APPLICATION OF EARNED VALUE MANAGEMENT(EVM) IN TANZANIAN CONSTRUCTION PROJECTS

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By

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CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Ardhi University a dissertation titled "***Application of Earned Value Management (EVM) in Tanzanian construction projects***" in fulfillment of the requirements for degree of MSc. in Construction Economics and Management, Ardhi University.

Dr. Harriet Eliufoo

(Dissertation Supervisor)

Date.....

DECLARATION AND COPYRIGHT

I, **SOLOMON, Emael** hereby declare that the contents of this dissertation are the result of my own study and findings, and to the best of my knowledge, they have never been presented elsewhere for a Diploma, Degree or any professional awards in any institution of higher learning.

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SOLOMON, Emael

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DEDICATION

This work is humbly dedicated to the Almighty God who gave me strength to accomplish this dissertation. This work is also dedicated to my beloved parents, Mr. Solomon B Massangya and Frida Majule who have constantly been the fountain of inspiration to my life and for their endless support. This dissertation is lastly dedicated to my brothers and sister for their endless support, encouragement and guidance

ABSTRACT

Earned Value Management (EVM) is one of the fundamental approaches acting as a comprehensive project management and controlling technique for tracking the costs and examining project expenditures relative to the physical progress of work. Majority of the previous literature reviews and findings indicates the positive contributions of EVM in monitoring the project time-cost performance progressively and forecasting its future trends. However, EVM was not widely used as practically, the traditional cost and schedule monitoring tool is still very common in the construction industry. Thus, this research was conducted using quantitative and qualitative methods to the identified quantity surveyors, project managers and engineers of contractor in Tanzanian construction firms to achieve the objectives of; (1) to assess the use of EVM in construction projects, (2) to examine the challenges in using EVM, and (3) to recommend on ways to enhance the application of EVM. Based on the results, it was found that only some parts of the concept of EVM were being used in construction projects but not the EVM as a whole. The application of EVM was found to be partial which some parties are not fully used like analysis of data collected and forecasting of time/cost through EVA. Despite the major challenges identified in using EVM due to the lack of EVM knowledge, expertise and experience by the user in the industry, the results also continuous training to the industrial practitioners on construction project management principles is one of the strategies proposed as measure of improving the application of Earned Value Management (EVM) for performance of Tanzanian construction projects.

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LIST OF ABBREVIATIONS

ACRONYM	DEFINITION
AC	Actual Cost
ACWP	Actual Cost Work Performed
AT	Actual Time
BAC	Budget at Completion
BCWS	Budget Cost Work Schedule
BCWP	Budget Cost Work Performed
CPI	Cost Performance Index
CR	Critical Ratio
CRB	Contractor Registration Board
CV	Cost Variance
EAC	Estimate Cost at Completion
EACt	Estimate Time at Completion
ERB	Engineer Registration Board
EV	Earned Value
EVA	Earned Value Analysis
EVM	Earned Value Management

EVMS	Earned Value Management System
EVT	Earned Value Technique
GDP	Gross Domestic Product
KPIs	Key Performance Indicators
NHC	National Housing Council
NASA	National Aeronautics and Space Administration
NDIA	National Defence Industrial Association
OBS	Organisation Breakdown Structure
PMB	Performance Measurement Baseline
PV	Planned Value
PPRA	Public Procurement Regulation Act
PMBOK	Project Management Board of Knowledge
RC	Remaining Cost to Complete
RT	Remaining Time to Complete
SPI	Schedule Performance Index
SV	Schedule Variance
VAC	Variance at Completion
WBS	Work Breakdown Structure

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Historical background

Earned Value Management is the classical tool to control and monitor the project performance. It originated from US Department of Defense (DoD) in which form Cost/Schedule Control System Criteria(C/SCSC) in 1967, mandated that the contractors of Department of defense must use the tool and report the progress in specified format. The tool was updated from C/SCSC to Earned Value Management System (EVMS) in 1997 by Electric Industry Association through ANSI/EIA-748 standard. The acronyms used with C/SCSC such as ACWP, BCWS, and BCWP were simplified to AC (Actual Cost), PV (Planned Value) and EV (Earned Value) respectively. DoD and US federal agencies adopted it replacing C/SCSC as EVMS was much more flexible (Fleming and Koppelman, 2005).

During the 1980s the tool emerged as a project management tool and was available also to other industries across the USA. In 1999, the PMI established its first College of Performance Management, today the premier professional organisation for EVM research and project planning and control, and included the tool in its standards (PMI, 2008). Consequently, the tool got across other countries and many industries. In the late 1980s and early 1990s, EVM emerged as a project management tool to be understood and used by managers and executives, not just the EVM specialists. By 1989, EVM leadership was elevated as an essential tool of programme management and procurement. In 1991, some defense projects and programme were cancelled because of performance problems detected by EVM (Marshall, 2007). These initiatives led to the high level of awareness about EVM

among the practising managers as supported by several studies (Kim *et al*. 2003; Besner and Hobbs 2006). Despite these attempts, EVM tool remains underutilised by the private industry (Kim *et al.,* 2003; Besner and Hobbs, 2006; Marshall *et al*., 2008; Kwak and Anbari 2012; De Marco and Narbaev 2013; Singh *et al*., 2014).

Theoretical and Conceptual Background

The performance indicator in construction projects is important because it allows to foresee the problems that may occur during the executions of the project, enabling corrections and adjustments, as well as avoiding deviations from the plan. EVM (Earned Value Management) is a powerful tool in managing scope, time and costs, allowing scheduled performance indices and costs to be achieved (Anbari, 2003). To monitor the construction project is to compare the planned situation with the current situation, by determining if the schedule and the costs are progressing according to planned situation, in order to take corrective measures when needed (De Marco, 2013).

The earned value management gives early indications to the project performance to highlight if there is a need for eventual corrective measures, it enables measuring actual work performance and associated cost and time versus an agreed plan (PMI, 2005). Alvarado *et al*. (2004) addressed that cost overrun and schedule delay must be considered in any construction project because if you did not put into consideration the project will be in trouble at its beginning and unfortunately managers of the project will not realise the problem until late, when the objectives planned of the project being difficult to be recovered or the ability to recover diminishes. According to the PMI (2005), EVM has proven itself to be one of the most effective performance measurement tools and feedback tools for managing construction projects and enabling project managers to close the loop in the plan-do check-act project management cycle. The purpose of managing construction project is to

complete it within the budget and on time while the conforming established requirements and specifications (Pewdum *et al*., 2009). The performance of the project can be judged by different traditional approaches like monthly or weekly management reports, day to day monitoring, performance reviews, project audit reports, key performance indicators, etc.

In traditional approaches, usually there two sources of data, the budget (planned) expenditures and actual expenditures, the comparison of the planned budget versus actual expenditures merely indicates what was planned to be spent against what was actually spent at given time (Mohd.Faris *et al*., 2011). Accordingly, this approach does not put into consideration the value of work accomplished, thus ignoring the third dimension, Earned Value (EV) of the work (Fleming and Koppelman, 2003). According to Al-Jibouri (2003), what is missing from the most of the analysis is an understanding on how much work has been earned during the execution of the project and its integration with time and cost.

Position of EVM in construction projects

Globally, De Marco and Narbaev (2013) also found that the Earned Value Management in European construction industry was still in an infanty stage. However, after a case study on the application of Earned Value Management was made on a facility construction project there, the authors found that Earned Value Management can be applied in many industries including the facility construction project of any complexity and size.

In U.S, Earned Value Management has been applied by both private and public sectors in different kinds of project management; either in infrastructure, manufacturing, technology or construction project (Alvarado *et al*., 2004; Pratt, 2006). According to Kim *et al.* (2003) Earned Value Management is highly accepted in the projects by the project managers, in USA 82 percent of the project managers surveyed strongly accepted the Earned Value Management concept. Also, the authors found that Earned Value Management has been

increasingly well-known in both private and public sectors and project managers even claimed that Earned Value Management can be applied successfully in both sectors. Even there are countries like UK, U.S.A, and Australia that have outlined the guidelines for the application of Earned Value Management.

According to Vertenten *et al*. (2009) even though Earned Value Management has been recognised by South African construction industry, it has not been utilised fully by the industry itself. They found that some parts of the concept of Earned Value Management were being used in construction projects but not the Earned Value Management as a whole.

Theoretically, EVM is known to be beneficial to the project team as it provides early warning of whether the project is behind schedule or the budget is overrun (Cleland and Ireland, 2007; Humphreys and Associates, 2012). Generally, it has been agreed by most researchers that EVM is reliable in identifying the construction project status in terms of cost, time and work scope (Fleming and Koppleman, 2002; PMI, 2013). Therefore, EVM helps the project team to accomplish the project objectives successfully.

Research gap

An appraisal of previous works showed that there is a conceptual, contextual and methodological study gap existing in application of Earned Value Management in Tanzanian construction projects. Majority of the studies conducted regarding the application of Earned Value Management are from developed countries (Czemplik, 2017; Cândido *et al*., 2014; Waris *et al*., 2012; Adebayo *et al*., 2018; Vyas and Birajdar, 2016; Nkiwane, 2016). Therefore, there is a need of conducting more research on EVM so as to improve the performance of the construction projects. This study focuses on the application of Earned Value Management in Tanzanian construction projects.

Table 1.1 Summary of previous studies relating to the application of Earned Value Management (EVM) in construction projects

Title	Author details	Key issue researched	Findings	Remarks
Application of Earned Value Method for evaluation the Time/Cost Consequences of Variation Orders in a Construction Project	Czemplik, 2017 Research Journal	The practical methodology of using EVM as the tool of accepting the acceptance decision of VO being considered during construction works presented in the paper	The main strength of the presented concept is a quick prognosis of the final project cost in case the VO accepted	The researcher on emphasised only on EVM as the tool of accepting the acceptance decision of VO. The research conducted in Poland
Critical analysis on Earned Value Management (EVM) technique in building construction	Cândido *et al.*, 2014 Research Journal	The aim was to explore in greater depth this debate through a case study on a construction project that applied EVM as a planning and control tool	The author concludes that EVM is just an extension of the traditional approach of measuring physical and financial advances over time	The researcher didn't put the emphasise on challenges in application of EVM. This research was conducted in Brazil
The Cost Monitoring of Construction Projects through Earned Value Analysis	Waris *et al*., 2012 Research Journal	To illustrate the application of EVA in real situation and demonstrate how this approach can be useful in cost monitoring and help the project organisation to monitor their performance	Cost monitoring through EVA is an effective approach for financial management of construction project	The researchers put no emphasise on time/schedule monitoring put only consideration on cost monitoring. This research conducted in Malaysia
Assessment of project monitoring and control techniques in Ondo State Agency for road maintenance and construction (OSARMCO)	Adebayo *et al*., 2018 Research Journal	Examined project management technique employed by (OSARMCO)	The result showed that that there is a relationship existing between all types of the project monitoring and control technique used by a construction company and project delivery/success and the use of	More emphasise on all tools of project monitoring in construction projects, also concentrates only on the road projects. But this research conducted in

Title	Author details	Key issue researched	Findings	Remarks
			programme evaluation and review (PERT) for time/schedule control and EVM	Nigeria
Tracking of construction project by EVM	Vyas and Birajdar, 2016 Research Journal	Focus on concept and importance of EVM	Tracking of construction project is more powerful in recognising the risk factor of the construction project and forecasting	The researcher focuses of concept and importance of EVM but didn't emphasise on challenges in application of EVM. But also, this research was conducted in India
The use of EVM for initiating directive project control decisions	Nkiwane, 2016 Research Journal	To investigate and link the monitoring and/or directive use of EVM to the project management maturity	Show the minimal use of EVM in the directive control of project, at the best the directive use of EVM is found to implied rather than deliberate and methodology	No emphasize put on application of EVM in construction project. The research was conducted South Africa

1.2 Statement of the problem

Globally, EVM has been proven to be an effective tool of project monitoring, in providing performance standard for the evaluation of progress report of the project. It also acts as a control device to take care of cost and time schedule by responsibility defined in Organisation Breakdown Structure (OBS) (PMI, 2008; Gower, 2007; Cleland and Ireland, 2007; Humphreys and Associates, 2012)**.** It provides better performance picture of the project and gives better forecast of the final completion cost (Bhosekar and Vyas, 2012). EVM is like an alarm to the managers to identify and control problems by taking timely corrective actions before they become too big to overcome (PMI, 2005).

