DEVELOPMENT OF LIFE CYCLE COST STRATEGY AND PROTOCOL ON COST DATA INPUT IN MALAYSIA

BY

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A thesis submitted in fulfilment of the requirement for the degree of Doctor of Philosophy (Built Environment)

Kulliyyah of Architecture and Environmental Design
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JANUARY 2014

ABSTRACT

Life Cycle Cost (LCC) is an economic assessment technique that produces outputs, which will give useful cost information to the clients, cost estimators and researchers in facilitating them to make better decision in the process of determining the most optimum total ownership costs of an asset over an anticipated life or in comparing the most cost-effective of mutually exclusive alternatives. The availability, accessibility, currency and reliability of cost data used as inputs in LCC analysis is of paramount importance that should be emphasized in the estimation to produce reliable LCC outputs. The aim of this research is to enhance quality of LCC outputs through the enhancement of quality data input requirements. There are different kinds of data inputs used in LCC analysis; however this research only focuses on cost data inputs of building LCC. This research seeks to achieve the following objectives; (i). to establish the background, evolution and the present practice of LCC with specific reference to its practice in the construction industry, (ii). to assess cost data used as inputs in the practice of LCC, (iii). to develop and propose strategies in relation to the practice of LCC focusing on data inputs, (iv) to develop, evaluate, validate and test protocol which provide procedures on how cost data as inputs of LCC could be made more available, accessible, current and reliable into the process of producing reliable LCC outputs in the Malaysian construction industry. The methodology employed comprises a literature review, modified Delphi and Focus Group Discussion (FGD). The literature study has found that one of the major hurdles in carrying out the LCC analysis is lack of current and reliable data. In addition, commentators pointed out that there is a very important need to give greater emphasis on the quality of data used as inputs in LCC analysis to ensure reliability in LCC analysis can be achieved. Furthermore, the literature study has found the practice of LCC analysis in the Malaysian construction industry has been relatively limited however; it has gone through the process of evolution. The results of modified Delphi show all the panellists have the same opinion that there is limited availability and inaccessibility of current and reliable cost data inputs of LCC in the Malaysian construction industry. In addition, the modified Delphi study has generated consensus regarding the most appropriate strategies that could be proposed to make the data more available, accessible, current and reliable as inputs into the process of producing reliable LCC analysis. Looking at the proposed strategies, there is an overwhelming requirement for a clear procedure to be prepared on the acquisition of cost data inputs in purposely to enhance quality data input requirements of LCC. Hence, a protocol of LCC data input requirements process that comprises a flow chart, step by step procedures and remarks was developed, evaluated, validated and tested in this research using FGD approach to provide robust procedures on how the cost data could be made more available, accessible, current and reliable as inputs into the process of producing reliable LCC outputs in the Malaysian construction industry.

