DEVELOPING A LIFE CYCLE COSTING ANALYTICAL FRAMEWORK FOR THE BUILDING AND CONSTRUCTION INDUSTRY IN TANZANIA

By

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CHAPTER ONE

INTRODUCTION

1.1.General Introduction

This study intends to develop a life cycle costing analytical framework for the buildings and construction industry in Tanzania. Life-cycle costing (LCC) analysis is a method used to evaluate the cost effectiveness of designs and materials alternatives of major project cost variables including initial costs, operating costs, maintenance and disposal costs over its entire life (Stanford University, 2005).LCC analysis is used for selection of optimal building designs based on assumed inflation rates and the time-value of money but discounted back to a fixed date (Amelio and VanGeem, 2000).Aoudad (2001; page 134) stresses the need to apply LCC in construction projects to reduce the occupancy costs which represent up to 70% of buildings total costs. An LCC analysis involves establishing objectives, determining the criteria for evaluating alternatives, identifying and developing design alternatives, gathering cost information and developing LCC for each alternative (Stanford University, 2005).

50% of the twenty fastest growing economies in the world are from Africa and this is inclusive of Tanzania which had a growth rate of 6.90 %and 7%in 2012 and 2013 respectively and therefore making it the fastest growing economy among the East African Community Partner States (World Bank, 2013).Construction sector which had a growth rate of 8.6% in 2013 is one of the fastest growing economic sectors in Tanzania (FB Attorneys, 2014).The Contractor's Registration Board (2012) revealed that in 2010 building works in Tanzania accounted for 50% of the annual turnover of all the projects. Despite such a large contribution of the construction sector to the country's economy, Tanzania is yet to develop an LCC analytical framework for its construction industry, and thus denying it the opportunity to enjoy the benefits of LCC including basic cost concepts, identifying the key cost drivers and providing cost plans and budgeting (Ministry of Works, 2003).

Kusiluka and Kongela (2009) and Kelly and Hunter (2009) reports on problems of initial capital construction and maintenance costs for buildings in Tanzania.Kelly and Hunter (2009) proposed that these problems can be reduced by formulating an LCC analysis framework to be used as a tool for cost control. From the above it is evident that lack of knowledge on LCC analysis in Tanzania has created a knowlegde gap which this study intends to adress by developing a standard life cycle costing analysis framework. Currently there is no any LCC analysis guideline developed purposely for use in the construction industry in Tanzania (Tanzania National Construction Industry Policy, 2003).This research intends to formulate LCC guidelines for the first time in Tanzania, to create awareness among stakeholders to solve high capital and occupational costs problems in construction sector in Tanzania.

The introductory chapter presents the general introduction, background to the study including historical, theoretical, conceptual and contextual backgrounds, statement of the problem, purpose of the study stating the main and specific objectives, research questions, significance and justification of the study and scope and limitation of the research.

1.2.Background to the study

1.2.1. Historical Background

1.2.2. There is no evidence of any LCC practice before 1847 when highway engineering economics was introduced to determine the most cost-effective and lowest construction and maintenance costs in the United States (Ozbayet al, 2003). From 1930s onwards LCC was applied as flood control technique but developed further in the 1950s as a means of minimizing the costs of transportation (Ozbay et al, 2003; page 9). In the 1930s building users began to think on the ways of minimizing maintenance, energy and management costs which were very expensive (Bulll,2003).Further researches on LCC development continued from 1960 resulting into development of empirical models in 1984 (Ozbayet al,2003), LCC guidelines for military procurement purposes in mid-1960s and LCC alternative energy design options mechanism in the late1970s both by the US Defence Department(Cole and Sterner,