Despite the availability of EVM tool as the project monitoring tool, contractors still fail to meet their committed time frames which at times lead to costs as a result of delays in delivery. Contractors still are not able to achieve their targeted profit in a project due to increased operational costs (Muhwezi, Acai & Otim, 2014; Warhoe, 2013; Sambasivan & Soon, 2007; Le-Hoai&Lee, 2008).

In developing countries like Tanzania, schedule and cost overruns is also a serious problem where the implementation of project faces many uncertainties (Eliufoo, 2017). According to Turner (1999) this problem will result to the wastage of scarce financial resources, delays in providing facilities, development and also make the construction costlier. Therefore, this study aims to assess the application of Earned Value Management (EVM) in Tanzanian construction projects which helps to propose how the application of EVM in Tanzanian construction projects can be enhanced in order to reduce the time and cost overrun in construction projects.

1.3 Objective of the study

1.3.1 General objective

The study aims to assess the application of Earned Value Management (EVM) by contractors in Tanzanian construction projects

1.3.2 Specific objectives

i. To assess the use of EVM tool in time and cost management for construction projects in Tanzania;
ii. To examine challenges in the application of EVM in Tanzanian construction projects;
iii. To propose how the application of EVM in Tanzanian construction projects can be enhanced.

1.4 Research questions

i. How is EVM applied in time and cost management of construction projects in Tanzania?
ii. What are the challenges facing the application of EVM in construction projects in Tanzania?
iii. How can the application of EVM in Tanzanian construction projects be enhanced?

1.5 Significance of the study

i. The study will provide essential information which will contribute in the existing literature. Such information will be useful to researchers and academicians wishing to carry out further research in the field;
ii. The information will also help the construction parties, policy makers, Government and all other stakeholders who can use the findings to make improvement within the industry and also in good decision making;

iii. The study will help other stakeholders and project managers to measure project progress of different tasks and provide early warning if the project is out of hand and recommend prompt corrective measures to get the project back on the track. This will help to meet the project cost performance and schedule performance.

1.6 Justification of the study

Cost and schedule overruns are one of the most common problems faced during project execution and if this problem is not addressed, it may lead to project delays, cash flow problems and this may end up affecting the performance of the project. In order to solve these problems, a substantial effort on managing the construction process must be provided and could not be done without an effective performance monitoring tool.

1.7 Scope of the study

Geographical Scope

The study was carried out within Tanzania and focused mainly on civil and building projects. Tanzania is one of the growing countries with a high level of infrastructure development including buildings and roads that connect to different parts of the country.

1.8 Operational Definitions

EVM is a technique to monitor time and cost performance of a project and to predict the final project duration and cost.

Construction is a process of constructing infrastructure which includes buildings, roads and Bridges.

Project is a planned set of interrelated tasks to be executed over a fixed period and within certain cost and other limitations.

Performance is a measure of the building project in terms of time, cost, and quality

1.9 Organisation of the dissertation

This research is divided into five chapters. Chapter one introduces the study in general and explains the problem statement, research objectives, research questions, scope of the study, and significance of the study.

Chapter two focuses on literature review where various studies at global, regional and national contexts are reviewed to generate concepts and variables that made the theoretical and conceptual framework of the study where theories and concepts related to the study are discussed.

Chapter three states the methodology that was used to carry out this research which includes research design and process, data collection techniques as well as research strategy.

Chapter Four deals with presentation of the findings on application of EVM in Tanzania construction projects. And Lastly, chapter five provides conclusion and recommendations of this study.

1.10 Chapter summary

This chapter has explained in detail the research background basing on assessing the application of Earned Value Management (EVM) in Tanzanian construction projects. It has further explained the reason of doing the research, stated the objectives of the study, the importance of the study and limitations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Literature review is an extensive search-related survey of prior investigations. Even if it may frequently be extensive, up to decades, maybe reaching centuries of content, it has to be closely made to address the scholarship directly linked to the research issue (Kothari, 2004). It further enables researchers to put their studies in a knowledgeable and historic setting by using a systematic approach to prior scholarships.

This chapter aims at furnishing the researcher with existing scholarly works which assist in understanding the subject clearly. It presents theoretical review and general understanding of the application of Earned Value Management (EVM) used by contractors Earned Value Management (EVM) adopted by different studies is also discussed in this chapter. Also, the empirical review of the previous studies was done so as to assist in discussion of the findings of this research. Challenges facing the application of Earned Value Management (EVM) are also discussed in this chapter.

2.2 Project management

PMI (2008) explains that Project management is an application of knowledge, tools and techniques, skills to the project activities in order to achieve project requirements. Also, Project management is accomplished through the application and integration of the project management processes.

But PMI (2004) explains EVM in its chapter seven on Project Cost Management. The section identifies five tools and techniques of cost control which are Cost Change Control System, Performance Measurement Analysis, Forecasting, Project Performance Reviews, Project

Management Software, and Variance Management. But all of these techniques are directly or indirectly related with the Earned Value Management methods.

2.3 Construction project management

Gower (2007) explained that the purpose of project management is to predict or foresee the problems and dangers as many as possible and to plan, organise also and control the activities so the projects are completed successfully in spite of the risks. This plan is needed early before the resources are committed, there is a need of organisation to have management technique and the process must continue until the works are finished. Kerzner (2009) also said that the project manager must control the company project resources within the time, cost and performance though most companies have six resources which are manpower, money, facilities, equipment, technology and materials.

2.3.1 Construction project management procedure

In order to meet requirement of the project, the project management process could be accomplished through the following intergraded and sequential project phases which are initiating, planning, executing, monitoring and controlling and close it out (PMI, 2008; and Bower, 2007).

2.4 Construction projects performance indicators

To weigh the performance of the construction industry over a variety of its activities, an appropriate set of Key Performance Indicators (KPIs) is required so that the stakeholders can monitor the industry's progress towards achieving its goals. In this sense on the identification of key performance indicators (KPIs) as it can help decision makers on the performance levels of projects (Chan and Hiap, 2012). Mainly we measure the variances of the current cost and schedule from plan and predict final costs and schedules at any point of time during contract duration. Key Performance Indicator (KPIs) According to Elshakour *et al.* (2012)

defines KPIs as a benchmark of ‘‘the continuous process of measuring products, services, and practices”.

From the various studies conducted by Construction Industry Institute (CII) (2004) in the USA, the Department of Environment, Transport and the Regions (DETR) and the Department of Trade and Industry (DTI) in the UK, and the Corporation for Technical Development (CTD) in Chile, have adopted the foundation base for KPIs for construction industry at the project level are cost, time scope, quality and safety (Elshakour *et al.*, 2012). According to Daniel and Joseph (2012), KPIs in construction project include mutual trust between project partners, Client’s satisfaction on quality of completed work (scope), and Time performance, cost not exceeding the final contract target or guaranteed maximum price value, and magnitude of disputes and conflicts.

The study conducted by NAO, (2010) for road work on Tanzania shows that the key performance indicator on road construction is time, cost and scope of the project. On construction project we measure the progress of the works packages that scope, budget cost and works schedule, performance measures are based on data, and tell a story about whether an agency or activity is achieving its objectives, and if progress is being made toward achieving policy or organisational goals The objective of performance and progress measure is used to measure or check how healthy we are doing the project (SPAR, 2008).

2.5 Concept of Earned Value Management (EVM)

Earned Value Management is the method of measuring the performance of the project. Earned Value Management is the programme management technique that uses “progress of the work” to indicate what will happen to the work in future. Earned Value Management is the system for planning and controlling project cost performances. EVM establishes the

work packages earned value baseline by integrating the project scope, cost and time schedule objectives (Chithkara, 2006) and (Lakade and Gupta, 2013).

The Analysis of variance from baseline provides cost related information for the problem identification, trend analysis and corrective measures such as re-planning and the revising budget. According to PMI (2008) and Chithkara (2006) Earned Value Management serves in two main purposes, it analyses the cost changes which result in cost and time overrun or underrun so the timely corrective measures are taken such as modification of cash flow, updating financial forecast and the project profitability expectations. The analysis of variance from baseline by using Earned Value Management systems gives variety of the variances which were analysed to provide the current status of the project, to initiate corrective measures and to forecast future trends of the project (Chithkara, 2006).

2.5.1 Construction projects performance measure using Earned Value Management (EVM) techniques

Kerzner (2003) recognised the value of EVM as the risk monitoring tool. Specifically, it provides the basis to determine if the risk handling actions are well achieving their forecasted results of the project. EVM allows the progress and performance of the project to be assessed at single point in time, usually repeated on regular basis such as monthly or weekly. Projects are composed of many activities (hundreds or sometimes thousands) with the differing of durations and start times. Therefore, at any point during project execution some activities have been completed, some are in progress, and some have not commenced, the only possible exception arises when the project is divided into the separate phases that do not overlap, and point of EV assessment happens to coincide with period of inactivity between those project phases. So, at that instant it would be possible for no work or activities to be in progress.

2.5.2 Key parameters of EVM

In implementation of EVM, a clear project scope is required together with the project budget and project schedule. Project budget must reflect all planned costs incurred by activities which the project consists. Then budget is distributed over all activities in project schedule. Cumulating the budgeted costs over the time a first measure is obtained, which is Planned Value (PV). PV is the value planned to have been spent in the project according to the original plan at certain point in a time. Budget at Completion (BAC) is a total cost of the construction project as it was budgeted at the start of the construction project and it is equal to the planned value at the end of the project.

During construction project execution there are two more measures obtained so that comparison can be made between the reality and the planned. Earned Value (EV) gives monetary value of the project activities finished at a certain point in a time. In another way of putting EV, equals to BAC multiplied by the percentage of work completed (PC) at certain point in a time (EV = PC*BAC). Another parameter applied in EVM is Actual Cost (AC), this represents real costs for all work executed at certain point in time.