خلاصة البحث

تكلفة دورة الحياةLCC هو عبارة عن تقنية تقييم إقتصادية، تنتج حصيلة تفيد في تقديم معلومات قيمة ودقيقة حول الزبون. لذا يسعى الكثير من الباحثين والاقتصاديين في تسهيل وتطوير هذه الآلية للحصول على أصوب قرار يتعلق بقيمة الممتلكات المقدمة ومقارنتها بطول الحياة المتوقعة للزبون. لذا فعامل التوفر، والسهولة، والحداثة، والوثوقية في البيانات المدخلة في تحليل LCC لها من الأهمية القصوى ما يدعو إلى تأكيدها وتقويتها في عملية التقييم المتواصل لإنتاج LCC موثوق وجاد. تهدف هذه الدراسة بشكل عام إلى تطوير نوعية نتائج نظام LCC من خلال تطوير نوعية ومتطلبات البيانات المتوفرة في عملية التقييم، هناك العديد من الأنواع المختلفة من البيانات و المعطيات المستخدمة في تحليل LCC. كما و تهدف هذه الدراسة إلى تحقيق الأهداف التفصيلية التالية. 1. تأسيس وبناء خلفية معرفية متكاملة حول النظام، وتقييم أوجه التطبيق الحالي لـ: LCC مع التركيز بشكل خاص حول تطبيقاته في مجال البناء والمقاولات 2. تقييم تكلفة البيانات المستخدمة في تطبيق LCC. 3. تطوير واقتراح استراتجيات جديدة متعلقة بتطبيق LCC بالاعتماد على قواعد البايانات المعطاة. 4. تطوير وتقييم واختبار اللوائح والآليات المؤسسة للإجراءات المتعلقة بتكلفة البيانات المستخدمة في LCC، وطرق جعلها متوفرة بشكل أكبر ومتاحة، وحديثة وموثوقة في عملية انتاج LCC قيّمة ومتزنة في قطاع المقاولات والبناء والماليزي. المنهجية المعتمدة في هذه الدراسة تقوم على عرض الدراسات والأبحاث السابقة في الموضوع، وكذا توظيف برنامج دلفي المعدل، ومنهجية فرق المناقشة المركزة FGD. وبتفحص الدراسات السابقة تبين أن العائق الأكبر أمام تطبيقات LCC هو غياب ونقص البيانات الحديثة والموثوقة، بالإضافة إلى ذلك، أشار معلقون إلى أن هناك حاجة مهمة جدا لإعطاء مزيد من التركيز على نوعية البيانات المستخدمة كمدخلات في التحليل LCC لضمان موثوقية في تحليل LCC يمكن تحقيقه. هناك اهتمام كبير الموجه من طرف المتخصصين في LCC في ماليزيا لعمليات التحول فيه، في مقابل قليل من الاهتمام بتوفر وسهولة وحداثة ووثوقية البيانات المستعملة. زيادة على ذلك يشير مسح الأبحاث السابقة في الموضوع إلى أن تطبيق LCC في مؤسسات ذات العلاقة في ماليزيا محدود نسبياً مقارنة مع المستوى المطلوب. لذلك وبتطبيق تقنية الدلفي المعدل تبيّن اتفاق المحللين والمحكمين حول حقيقة محدودية توفر، وسهولة البيانات الحديثة المستعملة في LCC بالمؤسسات الماليزية الذات العلاقة، بالإضافة إلى ذلك ولّد المنهج المعتمد اجماعاً حول أنسب استراتجية يمكن طرحها وتوظفيها لانتاج LCC أكثر وثوقية. وبالنظر للاستراتيجية المقترحة يوجد متطلبات متزايدة حول جملة من الآليات الواضحة التي يجب توفرها في سعينا لتوفير أفضل أداء لنظام LCC، لذلك فإن جملة من اللوائح التنظيمية المتعلقة بـ LCC وآليات انتقاء البيانات المستعملة فيه والتي تجمع بين التوضيحات المقتضبة واستعمال التوضيحات خطوة بخطوة والملاحظات تم تطوريها وعرضها في هذا الموضوع، بالإضافة إلى عملية تقييمية و تجريب عملي لها باستعمال طريقة فرق المناقشة المركزةFGD ، وذلك لتوفير تصور واضح حول كيفية جعل البيانات وتكلفتها في عملية LCC أكثر توفراً وسهولةً وحداثةً ووثوقيةً في عمل مؤسسات المقاولة والتعمير الماليزية

APPROVAL PAGE

The thesis of Mohd Fairullazi Ayob has been approved by the following:

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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.

Mohd Fairullazi Ayob

Signature…… Date ……

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Affirmed by Mohd Fairullazi Ayob.

…….. ……

Signature Date

To my parents, Datuk Ayob Ketot and Datin Zaiton Sulaiman;

To my parent-in law, Chik Azah Sepian;

To my wife, Farazana Yahya;

To my princess, Faira Umairah Mohd Fairullazi;

...Alhamdulillah

ACKNOWLEDGEMENTS

Alhamdulillah, all praise is to Allah S.W.T, the Almighty, the Most Gracious and Most Merciful for allowing me to complete the research. Salam also upon our Prophet Muhammad S.A.W, his family and companions.

First and foremost, I would like express my heartfelt gratitude to my research supervisor, Prof. Sr. Dr. Khairuddin Abdul Rashid for his invaluable guidance, assistance, inputs, advices and patience is supervising me throughout the research.

I would like to express highly appreciation to all the panellists that had participated in the modified Delphi study and Focus Group Discussion. Thank you very much for their willingness to share valuable knowledge and experience in relation to LCC data inputs study. Unfortunately, it is impossible to name all the panellists in this limited space.

I would like to express millions of appreciations to all academics and administrative staffs of KAED, IIUM that have given in directly or indirectly precious supports, understanding and relentless encouragement.

I also would like to express my sincere thanks to my fellow postgraduate researchers for providing valuable views, tips and assistance. I wish you all the best in your research too.

Last but not least, I would like to express my deepest gratitude to my parents, parent-in law, grandmother as well as the rest of the family. My never ending thanks and love go to my wife and daughter. Million thanks to all of you.

