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**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF BUSINESS AND ECONOMICS**  
**SCHOOL OF COMMERCE**

**The Relationship Between Earned Value  
Management Practices and Project Success:  
The Case of Rama Construction PLC.**

**By Abel Demere**

**ID: GSR/1036/14**

**A Thesis submitted to Addis Ababa University, School of Commerce in partial  
fulfillment of the requirements of the degree of Master of Arts in Project  
Management (MAPM)**

**Advisor: Adane Atara (PhD.)**

**June 2023**

**Addis Ababa, Ethiopia**



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# The Relationship Between Earned Value Management Practices and Project Success: The Case of Rama Construction PLC.

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## Declaration

I hereby declare that the project thesis entitled “*The Relationship Between Earned Value Management Practices and Project Success: The Case of Rama Construction PLC.*”, has been carried out by me under the guidance and supervision of Adane Atara (PhD.). The thesis is original and has not been submitted for the award of any degree or diploma to any university or institution.

Research Name

Signature

Date

Abel Demere Hailu

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## Certificate

This is to certify that the thesis entitled “*The Relationship Between Earned Value Management Practices and Project Success: The Case of Rama Construction PLC.*”, submitted to Addis Ababa University School of Commerce for the award of degree in Master of Project Management carried out by Mr. Abel Demere, under my guidance and supervision. Therefore, I hereby declare that no part of this thesis has been submitted to any other university or institution for the award of any degree or diploma.

Advisor Name

Signature

Date

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## List of Acronyms and Abbreviations

<b>AC</b>	- Actual Cost
<b>ACWP</b>	- Actual Cost of Work Performed
<b>AT</b>	- Current Time
<b>BAC</b>	- Budget at Completion
<b>BCWP</b>	- Budgeted Cost of Work Performed
<b>BCWS</b>	- Budgeted Cost of Work Scheduled
<b>CPI</b>	- Cost Performance Index
<b>CSFs</b>	Critical Success Factors
<b>CV</b>	- Cost Variance
<b>EAC</b>	- Expected/Estimate at Completion (cost)
<b>EAC(t)</b>	- Expected/Estimate at Completion (time)
<b>EV</b>	- Earned Value
<b>EVA</b>	- Earned Value Analysis
<b>EVM</b>	- Earned Value Management
<b>EVMS</b>	- Earned Value Management System
<b>EVT</b>	- Earned Value Technique
<b>KPIs</b>	- Key Performance Indicators
<b>PD</b>	- Planned Duration
<b>PMI</b>	- Project Management Institute
<b>PMO</b>	- Project Management Office
<b>PV</b>	- Planned Value
<b>SPI</b>	- Schedule Performance Index
<b>SV</b>	- Schedule Variance
<b>WBS</b>	- Work Breakdown Structure

## Abstract

*By definition, construction projects are dynamic, complex, and include a lot of feedback loops. Although there have been improvements in construction equipment, schedule and cost overruns are still common in projects. In an effort to treat these lingering symptoms, construction management's controlling components have garnered a lot of attention. The primary contribution of this study in this regard is to offer a comprehensive analysis of the factors affecting the acceptance, application, frequency of usage, and implications for the system of Earned Value Management (EVM) and its relationship with project success based on the information received from RAMA Construction PLC. A cross-sectional survey is conducted using ten different constructs in order to describe and explain the relationship. Nine more in-depth structured interviews were conducted in order to fill in the data gaps left by the questionnaire's design. Using pre-established scales, each questionnaire question generated a quantitative assessment of the practices related to the construct. Schedule and cost control procedures used by the company were assessed to be moderate. On the other hand, the EVM system is not fully developed, and the practice is only at a modest stage, lacking in frequency, intensity and discipline. Since the company lacks EVM policies, systems, discipline, consistency, status measuring metrics, trainings, and development plans, EVM is only used in pilot projects. The main obstacles to implementation are the control culture, policies, and procedures of the organization. EVM and project success are positively related to one another. This study will further shed light on the idea of EVM for construction project clients, contractors and policy makers if it's studied by taking multiple companies into account.*

**Keywords:** *schedule control, cost control, earned value management, project success*

# Chapter One

## 1 Introduction

### 1.1 Background of the Study

Project control is nested within Project Management. The project control procedure is designed to compare anticipated and achieved performance. It is necessary to continuously evaluate the project's performance to find any preventive or remedial measures (Wysocki, 2019). It is also crucial to maintain current, reliable information based on the project's output and related documentation.