Summarised EVM makes use of three key parameters:

i. Earned Value (EV) = (BCWP) Budgeted Cost of Work Performed

ii. Planned Value (PV) = (BCWS) Budgeted Cost of Work Scheduled

iii. Actual Cost (AC) = (ACWP) Actual Cost of Work Performed

2.5.3 Common Earned Value Management (EVM) Terminology and Application

EVM incorporated with several specific mechanics such as S – curve, work breakdown schedule (WBS), and the defined set of the performance metrics. These metrics integrate the project management triple constraint to control, monitor and forecast project performances (Marshall, 2007).

Table 2.1 shows the common terminology used in EVM concept and Figure 2.1 shows the application of indicators in the EVM.

Table 2. 1 EVM Terminology

Name	Formula	Explanation
Planned Value (PV)		The approved budget for the work scheduled to be completed by a specified date
Earned Value (EV)		The approved budget for the work actually completed by the specified date
Actual Cost (AC)		The costs actually incurred for the work completed by the specified date
Cost Variance (CV)	EV – AC	Negative means the project is over budget Positive means the project is under budget
Cost Performance Index (CPI)	EV / AC	Negative means behind schedule Positive means ahead schedule
Schedule Variance (SV)	EV – PV	Determination of value returned for every 1$ spent in the project • More than 1 indicates resources were used in an efficient manner • Less than 1 indicates cost overruns
Schedule Performance Index (SPI)	EV/ PV	Project progress compared to the baseline plan • More than 1 indicates utilise time in an efficiency manner • Less than 1 indicates schedule behind
Estimate at Completion (EAC)	EAC = AC + (BAC–EV) EAC = AC + (BAC–EV)/CPI	The estimate today of the total cost of the task May use two approaches to calculate the EAC: **Method 1**: Assumes the cost performance for the remainder of task will revert to what was originally budgeted. **Method 2**: Assumes the cost performance for the remainder of the task will be the same as what it has been for the work done to date
Estimate to Complete (ETC)	ETC = EAC– AC ETC = (BAC–EV)/CPI	Estimated cost required to complete the remaining works of the project
Budget At Completion (BAC)		Budgeted amount for total work

- PV, EV, AC: basic metrics to assess the schedule and cost performance throughout the construction project.
- CV, SV, CPI, SPI: indicators to describe the project's schedule and cost performance
- EAC, ETC, BAC: indicators to forecasting the project.

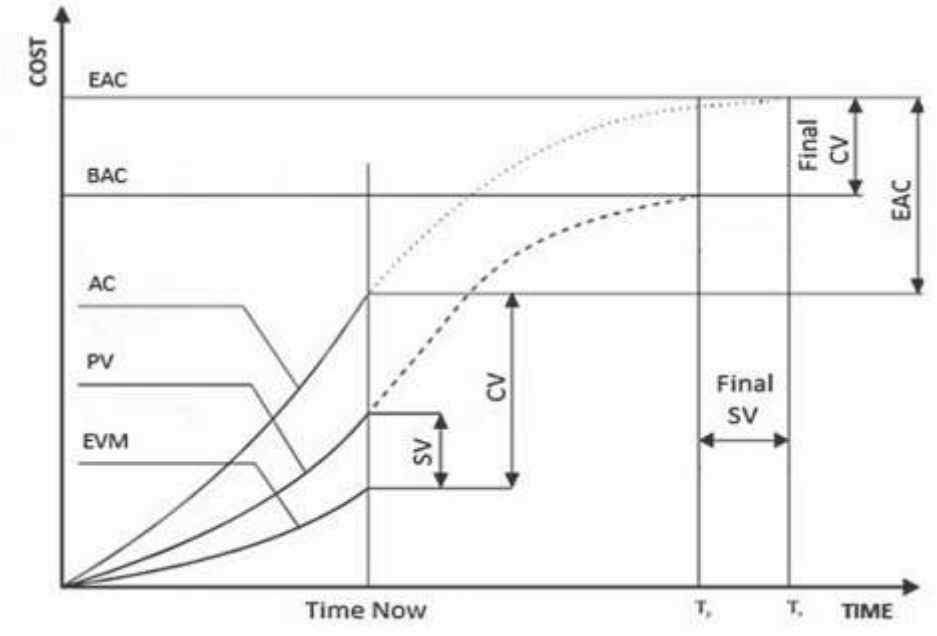

Figure 2. 1 Application of indicators in the EVM

Source: Own construction (2019)

2.5.4 EVM performance analysis and forecasting

EVM relies on the three key variables which represent fundamentals of its analysis. These are budgeted cost of work performed (BCWP) which is also referred to as EV, budgeted cost of work scheduled (BCWS), and actual cost of work performed (ACWP). The fourth data point is budget at completion (BAC) which represents the total BCWS for project. Four data points are used for deriving variances of the actual versus the budgeted performance and the associated indices, and also for forecasting project's cost and time at the completion. PMB is the standard against which project actual cost (ACWP) and the progress (BCWP) is compared from start to the finish.

Key practice of the EVM includes two steps: the first step is establishing performance measurement baseline (PMB) and, the second step is measuring and analysing project's performance against PMB. Steps to effectively build PMB includes the decomposition of work scope to manageable levels, to assigning responsibilities, also developing time-phased budget for each work task, and to maintaining PMB integrity throughout project. The Performance measurement and the analysis comprises recording of resource usage during a project execution, objectively measuring of actual physical of work progress, the analysing and forecasting schedule/cost performance, also reporting the performance problems, and taking corrective measures (PMI, 2011).

The Performance management works best when physical progress of the work is objectively planned and also measured. Techniques used in EVM in order to achieve this goal are the Earned Value measurement techniques which are sometimes called earning and the crediting methods (PMI, 2005).

Difference between PMB and actual status is measured by using two variances that are revised continuously throughout project life. Variances give precise monetary value of the positive or negative status and represent difference between the current status of project and baseline, in the monetary terms (Buyse & Vandenbussche, 2010)

Cost variance (CV) is the measure of budgetary conformance of ACWP and used to follow up the construction project budget. A negative/positive value points out that more/less has been spent for executed activities than what was an originally planned (CV = BCWP – ACWP),

While **schedule variance (SV)** is the indicator that provides a value that represents whether the project is within the schedule or not. SV is a difference between BCWP and the BCWS, the positive of these variances indicate that the project is under budget and ahead of schedule, while negative indicates that the project is over budget and behind schedule, respectively.

The variances can be derived as follows:

- Cost Variance: CV = EV – AC
- Schedule Variance: SV = EV – PV

Indices instead do not give the precise monetary value of project actual status, but used as the indicators of an actual performance. They are merely ratio which expressions of CV and SV as the Cost Performance Index (CPI = BCWP/ACWP), indicating how efficiently the project team is using its resources and the Schedule Performance Index (SPI = BCWP/BCWS) indicating how efficiently the project team is using its time. The above formula 1.00 indicates that the performance is on target, more than 1.00 indicates the excellent, and less than 1.00 indicates the inefficient performance of the project. Overall, both variances and indices are measures of the past behaviour, also are used to predict project final time and cost (CII, 2004). See figure 2.1.

2.5.5 Cost forecasting

Here the focus lies on predicting the final cost of the project. This final cost will be referred to as the Estimate at Completion (EAC). The EAC consists of the Actual Cost (AC), the cost that has been spent so far and an estimate of the cost of the remaining work (Estimate to Completion, ETC). In some literature, ETC is also referred to as Planned Cost of Work Remaining (PCWR) (Pieter, Buyse & Tim Vandenbussche, 2010). It can be calculated as follows:

$$ETC = \frac{(BAC - EV)}{Performance\ Factor}$$

Several different formulas exist to calculate the EAC, depending on the performance factor that is used to calculate the ETC (PMI, 2011).

2.5.6 Duration forecasting

EVM has also been used for more than forty years to predict the final duration of projects. This is done analogue to forecasting the EAC. The oldest method calculated the Independent Estimate At Completion (IEAC(t)). This estimate exists of the time that has already elapsed (Actual Time, AT) and the duration of what the remaining work is estimated to take (Estimate To Complete, ETC(t)). The time that is expected to complete the project is calculated by adjusting the work remaining (Estimate To Complete, ETC) for the work rate that is expected on the remaining of the project (PMI, 2011). ETC (t) is also referred to as Planned Duration of Work Remaining (PDWR) and can be calculated as follows:

$$ETC(t) = \frac{(BAC - EV)}{Work\ Rate}$$

2.6 EVM process in construction projects

For the successful implementation of the Earned Value Management system the following are the basic key steps.

2.6.1 Organisation Policy

Top management commits for implementation of EVM system, this will require an organisation to establish a policy. The policy is the foundation of the EVMS that places forward the position rules to support the system and will provide enough information regarding to organisation process.

2.6.2 Planning

The next step is planning after putting the system on organisation policy. This consists of all essential elements required on implementations of Earned Value Management system. These are the following:

2.6.2.1 Project Objectives

The primary step in the practice is designation of the project objectives. These objectives include broad explanation of the technical requirements of the project, its budget and the time outline for the work to be accomplished. Targeted commencing date and a completion date are included in this description. There may even be some guidance provided as to whether this is a technical, schedule and cost critical project (Humphreys, 2011 and Humphreys, 2014)

2.6.2.2 Work Scope Definition and Assignment of Responsibility

EVM requires decomposing the scope of the works. Broken down activities into minor management tasks, are preferred as point of control then planned and scheduled down to the detailed work package level (Fleming, 2009). A work breakdown structure (WBS) is a best tool used for decomposition of project until the lowest level manageable elements (Battelle, 2006).

Responsibility Assignment Work Teams, once the scope is defined the next step is to document that is responsible for the work, to identify the responsible persons for performing the work (Humphreys, 2011 and Humphreys, 2014).

2.6.2.3 Setting baseline plan

Nesterov (2015), states that baseline is a copy of a project that you can compare to the current progress. Baselines provide a "target" against which you can track a project's cost, schedule, and resource performance. Campbell (2011) describes baseline as an “Original approved Project Scope, timeline and cost”. According to Qureshi (2014), baseline used to find present performance of the project activity.

2.6.2.4 Schedule baseline

Bhosekar and Vyas (2014), the baseline schedule is a fixed project schedule. It is the standard by which project performance is measured. The current schedule is copied into the baseline schedule which remains frozen until it is reset. Resetting the baseline is done when the scope of the project has been changed significantly

2.6.2.5 Cost baseline

At the end of the planning stage, the cost information is translated to become baseline cost. In earned value terms, this cost is also referred to as the Budget at Completion (BAC) (Jessop, 2015). This BAC cost is calculated for tasks, resources and assignments, and then distributed over all the activities in the project schedule. By cumulating these budgeted costs over time, a first measure is obtained the Planned Value (PV). Planned Value (PV) is a budget planned to be spent according to the original plan at any given point in time. This is also known as the budgeted cost of work scheduled (BCWS) (Cable *et al.*, 2004).

2.6.3 To determine Earned Value Analysis (EV)

During project execution, as a project progresses, the status date will change and two more measures are obtained so that a comparison can be made between realities and plan its Earned Value (EV) (Lukas, 2008). Earned Value (EV), can be determined by multipling the actual cost completed at a point in time (AC), this is also known as the budgeted cost of work performed (BCWP) and the percentage of work completed at certain point in time (PC) (Kahkonen, 2014). EV=% Complete (PC) × BCWP

2.6.4 The Earned Value Analysis performance measures

After progress is measured against the plan and the actual cost is entered, The EVMS performance measures indicators (variable) variances and indices will be determined.