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LIST OF ABBREVIATIONS

ACDA	As Completed Detailed Abstract
AFM	Asset and Facility Management
ASTD	As Tender Detailed Abstract
ASTM	American Society for Testing and Materials
ATDA	As Tendered Detailed Abstract
BAS	Building Automation System
BCI	Building Materials Cost Index
BCIC	Building Cost Information Centre
BCIS	Building Cost Information Service
BIPC	Building Industry President Council
BITECH	International Building and Infrastructure Technology Conference
BLR	Base Lending Rate
BMCIS	Building Management Cost Information System
BMI	Building Maintenance Information
BQ	Bill of quantities
BQSM	Board of Quantity Surveying Malaysia
BRE	Building Research Establishment
BS	British Standard
BS ISO	British Standard and International Organization for Standardization
BSI	British Standards Institution
CAR	Contractor's All Risks
CBS	cost breakdown structure
CGC	Credit Guarantee Corporation Malaysia Bhd
CIDB	Construction Industry Development Board
CIR	Capital Investment Report
CGC	Credit Guarantee Corporation Malaysia Bhd
CIMP	Construction Industry Master Plan
CIU	Costs in use
CPI	Consumer Price Index
CREAM	Construction Research Institute of Malaysia
DEL	direct employed labour
DPP	Discount Payback
DSM	Department of Statistics Malaysia
EAC	Equivalent Annual Cost
ECA	Elemental Cost Analysis
Ed/eds.	Edition/editions; editor, edited by
EE	Energy Efficiency
e.g.	(exampligratia); for example
EPC	Energy Performance Contract
EPU	Economic Planning Unit
EQ	Environmental Quality
ERMS	Enterprise Resource Management System
et al.	(et alia): and others
ETP	Economic Transformation Programme

Etc.	(et cetera): and so forth pages that follow
EU	European Union
FEMP	Department of Energy's Federal Energy Management Program
FGD	Focus Group Discussion
FM	Facility Management
FST	fuzzy set theory
GASSIC	Green Assessment System in Construction
GBI	Green Building Index
GDP	Gross Domestic Product
GTFS	Green Technology Financing Scheme
GLCs	Government-Linked Companies
GTP	Government Transformation Programme
HICOM	Heavy Industries Corporation of Malaysia Berhad
IAM	Institute of Architects Malaya
ICT	Information, Communication and Technology
IBS	Industrialized Building System
i.e.	That is
IEM	Institution of Engineers Malaysia
IIUM	International Islamic University Malaysia
IMP	Industrial Master Plan
INSPEN	National Institute of Valuation
ISM	Institution of Surveyors Malaysia
ISO	International Organization for Standardization
IT	Information Technology
ICT	Information Communication Technology
IRR	Internal Rate of Return
IVMM	Institution of Value Management Malaysia
IWK	Indah Water Konsortium
JICA	Japanese International Corporation Agency
JPPH	*Jabatan Penilaian dan Perkhidmatan Harta* [Valuation and Property Services Department]
JUBM	Juru Ukur Bahan Malaysia
KAED	Kulliyyah of Architecture and Environmental Design
KeTTHA	Ministry of Energy, Green Technology and Water
KKH	*Kos Kitaran Hayat* (Life Cycle Cost)
KLCC	Kuala Lumpur Convention Centre
KPI	Key Performance Indicator
LCC	Life Cycle Cost
LHDN	*Lembaga Hasil Dalam Negeri* [Inland Revenue of Board Malaysia]
LICCOMS	Life Cycle Cost for Multi-Storey Housing
LRT	Lightweight Railway Train
m	meter
MAHB	Malaysia Airports Holdings Berhad
MBAM	Master Builders Association Malaysia
MGCC	Malaysian-German Chamber of Commerce and Industry
MiCRA	Management in Construction Researchers Association
MIDA	Malaysian Investment Development Authority
MOF	Ministry of Finance
MR	Material Resources