Project control concentrates on the project's time and cost criteria as a sub-function. The function's major goal is to give analysis of the available data and potential situations to support quick decision-making. Time and cost typically have a clear and significant link. The original cost estimates will almost certainly exceed actual costs if the targeted timeframe is overrun (Lock, 2007). In order to steer clear of delays and overspending, project managers use tools and techniques as control function.

Every day of a project's life, whether it be a working or non-working day, a weekday or a weekend, from the first day of the program until the last payment has been made, costs money. These expenses occur for a number of reasons and should be approached through integrated project management (Lock, 2007). As per Fleming & Koppelman (2010), the methodology, Earned Value Management (EVM), for this integrated management is a time-phased, integrated performance management baseline that takes into account measurements of the project's scope, schedule, resources, and risk to evaluate performance and progress against a baseline.

A project is a series of connected tasks that have a single objective and certain due date to be completed within the allocated resource and designed quality (Wysocki, 2019). Projects exist to produce deliverables and these deliverables are to be achieved through the application of scientific guidelines mixed with a practical experience which are supported by tools and techniques. These tools and techniques are designed to make better use of management of existing resources by getting work to flow horizontally as well as vertically within the organization structure (Kerzner, 2017). Different people may understand this technique of management in diverse way where some overlap it with control. The goal of project management is to maintain the project's deliverables, personnel, and processes all on schedule.

An activity must be completed within the project's time, budget, and performance restrictions to be considered successful. Due to the management's inability to accurately assess how effectively a project's constraints are performing, several good projects as well as project management structures have failed (Al-Zwainy et al., 2018). Project management involves five process groups as identified in the PMBOK® Guide (2017), namely: project initiation, project planning, project execution, project monitoring and control and project closure. The process of measuring, reviewing, and reporting a project's overall progress in order to achieve the performance goals set forth in the project management plan is known as monitoring and controlling the project.

Earned Value Management (EVM) is a tool for measuring project performance where actual work accomplished is measured against planned and budgeted work stated (planned) (Webb, 2003). Schedule and cost variances are calculated using these metrics for both the current period and the total amount of time completed (Wysocki, 2019). If the expense of the project is greater than the value of what the project is actually achieving, earned value gives the project manager a kind of "early warning" buzzer that sounds when looming difficulties are present. This enables them to take the appropriate remedial actions (Fleming & Koppelman, 2010).

Recently projects are managed as investments (Devaux, 2014). Meanwhile, investments make a tangible difference in the construction industry and every construction project is built on the foundation of project management. Because of their considerable contribution to global GDP (gross domestic product) and employment creation, construction activities are regarded as the backbone of the global economy (Horta et al., 2013).

Due to advancements in technology, the construction sector has undergone numerous evolutionary changes in recent decades. Tracing the status of construction, inconsistent time and cost management has been critical failure factors of construction projects. This situation has led to rethinking of the industry's performance and how it could be improved.

Variations in time and cost are a common issue in both developed and developing countries, according to assessments in the studies undertaken by (Alemayehu, 2018; Arega, 2018; Przywara & Rak, 2021; Sutrisna et al., 2020). As an example, construction projects in India had an average cost rise of 73%. Additionally, about 40% of the projects reported performance issues. In Nigeria, cost overruns on projects ranged from 5% to 80% more than the initial cost estimate. In Colombia, more than 50% of projects ran over budget and more than 80% experienced delays of 30 to 80 days or more. It has been observed that many projects, even in

industrialized nations like the United Kingdom with a variety of approaches and cutting-edge software for project control, nonetheless fall short of expectations in terms of time and cost.

Construction projects continue to encounter problems like delays, conflicts, lost productivity, subpar performance, coordination, and many others despite substantial scientific research and improved management strategies. Delays in construction projects have the potential to have numerous treacherous effects and can negatively impact the success of the project as a whole (Tariq & Shujaa Safdar Gardezi, 2023).

According to Oberlender et al., (2022), there are three variables that are crucial for a project to be successful throughout construction. These elements include an effective cost management system, a thorough construction schedule, and an effective communication system. It is believed that a project control system should be created to monitor, measure, and assess the cost, schedule, labor hours, and quality of work with regard to a certain construction schedule and cost control system.

## **1.2 Background of the Organization**

Rama Construction Private Limited Company is a category-one general contractor (GC). The Company, which is registered under the minister of construction, was founded in Addis Ababa, Ethiopia in 1995 with a vision - “To be a world class Construction Company which could undertake any kind of construction works in Ethiopia and internationally”, mission - “To participate on the country’s socio-economic development with highest level of ethical, reliable and Professional manner and carry out quality construction services to all stakeholders in a timely and cost effective manner” and core values of quality, fairness and respect, environment, team work, accountability, safety, continuous improvement, and relationship.