2.6.4.1 Variances

Variances represent the variation between the present status of the project and its baseline in monetary terms. Those are Schedule Variance (SV) and Cost Variance (CV) (Kahkonen, 2014). The Schedule Variance (SV), determines whether a project is ahead of or behind schedule. It is calculated by subtracting the Planned Value (PV) from the Earned Value (EV). A positive value indicates a favourable condition and a negative indicate unfavourable condition (Kahkonen, 2014)

Cost variance, a project's Cost Variance (CV) shows whether a project is under or over budget. This measure is determined by subtracting the Actual Cost (AC) from the Earned Value (EV) Valle and Pereira (2008), Kahkonen (2014). Negative (positive) value points out that more (less) has been spent for the executed activities than what was originally planned.

- Schedule Variance: SV = EV – PV
- Cost Variance: CV = EV – AC

2.6.4.2 Indices

Those are Cost Performance Index (CPI) and Schedule Performance Index (SPI). Earned Value and Actual Cost can also be used to calculate Cost Performance Index (CPI), which expresses the cost efficiency of the executed work, if CPI is less or more than one it means that the project is currently running over or under budget (Kahkonen, 2014).This helps to determine the cost for remaining work for a project to meet a specified endpoint or otherwise the team's revised Estimate at Completion (EAC). Schedule Performance Index (SPI) shows whether the project is performing on schedule or not. SPI of more or less than one means that the project is ahead or behind plan. SPI is calculated by dividing the (EV) and (PV) (Verma, 2014).

- Cost Performance Index: CPI = EV / AC
- Schedule Performance Index (SPI) = EV/PV

2.6.5 Forecasting cost and time at completion

Predicting the future with EVM is to predict the expected final project cost – Cost Estimate at Completion (EAC) is to determine how efficiently we must use our remaining resource and the time to finish the project, Time Estimate at Completion (EACt) is essential to project on predict the final duration of projects (De Marco, 2013). EVM acts as an early warning system that helps PMs to solve problems and exploit opportunities during project execution. Besides, these measures are also used to predict future performance of the project (Hakkinen, 2015).

2.6.6 Critical Ratio (CR)

The measure that considers both indexes is called Critical Ratio (CR). The Critical Ratio is obtained by CR = CPI * SPI and represents the overall status of the project (Cable *et al*., 2004). Used to determine how much a task is on schedule, a value of 1 the project is within the schedule but the value less than 1 is behind and larger than 1 is ahead of schedule.

2.6.7 Re-baselining

The project baseline is a schedule consisting of all the activities of the project. It might turn out that the original baseline becomes unrealistic as a basis for management control. This can be due to changes in scope, schedule, cost or a combination of these factors. Corrective action will need to bring the project back on plan (Kerzerner, 2001).

2.7 The level of applicability of EVM technique in construction projects

Many studies about the applicability of the Earned Value Analysis have been made.

Thamhain (1998) tried to evaluate the popularity of different practices of project management. Surveys were made with 400 professionals who worked with projects (managers, directors, people in charge) in 180 projects in Fortune-1000 companies. They were asked about the popularity and value of different techniques of performance evaluation. As a result, he could see that the Earned Value Analysis was used by 41 percent of people

who worked with projects. It is more used than critical path method, QFD (quality function deployment) and Crashing, among others. The Earned Value Analysis is almost as popular as the net PERT/CPM (Thamhain, 1998).

Wideman (1999) stated that a project of great importance requires a unit of planning and control that has professionals capable of collecting the information and making the Analysis of Added Value, turning its applicability justifiable.

Christensen (1998) stated in his studies, about the applicability of Added Value in government organizations in the United States, that the implementation of Earned Value requires a cultural change, which demands time and effort. This means to make sure that policies and knowledge are taught by the organisation and by the project in order to quicken the work of the ones involved. The Earned Value Analysis enables a supplementary value to the project because it offers a premature visibility of its results, in other words, it is possible to determine a tendency of costs and deadlines of the project in a certain phase of it, when there is still a possibility of implementation of corrective actions.

On the contrary, West & Mcelroy (2001) agreed that the Earned Value Analysis is an adequate tool for the generation of reports of work done and not a managerial tool, since the control in real time of the project, using all parameters of analysis becomes unviable: “the Earned Value Analysis shows to the project team the performance obtained until then, and not the future forecast of the project.”

Wideman (1999) supported that the technique is conceptually attractive, however it requires great efforts in its maintenance, therefore it needs a qualified team to understand and provide reliable information. He also states that many project managers don’t consider the analysis an appropriate cost-benefit ratio.

From those opposite points of view, we may imply that the Earned Value Analysis is a group of powerful intrinsic characteristics, wide and varied, like payment projection and

forecasting. However, it is bound to find great difficulty in either data collection or in the low speed of information generation.

Terrel et al, (1998) stated that, in order to make the Earned Value Analysis effectively implemented, it is necessary to have the information about the resources clearly defined. A failure in obtaining these data, motivates the creation of inaccurate performance measurement baseline (PMB), distant from the real scenario.

2.8 Challenges facing the application of EVM in construction projects

Table 2. 2 Challenges in Implementing EVM

Author	Challenges
Kim *et al*. (2003)	- High cost, complicated and burdensome paper work - Poor understanding of EVM - Distrust and conflict between project managers, project consulting and government - Pressures to report only good news
Fleming and Koppelman (2010)	- Absence of adequate project planning and documentation, - The construction schedule is compounded - Resource constraints such as resource availability limits and multiple calendars, - Activity and project delays encountered during project executions, - NO EVM analyst or specialist within the project team
Nkiwane *et al.* (2016)	- The parties of a contract cannot have a common understanding of performance in terms of earned value metrics
Carol and Christensen (2010)	-The customer has transferred the cost risk to the contractor and earned value is perceived to be less useful in fixed-price contracts
Lipke (2003)	- The classic SPI indicators which may provide false and unreliable time forecasts near the end of the project.

2.9 Theoretical and Conceptual framework

2.9.1 Theoretical framework

A theory is a system that explains phenomena by stating constructs and the laws that interrelate these constructs to each other (Mugenda and Mugenda, 2003). The research was conducted basing on the Theory of Goal Setting which was proposed by Edwin Locke in

1968, with focus on the area of performance measurement. Goal refers to future valued outcomes (Locke & Latham, 2013). While measuring performance, according to the theory of Goal Setting, there are five basic principles that allow goal setting to perform better. These include: charity, challenge, commitment, feedback, and task complexity (Locke & Latham, 2013)

Charity refers to a clear and measurable goal that can be achieved within specific timeline and within goal setting. In case of the construction industry, the charity is the CPI which is the ratio of the value of the work achieved to date, to the actual cost of achieving those results. The CPI identifies the work efficiency to date.

Challenge refers to the goals being able to achieve decent level of difficulty, motivating the individual and organisation to strive for positive goal achievements. In the construction of infrastructures, this is related to Schedule Variance which compares the value of the work achieved to date with the planned value of achieving those results.

Feedback provides information on the progress towards achieving goals. In building projects, this relates to the Schedule Performance Index (SPI) which is the ratio of the value of the work achieved to date, to the actual cost of achieving those results. SPI identifies the time efficiency to date.

Task Complexity makes the achieving of goals easier by laying down process and steps. In building projects, the critical ratio is a performance factor that acts as an indicator to predict cost at completion. According to this theory, the goal setting can be applied in all places where effective results are desired through efficient goal setting.

2.9.2 Conceptual framework

This is a scheme of variables which indicates the relationships among the variables in order to achieve the set objectives. The study shall focus on two dimensions namely Cost factors

and time factors (Enshassi *et al*., 2012) and the performance was measured in terms of time performance, cost performance, risk control and client satisfaction. The variables defined here are the dependent and independent variables. Variables within each group are interrelated and intra-related. A variable in one group can influence a variable in the others, and vice versa. Figure 2.2 illustrates the relationship between variables.

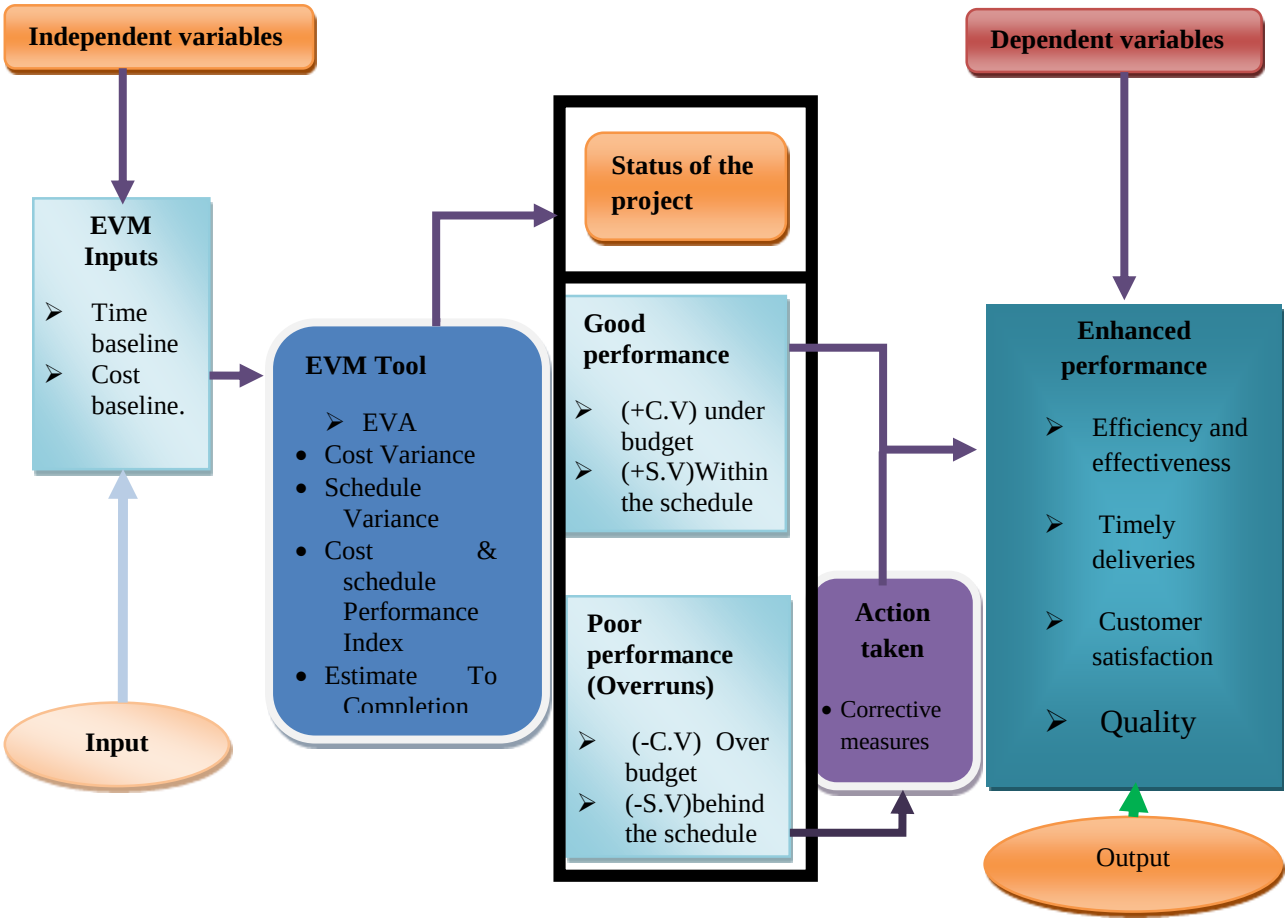

Figure 2. 2 framework for Conceptualising Application of EVM with the project performance

Source; (Own construction, 2020)

Effects of time and cost baseline on performance of the project

Time and cost baseline

Baseline is a copy of a project that you can compare to the current progress. Baselines provide a "target" against which you can track a project's cost, schedule, and resource performance. Baseline as an “Original approved Project Scope, timeline and cost”, baseline used to find present performance of the project activity.