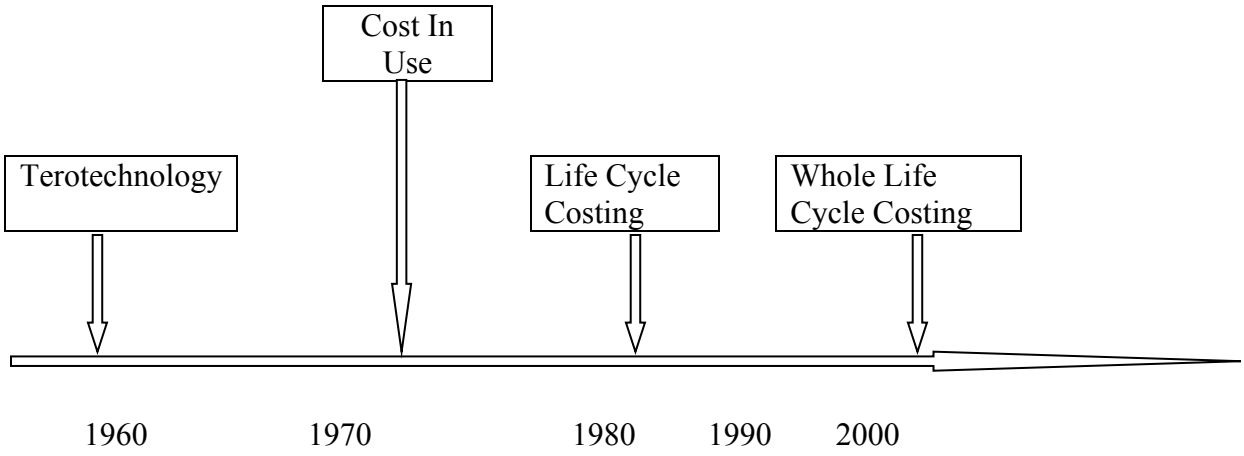
2010).The accurate future cost forecasting LCC mechanism was fully developed in the early 1970s (Kirkham and Boussabaine, 2004).From 1970s most clients, developers and professionals involved in building procurement started focusingon capital cost in their investments believing that they would realise substantial cost savings, and this led to the school of thought known as 'terotechnology' which was largely ignored at the beginning due ignorance of LCC, lack of available data and data collection mechanisms (Kirkham and Boussabaine, 2004).

In 1971, the Royal Institution of Chartered Surveyors established the Building Maintenance Cost Information Service (BMCIS) as a method of collectingoperational and running cost data. In 1977, the then UK Government published *Life-cycle costing in the management of assets* which was further developed with a diversity of LCC analysis models and techniques (Kirkham and Boussabaine, 2004). Since the late 1980s,LCChas been used as an appraisal methodology purposes (Kirkham, 2007), leading to the development of data collecting framework in 1983and the concepts of 'whole life costing' (WLC) and 'whole life-cycle costing' (WLCC) emerged (Kirkham and Boussabaine, 2004).In 2000 (ISO 2000) 156868 Part 1 –Service Life Planning was developed while in 2007 "*A common European methodology for Life Cycle Costing"* document in was established (Langdon, 2007) followed by International Standard for LCC for Buildings and Constructed Assets BS ISO 15686-5:2008,SCS Ireland Guide to LCCin 2010.In 2007, the UK Government baseline costs guide on construction costs and risk management (UK Government, 2007).

The Society for Chartered Surveyors (SCS) Ireland Guide was issued in 2010 to provide guidance in LCC calculations and analysis, models and focus on the financial risks (Dermot, 2010).Code of Practice for Life Cycle Costing was prepared by North Atlantic Treaty Organization (NATO) in 2009 and identified internal and external constraints for LCC evaluation (NATO, 2009). The Australian and New Zealand standard Life Cycle Costing - An application Guide (AS/NZS4536:1999) was developed in 1999 and provides a general introduction to LCC application, risk management and outlinemajor

challenges in LCC (The Australian National Audit Office, 1999). BS ISO 15686-5:2008 the first international standard for LCC for Buildings and constructed assets, was developed in 2008 by UK (BS ISO 15686, 2008).Aoudad et, Amaratunga, Bakis, Sun, Kishk, Al-Hajj and Pollock (2003) observed that the main problems associated with LCC analysis were the economic obsolescence of the building due to improper maintenance policy, lack of accurate data and a difficulty to visualize the impact of their decisions.