mySPATA	Sistem Pengurusan Aset Tak Alih Kerajaan
M&E	Mechanical and Electrical
NAFAM	National Asset and Facility Management
NAPIC	National Property Information Centre
NATO	North Atlantic Treaty Organization
NDP	National Development Plan
n.d.	No date
NFPEs	non-financial public enterprises
No/no.s	Number/numbers
n.p.	No place; no publisher
NEP	New Economic Policy
NFPEs	Non-Financial Public Enterprises
NPV	Net Present Value
NS	Net Saving
N3C	National Construction Cost Centre
OECD	Organisation for Economic-Co-operation and Development
OPD	Occupiers Property Databank
OPEX	Operation expenses
OPP1	Outline Perspective Plan 1
OPR	overnight policy rate
PDA	Preliminary Design Abstract
PGC	Putrajaya Committee on GLC High Performance
PFI	Private Finance Initiative
PhD	Doctor of Philosophy
PIAM	*Persatuan Insurans Am Malaysia* [General Insurance Association of Malaysia]
PKK	*Pusat Khidmat Kontraktor* [Contractor Service Centre]
PPP	Public Private Partnership
PPP	*Perakuan Pendaftaran Kontraktor* [Confirmation of Contractor Registration]
PROKOM	Project Management Excellent of Public Works Department
PV	Present value
PW	present worth factor
PWA	present worth annuity
PWD	Public Works Department
QS	Quantity Surveyor / Quantity Surveying
RAPIDKL	Rangkaian Pengangkutan Integrasi Deras Sdn. Bhd
REHDA	Real Estate & Housing Developers' Association
REIT	Real Estate Investment Trust
RI	relative index
RICS	Royal Institution of Chartered Surveyors
RISM	Royal Institution of Surveyors Malaysia
RM	Ringgit Malaysia
RSMD	riot, strike and malicious damage
SCRG	Sustainable Construction Research Group
SD	Standard deviation
SIRIM	Standard and Industrial Research Institute of Malaysia
SLSME	Scheme for small and medium enterprise

SMLCC	Standardized Method of Life Cycle Costing for Construction Procurement
SOF	Scale of Fees
SOP	standard of operation
SPV	Single present value
SYABAS	Syarikat Bekalan Air Selangor
SSPK	*Sistem Satu Pendaftaran Kontraktor* [One Registration System of Contractor]
TAM	Total Asset Management
TNB	Tenaga Nasional Berhad
TOC	Total Ownership Cost
TPI	Tender Price Index
UEM	United Engineers Malaysia
UPV	Uniform present value
U.S.	United States
USM	Universiti Sains Malaysia
Vol/vols.	Volume/volumes
VM	Value Management
WE	Water Efficiency
WLC	Whole Life Cost
WLCC	Whole Life Cycle Costing
WLCF	Whole Life Costs Forum
1ROC	One Registration System of Contractor
3PU	Public Private Partnership Unit of Prime Minister's Department

CHAPTER ONE

INTRODUCTON TO THE RESEARCH

1.1 INTRODUCTION

This thesis reports on a study of assessing data input requirements in life cycle cost (LCC) in the Malaysian construction industry. This chapter elucidates introductory elements of the research which include:

i. Statement of the research problem
ii. Aim and objectives of the research
iii. Significance of the research
iv. Scope of the research
v. Limitations of the research
vi. Organization of the research

1.2 STATEMENT OF THE RESEARCH PROBLEM

Life Cycle Cost (LCC) is an economic assessment technique that uses mathematical method to estimate total ownership costs of the building which connects the initial capital cost with the operation costs, maintenance costs, replacement costs, financial costs, and salvage cost over an anticipated life (BS ISO 15686-5, 2008; BSI, 2008; Davis Langdon, 2010). LCC analysis is applied to provide cost information, which is useful to facilitate the Government, clients, LCC practitioners and researchers to make better decision in the process of determining the most optimum total ownership costs of an asset or in comparing the most cost effective of mutually exclusive alternatives (Kelly and Hunter, 2009; ASTM International, 2010).

The LCC analysis process can be categorized into three main phases, i.e. data inputs, conversion and outputs, following the recommendation from LCC literature (BS ISO 15686-5, 2008; Kelly and Hunter, 2009; NATO Research and Technology Organisation, 2009; Rist, 2011). In this research, quality data refers to cost data inputs. Although there are different kinds of data inputs required for LCC analysis; however this research focuses only on cost data inputs of LCC. Cost data is the important inputs of LCC that should be identified and quantified by the estimators in early stage of the project (Fuller, 2009; Davis Langdon, 2010). The literature study has identified the following as the key quality of data input requirements required for producing reliable LCC outputs:

i Availability of cost data is defined as data certainty for LCC analysis (Gross and AEA, 2008; NATO Research and Technology Organisation, 2009; BS ISO 15686-5, 2008)

ii Accessibility of cost data is defined as the ease of access to obtain cost data for generating LCC analysis (Ren and Zhang, 2007; Schade, 2007; BSI, 2008; Ashworth, 2010)

iii Currency of cost data is defined as recent cost data used as inputs for producing reliable LCC analysis. Current data is frequently updated on a certain period of basis (i.e. monthly, quarterly or yearly) (www.statistic.gov.my; Khairani, 2009; DSM, 2010)

iv Reliability of cost data is defined as data consistency or data accuracy for LCC analysis (Annex 31, 2001; Creswell and Clark, 2007; King, 2007; CRES and Kikira, 2009; Giannarakis et al., 2011)