Earned Value (EV)

During project execution, as a project progresses, the status date will change and two more measures are obtained so that a comparison can be made between realities and plan (**Time and cost baseline**) its Earned Value (EV). Earned Value (EV), can be determined by multiplying the actual cost completed at a point in time (AC), This is also known as the budgeted cost of work performed (BCWP) and the percentage of work complete at certain point in time (PC). EV=% Complete (PC) × BCWP

Earned Value Analysis performance measures (EVM tool)

After progress is measured against the plan and the actual cost is entered, The EVM performance measures indicators (variable) variances and indices will determine.

i. Variances

Variances represent the variation between the present status of the project and its baseline, in monetary terms. Those are Schedule Variance (SV) and Cost Variance (CV). The Schedule Variance (SV), determines whether a project is ahead of or behind schedule. A positive value indicates a favourable condition and a negative indicate unfavourable condition. **SV = EV – PV.**

Cost variance, a project’s Cost Variance (CV) shows whether a project is under or over budget. This measure is determined by subtracting the Actual Cost (AC) from the Earned

Value (EV). Negative (positive) value points out that more (less) has been spent for the executed activities than what was originally planned. **CV = EV – AC.**

ii. Indices

Those are Cost Performance Index (CPI) and Schedule Performance Index (SPI). Earned Value and Actual Cost can also be used to calculate Cost Performance Index (CPI), which expresses the cost efficiency of the executed work, if CPI is less or more than one it means that the project is currently running over or under budget. This helps to determine the cost of remaining work for a project to meet a specified endpoint or otherwise the team's revised Estimate at Completion (EAC). **CPI = EV / AC**. Schedule Performance Index (SPI) shows whether the project is performing on schedule or not. SPI of more or less than one means that the project is ahead of or behind plan. **SPI = EV/PV**.

CHAPTER THREE

RESEARH METHODOLOGY

3.1 Introduction

This section discusses the research design, sampling methods, information collection and tools used to accomplish this study. It describes data management and analysis illustrating the significant reasons for the chosen strategy. This section also discusses the presentation and analysis of the information to answer the research questions. Energies were made to deliberate and explain why research methods were selected and why they were deemed appropriate for this study.

In order to achieve the objectives of this research, the procedure must pass over a stage which is known as research methodology. Zikmund *et al.* (2010) referred to research methodology as a segment which explains the suitable technical processes for the research or study through explaining the research design and sampling design adopted for the research, gathering of data and investigation performed for the research work and the examination performed on the data composed. Nevertheless, Dawson (2013) explained that research methodology is the research's guiding idea or overall code.

3.2 Research Design

The purpose of a research design is to link the investigation from data gathering to conclusions, in order to make sure that proof acquired will enable to respond to the research questions and generate recommendations for making effective decision about the problem. There are various types of research designs, depending upon the aims of the research (Creswell, 2014). The research design adopted in this study is Survey research design which has integrated of qualitative and quantitative data collected for analysis.

3.2.1 Survey Research design

Survey Research design is a valuable tool for assessing opinions and trend, often its low cost, easily accessible information and the data can be collected more than in one case at single point, in time for collective both qualitative and quantitative data of two or more variable (Magigi, 2015). The use of this tool is in line with the objectives of the study. The data were collected by sending the structured open ended and closed ended questionnaire to the respondents.

3.2.2 Research design process

In research, the design is a logical arrangement that connects the practical data to research questions and eventually to its conclusion. Research design is also defined as the plan that directs the processes of collecting, analysing and interpreting explanations. It is like a proof that permits the researcher to draw inferences concerning relationship between variables under study.

According to this study, research design process used was based on the following successive arrangement of activities which are as follows: First of all, to achieve at this stage the researcher started to select broad research area depending on the area of interest. After that the researcher identified and formulated the research issue by reviewing theories and literature in order to have concrete conceptual framework. In this section, research questions were structured based on concepts and variables related to Application of Earned Value Management (EVM) in Tanzanian construction projects. Thus, methodology used for data collection and analysis about data gathered from the field to handle this research up to the final stage were provided in the research design process. To achieve objectives of this research, the above information provided was about research design process then the following figure gave the process used to arrive at conclusion and recommendations of this research.

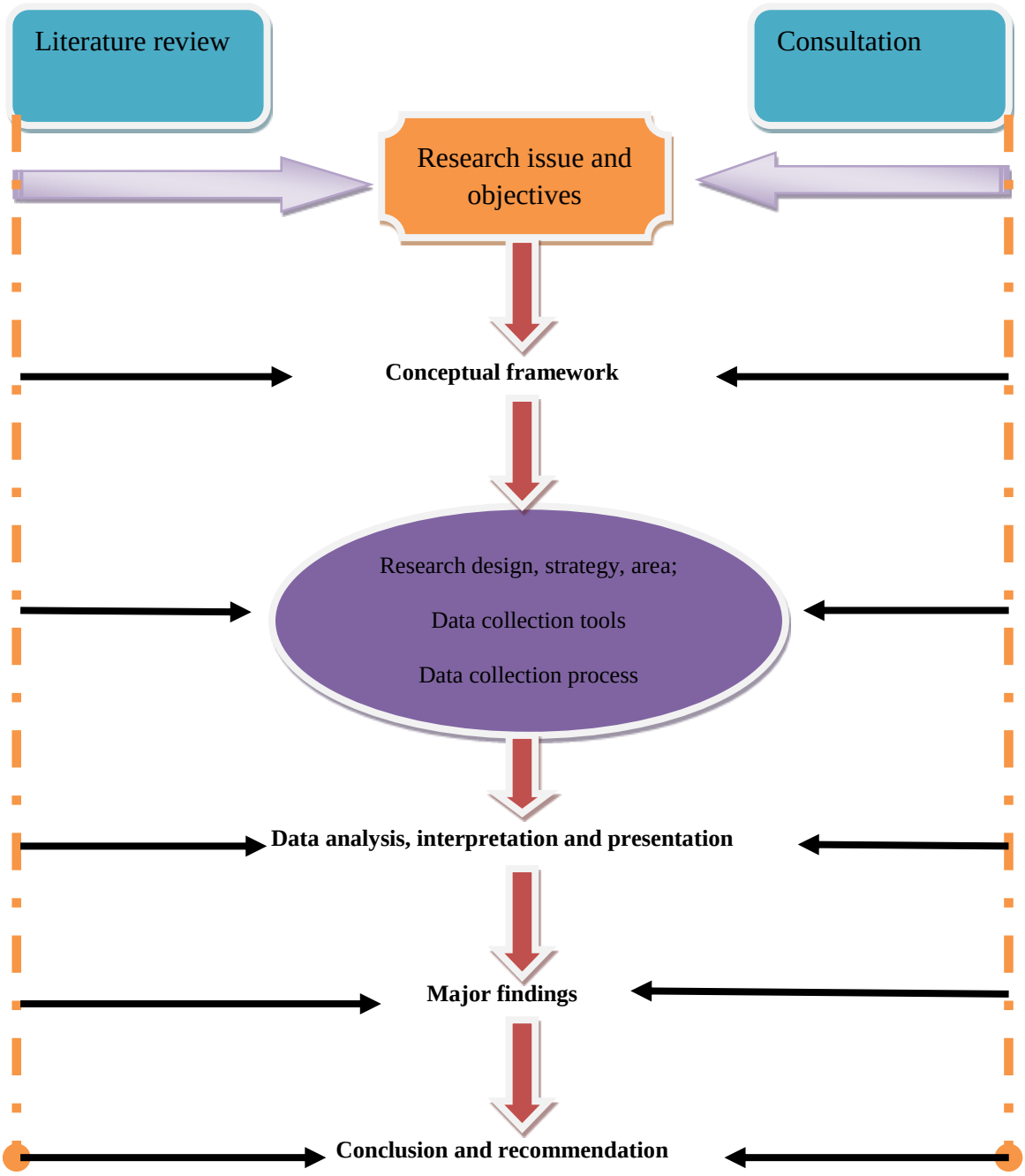

Figure 3. 1 Research design process

Source; (Own construction, 2020)

3.3 Study Population

In any ground of investigation there is a need to constitute population. An absolute record of all the substance in the population is known as a census. A population refers to a whole

group of "people, events or elements of interest" that a researcher desires to study (Kothari, 2014).

The category and number of respondents were chosen based on importance and wide range to provide credible and valid data and other information required by the researcher. The study population comprises of both building and civil contracting companies (Class I and II) as the findings of pilot study found that those are the classes which they have technical and specialised knowledge about the topic under investigation by virtue of the offices that they held, total as registered by CRB is 201 as described in the Table 3.1 below.

Table 3. 1 Target population

Class of Registration	**Population**		**Total population**
	Building contractors	Civil contractors	
Class I	68	72	**140**
Class II	41	20	**61**
Total	**128**	**52**	**201**

Source: (CRB, 2019)

3.4 Sampling design

3.4.1 Sample Size

According to Kothari (2004), a sample is a small subset of the population which was chosen for the study. Because of timeframe, cost and human resources and to have in-depth insight of the study phenomena the sample size considered to be small (Magigi, 2015). To determine the sample size for small populations, researcher use the normal approximation to the hyper-geometric distribution formulas. It has ability to estimate sample sizes from small populations accurately. The sample size formula is:

$$n = \left\{ \frac{NZ^2pq}{e^2(N-1) + Z^2pq} \right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Equation\ 1$$

Where N is population size, Z is the level of confidence (1 - ∞), if assumed the level of confidence is 95% value for Z is 1.96, the acceptable sampling error (*e*) will be 5%, p and q are the population proportion set each 0.5 (Magigi, 2015).

Then the sample size will be:

Table 3. 2 Proposed sample size

Class of Registration	**Population**		**Total population**	**Proposed sample size**
	Building contractors	Civil contractors		
Class I	68	72	**140**	**103**
Class II	41	20	**61**	**53**
Total	**128**	**52**	**201**	**156**

Source: (Own construction, 2020)

3.4.2 Sample Technique and Procedure

Samples techniques can be either probability samples or non-probability samples. In the probability samples every element has a chance of being included in the sample, while non probability samples do not allow this (Kothari, 2004). In this study because detailed technically specific data were needed to be collected, the researcher focused on particular characteristics of population as shown on the Table 3. 2 . Both probability samples and Non probability were used in this study.