Figure 1: The Evolution Timeline of Whole Life Cycle Costing



Source: Whole Life Cycle Costing, Risk and Risk Responses, Kirkham and Boussabaine (2004), Page Nr.4

1.2.3. Theoretical Background

Life cycle costing (LCC) was developed on traditional investment computation focusing on initial capital costs but later on it was improved to include future operational and demolition costs. Its history began in the US in the mid-1960s for military procurement purposes but since 1980 it was further developed through researches to become a methodology for the construction industry (Gluchand Baumann,2004). The LCC analysis theoretical assumptions developed from the normative neoclassical economic theory seeks to maximise profits. The behaviour of the 'economic man' in neoclassical economic theory is always rational unlike descriptive decision-making studies which deny rational decisions especially when uncertainty is involved (Gluchand Baumann,2004).

Kelly and Hunter (2009) pointed out dangers associated with data in LCC analysis as: data inaccurancy,data can be missing, difficult in downloading data, huge variation in the data and data are often not up to date. Gluchand Baumann (2004) cites limitations in neoclassical economic theory as mainly failure to handle decision-making under genuine uncertainty, assumptions that alternatives are always available andthe use of discounting techniques in forecasting future costs.Poor quality of the data, non -availability and reliability of data are the main obstacles to LCC analysis.

Aoudad et al (2003) suggests creation of a LCC database to overcome data related challenges and problems including Open Systems for Construction (OSCON)database technology developed to facilitate information integration.The data base for this research can be built from reliable statutory organizations sources such as Bank of Tanzania, National Bureau of Statistics, Tanzania Electricity Supply Company (TANESCO) which have data storage mechanism for their utilities.

1.2.4. Conceptual Background

LCC is an economic analysis method deployed to compute different buildings owning, operating, maintaining and disposing costs over a given period of time with all costs discounted to reflect the time – value of money (Fuller and Peterson, 1996). LCC technique compares the net cost of buildings and components throughout their life and gives cost comparison of different materials (New Zealand Study Report, 1997). LCCanalysis outlines how to perform its analysis, estimate its input parameters, interpret its results, provides common flaws in its practice which discusses weaknesses/shortcomings and possible risks in involved economic evaluations (Ozbay et al,2003).

LCC analysis is a technique for evaluation of long-term performance of projects based on benefits and costs computations and serves as a mechanism for optimal selection in evaluation process (Ozbay et al, 2003).LCC analysis is an economic analysis tool used to prioritize funding allocation to capital investment projects when faced with limited funding problem (Fuller and Peterson, 1996).Whole Life Cycle Costing

(WLCC) is made up of accumulated sum of all the individual buildings life cycle costs ranging from initial construction, replacement, operational, energy and disposal costs (Kehily and Grady, 2010)..

Buildings principal elements for which LCC analysis can be carried out are frames, upper floors, external and internal walls and partitions, roofs, doors, windows, floor, finishes and decorations and building services (Kirkham, 2007).Mechanical properties of materials used in buildings construction such as weight, strengths, ductility, toughness, impact resistance, fatigue resistance, elasticity and creep under load influence their initial and maintenance costs (Orton, 2001).

1.2.5. Contextual Background

Tanzania is yet to develop LCC guidelines for construction industry despite of its large volume of construction. LCC guideline is even missing in the Tanzania National Construction Industry Policy (2003) which is charged with developing a construction sector in terms of construction needs, rehabilitation and maintenance of works (MOW, 2003).Lack of appropriate LCC guidelines has caused the initial construction costs and maintenance costs for buildingsin Tanzania to be unnecessarily high (Kusiluka and Kongela, 2009).High initial capital costs and future operational and maintenance costs increase overall life cycle costing of construction investments and therefore causing the developer to incur losses which could have been avoided (Kelly and Hunter, 2009).With introduction of proper LCC analysis framework in Tanzania, LCC analysis can be conducted at design or construction stage to establish possible savings in the capital or future operational costs.There is therefore a need to carry out a research on life cycle costing analysis in order to adress these problems and create costing awareness among construction industry stakeholders.

In South Africa, a study conducted on the energy systems established that the belief that sustainable and renewable energy alternatives are too expensive is a false perception created by looking no further than initial capital costs. It was therefore recommended to apply both initial capital and future operational and maintenance costs in LCC studies to lower life cycle costing for renewable energy.

