The survey has revealed that there are 57 LCC components that can be emphasised in LCC calculation. The analysis using standard deviation, mean and relative importance index (RII) was used to determine the prominence components and the finding showed that the most important LCC components are management cost, value management cost, consulting services cost, product specification verification cost (active devices/ products), design and professional fees, eco labelling cost (active devices/products), documentation cost, advertisement cost materials costs, construction contract costs, initial cost (purchase of the active devices/product), electricity costs, facility management costs and periodic maintenance costs. However, this list acquires additional LCC components such as land cost, temporary work costs and local authority costs. Hence, this list will help design professionals use this framework during the concept design and detail design stages. In any construction project, cost-effectiveness plays a crucial role. It is a rationale 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.

# ACKNOWLEDGEMENT

Firstly, I wish to thank Allah for giving me the opportunity to embark on my master and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor, Sr Dr Natasha Khalil and co supervisor, Prof Madya Dr Kharizam Ismail. I am extremely grateful for their sharing expertise, guidance, patience and encouragement and most of all, for believing in me.

My deepest appreciation goes out to all those people that had assisted, guided, supported and encouraged me during the writing of this thesis.

Finally, this thesis is dedicated to my very dear husband, thank you for believing in my dreams and endless love and support. Thank you to my mother, father and other family member for the vision and determination to educate me. This piece of victory is dedicated to all of you.

"There will never be another like you, you are the greatest gift of all"

Alhamdulilah, we've made it!

# TABLE OF CONTENTS

# CHAPTER ONE
# INTRODUCTION

## 1.1 Research Background

Construction industry is developing rapidly and become one of the backbones of the country. One of the 11th Malaysia Plan related to the construction industry is to achieve sustainability of economic development, social and environmental, without compromising future generations (Rum, N.A.M. & Akasah, Z.A., 2012). Due to the budget blow, expectations have gone beyond designing and constructing a green building in today's critical economy. The significant barrier for growth in the green building market is the perception of higher first costs associated with these buildings. It has long been recognised that estimating project costs solely on the basis of their initial costs is unsatisfactory.

The more complex a building or structure is, the more difficult it is to make a decision on whether to build it. The LCC is an attempt to price as many factors as possible which influence the building cost and to calculate it on one single basis where this cost can be compared with several alternative decisions or with such factors as appearance, comfort and convenience which are difficult to price and depend on personal evaluation. In addition to the many projects, the cost planning of a project will not be effective except where the overall cost which includes the initial and future costs are taken into consideration (Haji Ahmad, 2011). Hence, Life-Cycle Cost (LCC) is beneficial in allowing owners and clients to make an informed decision on the building materials towards sustainability. Through LCC, the total ownership of cost that includes operation and maintenance costs for building items calculated in the design stage to get a more accurate projection.

When it comes to energy performance measures, the building sector represents 40% of the world's energy consumption and contributes to one-third of GHG emissions. Therefore, the Ministry of Energy, Technology, Science, Climate Change, and Environment (KeTTHA) or currently known as Ministry of Energy and Natural Resources (KeTSA), have created the Low Carbon City 2020 policy to achieve Sustainable Development and Climate Change Agenda and energy efficiency towards low carbon cities (Mustafa, 2012). Ideally, LCC's criteria or components in energy