Firstly, Probability sampling technique is the one in which each component within the population bears equal opportunities to be chosen to represent the population. Probability sampling includes: simple random, systematic, stratified random, cluster, multistage and multiphase sampling (Taherdoost, 2017). In this study, stratified random sampling was used because of the heterogeneous characteristics of the population of firms (Class I to II).

Secondly: then non probability sampling by employing a purposive sampling technique was used to draw the sample from the selected contracting firm above. These was including the Quantity Surveyors, Engineers and Project managers from their respective firms

(Contractors). These key informants were purposively sampled because they are believed to have technical and specialised knowledge about the topic under investigation by virtue of the offices that they held.

3.5 Data collection Methods

3.5.1 Questionnaire Survey Method

The Questionnaires were designed to reflect the current capacity to answer the objective of the research (Kothari, 2014). "Self-administered semi structured questionnaire were used as the research instrument. A questionnaire consists of a number of questions printed or typed in a definite order on a form or set of forms" (Kothari, 2004). The self-administered questionnaires cover the advantage of being flexible because they hold both open and closed-ended question for gathering comprehensive information to ensure relevancy and consistency of information gathered as the responses are objective, standardised and comparable.

The questionnaire of this research involved three-parts part A and B. Part A carries Personal information questions and Part B each question developed to address a specific objective (i, ii, iii) of the study respectively, for more detailed about questionnaire seen on appendix.

3.5.2 Pilot Study

A pre-trial and pilot study was performed between September 2019 and October 2019 to make sure that the questionnaire provides usable and consistent data. According to Saunders, Lewis and Thornhill (2007), the rationale for conducting pre-trial planning is to identify the correctness and suitability of study design and instrumentation. Reliability was evaluated using sixteen (16) questionnaires piloted by randomly chosen building and civil contracting companies whereby the selected units did not form part of the study's population. A pilot study involved 20 percent of the sample size in which the units were equivalently distributed according to their classes (Class I to Class VII).

From the finding of the pilot study found class I and II are the firms which they aware with the application of Earned Value Management (EVM).

3.6 Validity and Reliability of the Research Instruments

Reliability and validity tests were conducted to ensure the accuracy of the methods and data collected (Kothari, 2014).

3.6.1 Validity

To ensure validity, the questionnaire was developed and given to the experts to see the relevance of each question in providing answers to the study. The questionnaires were also reviewed by the research supervisor; corrections were made to some questions to ensure clarity and relevance (Kothari, 2014)

3.6.2 Reliability

A pre-test (Pilot study) was done on 16 respondents who were not part of the final study. Data were coded and entered into the computer. Cronbach's Alpha Reliability Coefficients were generated using the statistical package for social scientists (SPSS 20) computer programme to estimate the reliability of the questionnaire. The Cronbach's Alpha Reliability Coefficient of above 0.7 will be acceptable (Sekaran, 2003).

3.7 Data Analysis

3.7.1 Analysis of Quantitative Data

Data analysis encompasses treating of fresh data into valuable information. It is significant that raw data should be managed well for simplicity of analysis (Boeije, 2010). The drive for analysing data is to clean, convert and model data with the aim of ascertaining and highlighting valuable information that can be used to draw conclusion and recommendations.

Data collected from the questionnaire was edited to ensure totality, coded, amended and inserted into SPSS (20). Data coding includes allocating number(s) to the responses of the respondents in order to be entered in software (Sekaran and Bougie, 2011).

Cronbach's Alpha was used to measure the accuracy of the research instrument from the questionnaires collected for pilot study. Cronbach's Alpha is the most accurate method since it provides answers which are error free and steady (Sekaran and Bougie, 2011). According to Hair et al (2010), instruments with Cronbach's Alpha coefficients of 0.60 are regarded to have an average reliability while coefficient of 0.70 and above indicates that the instrument has a high reliability standard.

3.7.2 Analysis of Qualitative data

Qualitative data were analysed using content analysis. Responses from key informants will be grouped into recurrent issues. The recurrent issues which emerged in relation to each guiding question were presented in the results, with selected direct quotations from participants offered as illustrations.

3.8 Measurement of variables

Data on the respondent's views and opinions about EVM were obtained using scaled variables from a self-developed questionnaire. A five point-Likert scale of 1= strongly disagree (SD), 2= disagree (D), 3= not sure (Not), 4= agree (A), 5= strongly agree (SA) and 5=Very frequently (VF), 4= Frequently (F), 3= Rarely (R), 2= Very Rarely (VR), 1=Not at all (Not) used to tap respondent's perception on the study variables.

3.9 Ethical Consideration

A letter from Ardhi University was required before the data were collected as an introduction to Contractors Registration Board (CRB); in order to obtain the list of contractors in Tanzanian construction projects.

The use of offensive, discriminatory or any other unacceptable language was avoided during the preparation of questionnaire and focus group interview questions. This was done by ensuring that the addressed questions are clear and the language used is not emotional.

In the process of data collection, the study acknowledged the work of other authors used in any part of the study with the use of Harvard referencing system. Also, the respondents were reminded to complete the questionnaires by sending them emails, and calling them.

3.10 Methodological Problems

During the data collection of this research some methodological problems were encountered. One of the problems which was faced was COVID-19 pandemic. This pandemic was an enormous challenge for researchers because devastating and unpredictable spread of COVID-19 throughout the world has caused unprecedented global lockdowns and immense burden for different activities. This pandemic caused the difficulties to self-administered questionnaires to the respondents.

This challenge made the researcher switch from self-administered questionnaires by hand to the online questionnaire by using Google Forms which were easy to reach the respondents without direct contact with them by contacting them through different platforms by sending the link of questionnaire to fill and then to submit. Also, the exercise of filling questionnaire on time was a bit difficult. However, by making the close follow up eventually respondents managed to fill 102 questionnaires for the period of more than five months. Also, some respondents had good attitude and perception that the research was purely academic and nothing to do with their own private personal matter.

3.11 Chapter summary

This chapter has described the research design, sampling techniques, data collection and instruments for the study. The management of data and analysis is described showing the reasons for the approach selected.

Furthermore, this chapter has described the way the data were presented and analysed to answer the research questions. Efforts were made to discuss and give reasons for the selection and consideration of research methods in the study.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

4.1 Introduction

This section analyses the gathered data from the field into useful information by making intensive discussion of the results. The main objective of this research was to assess the application of Earned Value Management (EVM) by contractors in Tanzanian construction projects. Data were collected, analysed and presented using SPSS (20), Microsoft Word and Excel (Tables) in order to get more accurate computation that mapped out a pattern or relationship between measured or comparable variables. The study adopted the use of quantitative analysis method by using syntax mathematical operation in determining the mean score,

- Mean Score Value $=\sum\frac{F x S}{N}$

Where: ***F*** = Frequency of response for each score

S = Score given each cause

N = The total number of respondents for each factor

Mean score value (M.S) comparison

The value from mean score was categorised into three groups where the value from 4 to 5 were ranked as the high mean score, from 3 to 3.9 ranked as medium/moderate mean score and 1 to 2.9 ranked as low mean score as presented in table 4.1 below.

Table 4. 1 Mean score values (M.S) comparison table

SN.	Mean Score (M)	Ranking	Colour
01.	$4.0 \leq M \leq 5.0$	High Mean Score	
02.	$3.0 \leq M \leq 3.9$	Medium/Moderate Mean Score	
03.	$1.0 \leq M \leq 2.9$	Low Mean Score	

Source: (Jongo *et al*, 2019)

4.2 Response Rate

This study aimed to assess the application of Earned Value Management (EVM) by contractors in Tanzanian construction projects. The number of sample size of registered building and civil contracting in Tanzania was 103 and 53 for Class I and II respectively (CRB, 2019). The questionnaires were distributed to the chosen companies, in which the researcher collected an overall of 63.35 percent of the distributed questionnaires as presented in Table 4.2.

Table 4.2 Response rate

SN.	Classes of Contractors	Questionnaire Distributed		Questionnaire Returned		Response Rate
		No	%	No	%	%
01.	I	105	65.22%	58	56.86%	55.24%
02.	II	56	34.78%	44	43.14%	78.57%
	Total	**161**	**100.0%**	**102**	**100.0%**	**63.35%**

Source: Survey Data, 2020

4.3 Reliability Analysis

The Cronbach's Alpha Test shows values ranging from 0.819 (Challenges facing the use of Earned Value Management) to 0.944 (Measures to be taken to enhance the Application of Earned Value Management) as shown in the Table 4.3. All items related to application of EVM were included in the research tool because they contained coefficients of more than 0.70 which are considered to be highly reliable for the tool (Hair *et al*, 2010).

Table 4. 3 Reliability Analysis

Items	Cronbach's Alpha	Number of items
Use of Earned Value Management	0.907	14
Challenges facing the use of Earned Value Management	0.819	13
Measures to be taken to enhance the Application of Earned Value Management	0.944	10

Source: Survey Data, 2020

4.4 Population Characteristics

This part mainly designed to provide general information about the respondents in terms of category of the organisation, professional of the respondent, designation, experience.

4.4.1 Company categories

This study included construction company Class I 58(57%) and Class II 44(43%) of civil and building contractors.

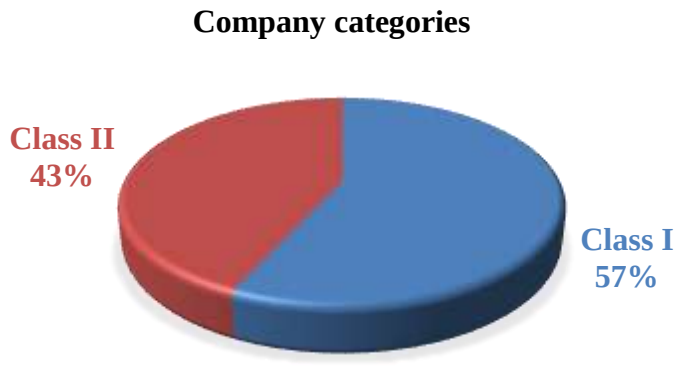

Figure 4. 1 Company categories

Source: Survey Data, 2020

4.4.2 Professionals in respondents' firms

There are various designations in construction industry which include Quantity Surveyors, project managers and Engineers. The respondents form this study 40.2 percent were Quantity surveyors, Project Managers 36.3% and Engineers 23.5%.

Table 4. 4 Professionals in respondents' firms

SN.	Respondent	Frequency	Percentage (%)	Cumulative Percent
01.	Quantity Surveyor	41	40.2	40.2
02.	Project Manager	37	36.3	76.5
03.	Engineers	24	23.5	100.0
	Total	**102**	**100.0**	

Source: Survey Data, 2020

4.4.3 Experience of the respondents

The respondents experience in relation to construction project was a major factor to be considered in this study as seen in Table 4.5.

Table 4. 5 Experience of the respondents

SN.	Years	Frequency	Percentage (%)	Cumulative Percent
01.	Less than 5 years	7	6.9	6.9
02.	5 – 10 years	17	16.7	23.5
03.	11 – 16 years	44	43.1	66.7
04.	17 years and above	34	33.3	100.0
	Total	**102**	**100.0**	

Source: Survey Data, 2020

4.4 The use of EVM in time and cost management of construction projects in Tanzania

This objective assessed the use of EVM in time and cost management of construction projects in Tanzania. The following activities were considered constituting EVM: The work scope was planned for the project to completion, all work scope was broken into finite pieces and assigned to either individual or organisation to control, actual costs incurred were used in measuring work value accomplished, accomplishments were objectively assessed at the work performance level, analysis of data the collected through EVA was done, schedule analysis by comparing budgeted vs actual performed, cost analysis by comparing budgeted vs actual performed, impacts of variance from the planned were forecasted and completion status estimated, forecasting of Time Performance was done through EVA, Forecasting of Cost Performance was done through EVA, Analysis of EVA by Using Project Management Software, Forecasting of Project Performance was done by Using Project Management Software, Monitoring of Project Performance was done by Using Project Management Software and Issuance of Payment was based on work performed.