1.3.Statement of the Problem

Despite a large contribution of the construction sector to the country's economy, Tanzania is yet to develop an LCC analytical framework suitable for its construction industry and therefore denying the construction sector and the country in general the benefits of LCC which include providing a better insight of costs, identifying the key cost drivers and providing cost plans and budgeting (Ministry of Works, 2003). The World Bank report (2013:page 1),revealed that construction sector which had a growth rate of 7% in 2013 when Tanzania had a remarkable growth rate of 8.6% is one of the fastest growing economic sectors in Tanzanian (FB Attorneys, 2014).In addition this sector had a growth rate of about 12 per cent of the GDP in 2010 and an annual turnover of 1.9 billion US dollars (about 2.8trillion) out of which building works accounted for 50% of the total value of the projects (CRB, 2012).

The problems associated with the absence of LCC analytical framework in Tanzania are supported by two research reports in the construction industry released in 2009 and 2013. A research paper titled 'Prospects for Sustainable Construction Practices in Tanzania' presented at the European Real Estate Society Conferencein Stockholm, 24 – 27 June, 2009 revealed the problems of high initial construction and maintenance costs. The study was conducted on 12 buildings in Dar –Es –Salaam including Ubungo Plaza, Umoja House, NASACO, ILO House, BOT Twin Towers, USA Embassy Building, International House and PPF Towers (Kusiluka and Kongela,2009).Another research report by the National Construction Council (NCC) (January, 2013) revealed excessive unplanned high budgets for repairs and maintenance for Government and local Authorities buildings because of absence of guidelines which would outline the maintenance and rehabilitation strategies for such buildings in Tanzania (NCC, January, 2013).

Two authors Mokheseng (2010)and Kelly and Hunter(2009) point out the sources of the above problems and suggest ways of overcoming them.Mokheseng (2010)is of the opinion that the problems

of high buildings occupancy costs which range between 50% and 80% are due to operation, maintenance and retrofitting costs.Kelly and Hunter(2009)suggest thatthe problems of highlife cycle costsare caused by maintenance costs of buildings but these can be reduced by deploying appropriate maintenance strategies through LCC analysis techniques during project design stages.

It can therefore be concluded that the construction industry in Tanzania is faced with the problems of high initial construction costs, maintenance and future occupancy costs and thus increasing the overall LCC costs. Such problems as observed by Kusiluka and Kongela and NCC are due to lack of awareness on the concept of LCC analysis. Life cycle costs can not be properly designed without having LCC in place and therefore the absence of guidelines suitable for Tanzania makes the situation precarious. There is therefore a knowledge gap in terms of LCC analysis guidelines in construction industry which needs to be adressed. This creates a knowlegde gap that denies policy makers chance to access recommendations based on empirical facts.Moreover, scholarly attention to this area within economics and project management remains limited.This study therefore intendsto develop a standard life cycle costing analysis framework for buildings and construction sector in general in Tanzania.

1.4.Purpose of the study

The purpose of this research is to develop a standard life cycle costing analysis framework for the buildings and construction sectors in Tanzania.

1.4.1. Specific Objectives

The specific objectives of this research are as follows:

1. To explore the nature of the construction industry in Tanzania
2. To explore the level of stakeholder awareness of the lifecycle practices in buildings and construction industry in Tanzania
3. To identify and determine the major life cycle costs in the building sand construction industry
4. To develop a standard life cycle costing analysis framework for the buildings and construction industry in Tanzania.

5. To carry out a "Dry run" i.e. simulation model to test the application of LCC model developed.

1.5.Research Questions

1.5.1. Research Questions

1. What is the nature of the construction industry in Tanzania?
2. What is the level of stakeholder awareness of the life cycle practices in buildings and construction industry in Tanzania?
3. What are the major life cycle costs in the buildings and construction industry?
4. How can a standard life cycle costing analysis framework for the buildings and construction industry in Tanzania be developed?
5. How can a "Dry run" i.e. simulation model be carried out to test the application of LCC model developed?

1.6.Research Hypothesis

There is no hypothesis developed for this research on development of a life cycle costing analytical framework for the construction industry in Tanzania because this is an area of study that has no previous research and not much is known to support formulation of a hypothesis. Mugenda and Mugenda (2003) recommend that hypothesis in studies, which do not have strong support from previous research, or professional experience should be avoided. Mugenda and Mugenda (2003) further argues that hypothesis are difficult to formulate in areas of knowledge that have very little or no previous research because there is no sufficient information known to support formulation of a hypothesis and therefore they should be omitted and the study be guided by the research objectives. Naoum (2003) supports this argument and advises that a research hypothesis should clearly and specifically state the position for the argument or investigation and should be designed to test or validate it. Since Tanzania does not have any existing life cycle costing guidelines for its construction industry, it becomes difficult to give a prediction which should be tested or validated.