The following are the responses from the respondents on the use of EVM in time and cost management of construction projects in Tanzania

Table 4.6 indicates that the top ranked are: All work scope was planned for the project to completion applied in construction projects, the work scope was broken into finite pieces and assigned to either individual or organisation to control, issuance of Payment was based on work performed and Actual cost incurred were used in measuring work value accomplished which mean score greater than 4.0. Furthermore, the lowest in rank are: Analysis of data collected through EVA, forecasting of cost performance is done through EVA, forecasting of time performance is done through EVA, analysis of EVA by using Project Management Software.

With regard to the interpretation scale table 4.1: most of the responds from the respondents fall into high mean score and medium mean score, while few falls into low mean score.

Table 4. 6 The use of EVM in time and cost management in Tanzanian construction projects by contractors.

SN	Application of EVM	VF	F	R	VR	Not	M.S	RANK
		%	%	%	%	%		
01.	All work scope was planned for the project to completion	54.9	41.2	1	3		4.48	1
02.	All work scope was broken into finite pieces and assigned to either individual or organization to control	45.1	51	2.9	1		4.40	2
03.	Actual cost incurred were used in measuring work value accomplished	35.3	52.9	9.8	2		4.22	4
04.	Accomplishments were objectively assessed at the work performance level	23.5	54.9	18.6	2	1	3.98	5
05.	Analysis of Data Collected through EVA	2	17.6	24.5	9.8	46.1	2.20	14
06.	Schedule analysis by comparing budgeted vs actual performed	7.8	54.9	31.4	4.9	1	3.64	7
07.	Cost analysis by comparing budgeted vs actual performed	10.8	52	33.3	2.9	1	3.69	6
08.	When the variance from the planned occurred, impacts were forecasted and estimated at completion	4.9	39.2	48	6.9	1	3.40	10
09.	Forecasting of Time Performance is done through EVA	2.9	18.6	23.5	7.8	47.1	2.23	12
10.	Forecasting of Cost Performance is done through EVA	2.9	18.6	22.5	8.8	47.1	2.22	13
11.	Analysis of EVA by Using Project Management Software	2	23.5	19.6	6.9	48	2.25	11
12.	Forecasting of Project Performance is done by Using Project Management Software	11.8	41.2	37.3	8.8	1	3.54	8
13.	Monitoring of Project Performance is done by Using Project Management Software	11.8	42.2	34.3	10.8	1	3.53	9
14.	Issuance of Payment is based on work performed	52	37.3	8.8	2		4.39	3

Source: Survey Data, 2020

Discussion of findings

Table 4.6 depicts it was identified that the key players in Tanzanian construction industry have applied some parts of EVM concepts during construction projects. The application of EVM in Tanzanian construction industry from the data was found to be partial. This finding is similar to the finding by Vertenten *et al*., (2009), who found that only some part of the concept of EVM was being used in construction projects but not the EVM as a whole. Following are the most applied components of EVM in the projects:

The work scope was planned for the project to completion

Table 4.6 depicts was ranked first with mean score of 4.48, whereby, the contracting companies they were planning their work scope for the project to complete.

All work scope was broken into finite pieces and assigned to either individual or organization to control

This was ranked second with mean score of 4.40, as seen in Table 4.6 whereby, supported by Fleming, (2009) in which EVM requires to decompose the scope of work into detailed work package level.

Issuance of Payment is based on work performed

This was ranked third with mean score of 4.39, as seen in Table 4.6 whereby, payment to the contractor in the construction project was based on the work performed by the contractor.

4.5 Challenges in the application of EVM in Tanzanian construction projects

This objective examined challenges in the application of EVM in Tanzanian construction projects. The study acknowledged in various weights challenges facing EVM in construction projects. These, in chronological order, were: lack of EVM knowledge and procedure, poor understanding of EVM, lack of motivation and top management support in EVM, there was no EVM analyst or specialist within the project team, lack of interest of project team in EVM, EVM not required by client, absence of adequate project planning and documentation, pressures to report only good news, tedious reporting procedure, tedious data collection procedure, large time and cost commitment, EVM is complicated and burdensome paper work, and EVM is not suitable for all projects.

Table 4.7, what is noted from the study identified the following: lack of EVM knowledge and procedure is the most reported challenge facing the application of EVM in construction

project which was ranked first. This was followed by poor understanding of EVM, lack of motivation and the top management, no EVM analyst or specialist within the project team, lack of interest of project team in EVM and not required by client with mean score greater than 4.0.

Table 4. 7 Challenges in the application of EVM in Tanzanian construction projects by contractors

No	Challenges	SA	A	Not	D	SD	M.S	Rank
		%	%	%	%	%		
01.	Absence of adequate project planning and documentation	7.8	72.5	10.8	6.9	2	3.78	7
02.	Lack of interest of project team in EVM	38.2	44.1	11.8	2.9	2.9	4.12	5
03.	Tedious data collection procedure	5.9	34.3	52.9	4.9	2	3.37	10
04.	Tedious reporting procedure	6.9	32.4	54.9	3.9	2	3.38	9
05.	Lack of EVM knowledge and procedure	56.9	36.3	3.9	2	1	4.46	1
06.	Lack of motivation and top management support in EVM	56.9	26.5	10.8	2.9	2.9	4.31	3
07.	Large time and cost commitment	2	25.5	57.8	10.8	3.9	3.11	11
08.	EVM is not suitable for all projects	2	2.9	34.3	28.4	32.4	2.14	13
09.	Not required by client	34.3	49	7.8	2.9	5.9	4.03	6
10.	EVM is Complicated and burdensome paper work	5.9	11.8	64.7	14.7	2.9	3.03	12
11.	Poor understanding of EVM	52.9	33.3	10.8	2.9		4.36	2
12.	Pressures to report only good news	8.8	62.7	25.5	2.9		3.77	8
13.	No EVM analyst or specialist within the project team.	46.1	31.4	18.6	3.9		4.20	4

Source: Survey Data, 2020

Discussion of findings

Lack of knowledge and procedure

This was ranked first with mean score of 4.46, as seen in Table 4.7. The findings are supported by Brandon (1998) who suggests that, low level of knowledge and application of EVM in the construction industry is the main reason as to why EVM is not applied in the

construction industry for application of EVM in monitoring and controlling performance of projects.

These findings revealed that the knowledge and procedure of EVM in this industry is still low probably due to ‘unfamiliarity’ towards this tool and not widely used as a ‘standard’ project management tool by the industry as in Ibrahim *et al*., (2018).

Poor understanding of EVM

This was ranked second with mean score 4.36, as seen in Table 4.7. Most of the contracting company workers were facing the challenge of poor understanding of EVM which caused difficulties in applying EVM. These findings are supported by Kim *et al.,* (2003) who mentioned poor understanding of EVM as the challenge facing the use of EVM.

Lack of motivation and the top management

This was ranked third with mean score of 4.31, as seen in Table 4.7 whereby, there were no support from the company management in using EVM as the tool of project monitoring in the construction company.

4.6 Measures to be taken to enhance the application of EVM in Tanzanian construction projects

This objective was examining measures to be taken to enhance the application of EVM in construction projects, the following are the challenges facing EVM in construction projects which are as follows: all work scope must be planned for the project to completion, all work scope must break into finite pieces and assigned, provide Integrated project plan, provide of correct schedule and budget, provide Schedule and budget contingency in the project, contingency management in the project, provide accurate cost collection system, provide accurate report progress, management support in application of EVM and provide training to the project team on using EVM.

The following are the responses from the respondents on measures to be taken to enhance the application of EVM in Tanzanian construction projects.

Table 4.8 indicates that: management support in application of EVM was very important measure to enhance the application of Earned Value Management (EVM) in Tanzanian construction projects. Another measure was to provide training to the project team on using EVM, all work scope must be planned for the project to completion, all work scope must break into finite pieces and assigned, provide accurate progress report, provide integrated project plan, provide of correct schedule and budget, provide accurate cost collection system, provide Schedule and budget contingency in the project, management support in application of EVM which mean score greater than 4.0.

Table 4. 8 Measures to be taken to enhance the application of EVM in Tanzanian construction projects

SN	Measures	SA	A	Not	D	SD	M.S	RANK
		%	%	%	%	%		
01.	All work scope must be planned for the project to completion	46.1	48	4.9		1	4.38	3
02.	All work scope must break into finite pieces and assigned	43.1	52	3.9		1	4.36	4
03.	Provide Integrated project plan	39.2	51	7.8	1	1	4.27	6
04.	Provide of correct schedule and budget	34.3	57.8	7.8			4.26	7
05.	Provide Schedule and budget contingency in the project	25.5	55.9	18.6			4.07	9
06.	Contingency management in the project	23.5	52	24.5			3.99	10
07.	Provide accurate Cost collection system	36.3	52.9	9.8	1		4.25	8
08.	Provide accurate report progress	40.2	52	6.9	1		4.31	5
09.	Management support in application of EVM	52.9	37.3	8.8	1		4.42	1
10.	Provide training to the project team on using EVM	54.9	31.4	12.7		1	4.39	2

Source: Survey Data, 2020

Discussion of finding

Management support in application of EVM

This was ranked first with the mean score of 4.42, as seen in Table 4.8 whereby, management should have or establish monitoring and control departments/units within their companies as this is essential and integral to the successful execution and delivery of projects and qualified and well-trained persons/professionals should be put in charge of handling the project monitoring and control departments/units of construction companies and the techniques and tools used therein.

Provide training to the project team on using EVM

This was ranked second with the mean score of 4.39, as seen in Table 4.8 whereby, the study found that, introduction of and training on application of EVM can be one of the mitigation strategies for applying EVM in the construction projects in order to monitor and control performance of the projects. The construction firms must conduct the training about EVM several times in the firm in order to improve the awareness of EVM among the project team within the firms.

All work scope must be planned for the project to completion and all work scope must break into finite pieces and assigned

This was ranked third and fourth with the mean score of 4.38 and 4.36 respectively, as seen in Table 4.8. The importance of this measure is emphasised by (Awoles et al, 2015; Dolage and Pathmarajah, 2015; Kaliba *et al*, 2009; Memon, 2013a) who insist on proper project planning and scheduling in mitigating delay and cost overruns. They narrate that; contractors should appoint project managers, who are expected to draw up a workable project plan, and strategies which should implement the project activities in the proper sequence, to complete the defined stages of the project within the stipulated timeframe, with designated resources.

Furthermore, (Koushki, 2007; Ramabhadran, 2018) also insist on performing appropriate and proper preconstruction planning on tasks and resources, which may help on monitoring the project progress against stipulated time and budget.

Provide accurate report progress

This was ranked fifth with the mean score of 4.31, as seen in Table 4.8 whereby, the project team must provide the accurate progress report for the project in order to enhance the application of EVM in Tanzanian construction industry.

4.7 Chapter summary

This chapter discussed the research findings from the specific objectives developed in chapter one. The way the analysis was made and interpretation of the constructed questions in the questionnaires has been made. Also, the ways of how the application of EVM in Tanzanian construction projects can be enhanced.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study aimed at assessing the application of Earned Value Management (EVM) by contractors in Tanzanian construction projects. This chapter is nevertheless comprised of conclusions on the research objectives, recommendations for practical implications and areas of further study.

5.2 Conclusions

5.2.1 Use of EVM in time and cost management for construction projects in Tanzania

This objective assessed the use of EVM in time and cost management for construction projects in Tanzania, the study identified that the contractors in Tanzania applied some parts of EVM concepts during construction projects but the application was not found to be intensive. Found that only some parts of the concept of EVM was being used in construction projects but not the EVM as a whole. The application of EVM in Tanzanian construction projects was found to be partial.

For instance, the study established that all work scope was planned for the project to completion which was ranked first, followed by the work scope being broken into finite pieces and assigned to respective individual or department to control. Furthermore, issuance of payment was based on work performed and accomplishments were objectively assessed at the work performance level.

But on the other hand, aspects such as analysis of data collected through EVA and the forecasting of cost and time performance was done through EVA were minimally used.

5.2.2 Challenges in the application of EVM in Tanzanian construction projects

This study reveals that challenges of implementing EVM in Tanzanian construction project are:

i. Lack of EVM knowledge and procedure plus poor understanding of EVM are the main reasons as to why EVM is not applied as whole in monitoring and controlling performance of projects.

ii. Lack of motivation and top management supports. Besides, top management supports are important as well to provide encouragement in implementing EVM in Tanzanian construction project.

iii. No EVM analyst or specialist within the project team; the study found that there was no EVM analyst or specialist in the construction projects in which the absence of specialist will hinder the application of EVM in construction projects.

iv. Lack of interest of project team in EVM; the study found that most of the project teams were not interested in the application of EVM that is why this was ranked as among the challenges facing the application of EVM in the construction projects.

v. EVM not required by clients; clients did not set the condition in which will make the contractor use EVM as a tool of project monitoring in the project.

5.2.3 Measures to be taken to enhance the application of EVM in Tanzanian construction projects

This objective identified measure to be taken to enhance the application of EVM in Tanzanian construction projects, in which out of ten measures, management support in application of EVM was ranked first. This was followed by the provision of training to the project team on using EVM. Furthermore, the respondents insisted on more attention to be paid on the work scope to be planned for the project to completion and all work scope must to be broken into finite pieces and assigned, to provide accurate progress report, to provide

integrated project plan, provision of correct schedule and budget, provide accurate cost collection system and provide schedule and budget contingency in the project.

Project Management awareness must be created and adequate training programmes and seminars should be set on some close defined intervals and it must be a compulsory skill within the industry. This will equip the specialists with latest tools of project management and its application.

Management of construction companies should have or establish monitoring and control departments/units within their companies as this is essential and integral to the successful execution and delivery of projects. Also, qualified and well-trained persons/professionals should be put in charge of handling the project monitoring and control departments/units of construction companies and the techniques and tools used therein.

5.3 Recommendations

In line with the findings on the application of Earned Value Management (EVM) by contractors in Tanzania construction projects, the following recommendations are made;

i. The study found during the use of EVM only some parts of EVM were applied and not the EVM as a whole. It recommended that the effort of using the remained components should be made. Those components are data collected must be analysed through EVA, forecasting of cost and time performance must be conducted through EVA and Using Project Management Software to conduct analysis of EVM;

ii. Due to the lack of knowledge and procedure plus poor understanding of EVM, the study recommended that continuous training to the industry practitioners as the measure of improving the application of Earned Value Management (EVM) for performance of Tanzanian construction projects. Project Management awareness must be created and adequate training programmes and seminars should be set on

some close defined intervals and EVM must be a compulsory skill within the industry. This will equip the specialists with latest tools of project management and its application;

iii. Due to the lack of motivation and Management support in application of EVM challenge, the study recommended that management of construction companies should have or establish monitoring and control departments/units within their companies as this is essential and integral to the successful execution and delivery of projects and qualified and well-trained persons/professionals should be put in charge of handling the project monitoring and control departments/units of construction companies;

iv. Furthermore, it recommended that there must be EVM analyst and specialist within the project team in order to use the EVM in project monitoring which will the project to perform

v. With regard to lack of interest of project team in application of EVM, it is recommended that the regulatory bodies should set policies so as to build the capacity of contracting firms in application of EVM. Also, application of EVM has to be encouraged by all the stakeholders in the construction industry so as to make sure that there is a cautious management in application of EVM and henceforth improved application of EVM in contracting companies; and,

vi. For the challenge of EVM being not required by clients, it is recommended that clients must set the conditions which will make it mandatory for contractors to use EVM as a tool of project monitoring in the project. The conditions can be included in project contract.

5.4 Area of Further Studies

i. ***Integration of Earned Value Management (EVM) and other monitoring tools in construction projects***. There is a need of knowing the efficiency of integrated tools for project monitoring in order to add the knowledge on whether project stakeholders can combine all monitoring tools to improve the performance of the construction projects.

ii. ***Impact of Earned Value Analysis (EVA) in controlling the accepted risk in the construction project.*** Failing to control the accepted risk will result to the poor performance of the project, so there is need of knowing how the use of EVA in controlling the accepted risk can help in maintaining the provided cost for the risk accepted (contingency).

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APPENDICES

APPENDIX I

QUESTIONNAIRE

Research Title: "*Application of Earned Value Management (EVM) by contractors for construction projects in Tanzania*"

Dear Respondent,

I am a student of Ardhi University, pursuing a Master's of Science in construction economics and management. This questionnaire is intended to help the researcher get information on the Application of Earned Value Management (EVM) by contractors for construction projects in Tanzania. The purpose of this study is purely academic and the information given will be treated with the highest degree of confidence. You have been selected as a key respondent for this study. Kindly, complete the questionnaire to enable the researcher complete the study. Please tick the answer which represents your opinion on the subject.

I appreciate your participation in this effort.

Thank you,

……..

SOLOMON, Emael

Part A: BACKGROUND INFORMATION

1. Name of the contractor (optional)……

2. Position of the respondent……..…….

3. Professional background

	Tick	
Quantity surveyor	Engineer	Project Manager

4. What class is your company registered under Contractors Registration Board (CRB)

Class I ☐

Class II ☐

5. Duration of practice as a registered construction

	Tick
Less than 5 years	
5 – 10 years	
11 – 16 years	
17 years and above	

	Yes	No
6 Are you using the Earned Value Management as a project monitoring tool?		
7 And if yes have you found it of benefit the project?		

8 If you are not using Earned Value Management as a monitoring tool what are the reason?.....

.....

Part B

Section A: The use of EVM in time and cost management of construction projects in Tanzania.

This section aims at assessing the use of EVM in time and cost management of construction projects in Tanzania. Please indicate if these practices are used in your company by putting a tick in the appropriate box using the following scale. (Key 1 - Never, 2 - Very rarely, 3 – Rarely, 4 - frequently and 5- Very frequently).

No	Application of EVM	5	4	3	2	1
1	All work scope was planned for the project to completion					
2	All work scope was broken into finite pieces and assigned to either individual or organization to control					
3	Actual cost incurred were used in measuring work value accomplished					
4	Accomplishments were objectively assessed at the work performance level					
5	Analysis of Data Collected through EVA					
6	Schedule analysis by comparing budgeted vs actual performed					
7	Cost analysis by comparing budgeted vs actual performed					
8	When the variance from the planned occurred, impacts were forecasted and estimated at completion					
9	Forecasting of Time Performance is done through EVA					
10	Forecasting of Cost Performance is done through EVA					
11	Analysis of EVA by Using Project Management Software					
12	Forecasting of Project Performance is done by Using Project Management Software					
13	Monitoring of Project Performance is done by Using Project Management Software					
14	Issuance of Payment is based on work performed					

*EVA =Earned Value Analysis

Section B: Challenges in the application of EVM in Tanzania construction projects

This section aims at examining Challenges in the application of EVM in Tanzania construction projects. Please indicate to what extent are these challenges facing your company during the using of project monitoring technique by putting a tick in the appropriate box using the following scale. (Key: 1= strongly disagree, 2= disagree, 3= not sure, 4= agree and 5= strongly agree).

No	Challenges	5	4	3	2	1
1	Absence of adequate project planning and documentation					
2	Lack of interest of project team in EVM					
3	Tedious data collection procedure					
4	Tedious reporting procedure					
5	Lack of EVM knowledge and procedure					
6	Lack of motivation and top management support in EVM					
7	Large time and cost commitment					
8	EVM is not suitable for all projects					
9	Not required by client					
10	EVM is Complicated and burdensome paper work					
11	Poor understanding of EVM					
12	Pressures to report only good news					
13	NO EVM analyst or specialist within the project team.					

*EVM=Earned Value Management

Section C: Measures to be taken to enhance the application of EVM in Tanzanian construction projects

This section aims at examining measures to be taken to enhance the application of EVM in Tanzanian construction projects. Please indicate in your opinion on measures to be taken with your company during the using of project monitoring technique in order to enhance the application of EVM by putting a tick in the appropriate box using the following scale. (Key: 1= strongly disagree, 2= disagree, 3= not sure, 4= agree and 5= strongly agree).

No	Measures	5	4	3	2	1
1	All work scope must be planned for the project to completion					
2	All work scope must break into finite pieces and assigned					
3	Provide Integrated project plan					
4	Provide of correct schedule and budget					
5	Provide Schedule and budget contingency in the project					
6	Contingency management in the project					
7	Provide accurate Cost collection system					
8	Provide accurate report progress					
9	Management support in application of EVM					
10	Provide training to the project team on using EVM					

And if others, please specify below

……

……

……

Thank you for your participation!

APPENDIX II: **INTRODUCTION LETTER**

ARDHI UNIVERSITY

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P. O. Box 35176
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Ref.No. ARU/CD,68/184/01/ **5th March,2020**

TO WHOM IT MAY CONCERN

Dear Sir/ Madam,

RE: INTRODUCTION LETTER FOR POSTGRADUATE STUDENT

Refer to the subject above.

The Student above is pursuing Masters of Science in Construction Economics and Management (MSc. CEM) in our University. As a Student he is required to do dissertation work as part of the requirements for the award of the Masters of Science in Construction Economics and Management (MSc. CEM). For the accomplishment of this exercise, students are required to carry out literature review, extensive search for field data and subsequently analyse the same for conclusive scientific results.

We are therefore requesting you to assist the bearer of this letter **Mr. SOLOMON EMAEL, with Reg. No. HD/T.1209/2018**, who will need information from your organisation. The title of his Dissertation is ***"Application of Earned Value Management for Construction Projects in Tanzania."***.

Thank you for your cooperation and contribution.

Yours Sincerely,

Dr. Shubira Kalugila
For: Deputy Vice Chancellor
Academic Affairs

ARDHI UNIVERSITY P. O. Box 35176 DAR-ES-SALAAM