1.7.Significance of the Study

1.7.1 Rationale of the Study in Terms of Academic or Literature Contributions

Academicians and researcher will read the research and utilize its findings to disburse knowledge to students and researchers.

Based on Tanzania Life cycle costing guidelines developed from the research future studies will be able to make improvement and advancement in the application in performing LCCanalysis.

1.7.2 Rationale of the Study in Terms of Policy Considerations Contributions

The research results will improve cost awareness and provide practical guidance to construction cost professionals and stakeholders in carrying out LCC analysis and application of its models in Tanzania. In addition the results will impart knowledge on the comparisons of different building designs and investments, to prepare LCC plans for construction projects and cash flow prediction.

Through LCC analysis borrowers and lending institutions will realize risks and uncertainly involved and therefore safeguard clients against rising costs and excessive maintenance and replacement costs.

1.7.3 Rationale of the Study in Terms of Personal Contributions

The researcher will be awarded Doctor of Philosophy Degree in Economics by Mbarara University of Science and Technology upon development of LCC analytical framework in Tanzania.

1.8.Justification of the Study

The study intends to address a serious problem of absence of LCC guidelines in Tanzania which has caused unnecessary high initial, operational, maintenance and disposal costs which could be saved.

1.9.Scope of the Study

The scope of this study is limited to the application of LCC in buildings and Tanzanian construction industry in focusing mainly on cost reduction. It is also limited to a major Commercial City of Dar –Es –Salaam region and former Tanzania headquarters where most of the intended respondents have have their offices located and therefore facilitating the data collection process. In terms of time scope, the study is limited to three years

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Literature review is intended to identify previous literature on LCC concepts and methodology from academic journals, conference proceedings, dissertation and thesis, occasional technical reports, government publications, newsletters, textbooks and the internet in order to understand what has been done in this area. Literature review attempts to integrate what others have done, criticize previous scholarly works, to build bridges between related topics, to identify the central issues in the research and summarizing by discussing, pointing out their strengths and weakness.The contents of this chapter are the theoretical and conceptual frameworks, buildings and construction industry, LCC concept, LCC guidelines and their main contents, comparison of use of LCC in public and private sector,cost components of LCC, performing of LCC,barriers to LCC applications and comparison between LCC and whole life cycle costing, value engineering, LCC assessments and sustainability.

2.2 Theoretical Framework

Kombo and Tromp (2006) defines a theoretical framework as a collection of interrelated ideas based on theories and is a reasoned set of prepositions derived from and supported by data or evidence clarifying why things are the way they are based on theories. Kirkham (2007) considers an LCC guideline as a document intended to meet the needs of professionals throughout the life cycle of a built facility, including planning, construction, occupation, operational and maintenance, adaptation and expansion.

An LCC guideline provides a practical guidance and assistance for construction cost professionals in carrying out LCC analysis, producing LCC models, proposes structure and methodology, explain how LCC calculations can be computed. It further focuses on the financial risk that could occur during the construction period due to over budgets and time overruns (Kehily and Grady,2010).The LCC method can be used for evaluating cycle cost calculations for various alternatives for building construction,

(Stanford University, 2005). LCC feature includes previous (historical) costs, current costs and forecasted future costs and incorporates discounting techniques using nett present value methods to compare design alternatives of buildings (Zhang, 1999).Fuller and Peterson (1996) considers LCC as a economic analysis tool which applies first-cost or short-term considerations information in developing discounted cash flow, constant versus current dollars and price escalation rates concepts.

2.3 Conceptual Framework

Conceptual framework refers towhen a researcher conceptualizes the relationship between variables in the study and shows the relationship graphically or grammatically and this enables the reader to quickly see the proposed relationships. It is a hypothesized model identifying the concepts under study and their relationship (Mugenda and Mugenda, 2003).Conceptual framework is based on ideas that may be formulated from a researcher's own perception which can be from observation or experience (Kombo and Tromp, 2006).