The construction industry has grown increasingly competitive in recent years as more and more contractors compete to stand out and complete their projects. Cost overruns and schedule delays, however, are ongoing issues in the construction sector that can have serious consequences. As a result of this dynamic behavior of the industry, RAMA is facing these issues within and across projects even though the firm implements variance analysis. How to overcome the sources of these delays and overruns is unknown. As a result, it is deemed that a project cost and schedule control system tool will be assessed and recommendations will be provided.

### **1.3 Statement of the Problem**

Companies involved in the construction industry are becoming more and more project-oriented in the highly competitive business environment of today. With this decision, they are better able to facilitate activity coordination, progress control, and performance communication (Horta et al., 2013). The methodologies, processes, and activities involved in projects are never the same since they constantly result in new products or services that did not previously exist (Söderlund & Lenfle, 2011). Yet, in order to develop or strengthen business competency, one must utilize good project management approaches/techniques (Barlow et al., 2016). The project managers' responsibility in monitoring and controlling the project takes on increased significance in this regard. To fulfill a project's goals in terms of cost, time, and quality project management entails repeated planning, organizing, monitoring, and controlling of all components of a project (Herath & Chong, 2021).

Construction projects by their very nature are dynamic, complex, and involve numerous feedback loops (Park & Pena-Mora, 2012). Although advancements in construction equipment, schedule delays and cost overruns are still frequent in construction projects. The planning and control parts of construction management have received a great deal of attention in an effort to alleviate these persistent symptoms (Lee et al., 2006). These initiatives guarantee completion within a predetermined time schedule, budget, level of quality, and specification (Betru, 2021).

The fact that a significant number of construction projects that have fallen through in recent years is well known and well-documented. According to Wysocki (2019), when a project adheres to the set timetable, budget, and client expectations, it is deemed successful. To fulfill the expected scheduled time and budget in order to achieve the stated objectives, an efficient control must be in place (Kerzner, 2017). Thus, it is necessary to swiftly implement project control tools and techniques in almost every area of a project's phase. Among the tools and techniques, earned value management (EVM) is a crucial one if designed and implemented (Mulugeta, 2017). Understanding the effects and influences of EVM, as well as keeping it in check, is essential to the effective completion of a project as a project manager.

As no two construction projects are ever precisely the same, they are more likely to be uncertain and require effective control techniques like EVM (Temam, 2018). As per Deneke (2020) construction project failure in Ethiopia is typically the result of a number of little issues, each of which can have a significant impact on the project's cost, schedule, and performance, depending on how they are handled. One of the main issues with these construction projects is

their failure to be completed on schedule, within the allotted budget, and to the required quality standards. Mulugeta (2017) also noted that cost overruns, time overruns, and poor delivery quality are now commonplace in construction projects of Addis Ababa, which frequently results in the dissatisfaction of clients.

When trying to track schedules, earned value tracking gets a little odd (Devaux, 2014). Naturally, each of the tasks and work packages had dates when they were supposed to take place during a project. The cost of the task must be charged as an actual cost as soon as the work is completed in order to maintain project management. Due to this and the fact that they feel intimidated by them, many companies and project managers avoid using earned value procedures. These individuals don't fully understand the acronyms and haven't absorbed the formulas.

Alemayehu (2018) identified the control tools and techniques implemented to analyze the performance of projects in terms of time and cost to ensure that the project's objectives are satisfied but failed to illustrate the impact of application of EVM. Mulugeta (2017) and Temam (2018) also look into project management and control procedures but failed to specifically examine implementation, usage frequency and implications for future of EVM. This study's key contribution in this regard is to provide a thorough examination of the variables influencing the acceptance, application, frequency of usage, and implications for the system of EVM based on the data gathered from the construction firm and its relationship with project success.

#### **1.4 Research Question**

The followings are the research questions that were raised in this study.

1. What is the project schedule control practice of Rama construction PLC?
2. What is the project cost control practice of the organization?
3. What is the Earned value Management system practice of the organization?
4. What are the factors affecting the application of Earned Value Management at Project Control Mechanism in the organization?
5. What is the relationship of Earned Value Management and project success in the organization?

## **1.5 Research Objective**

### **1.5.1 General Objective**

The aim of this study is to describe and explain the relationship between earned value management practices and project success of construction projects in the case of Rama Construction PLC.

### **1.5.2 Specific Objectives**

This study will specifically focus on:

- Evaluating project Schedule Control Practices of the organization,
- Evaluating project Cost Control Practices of the organization,
- Assessing the Earned Value Management System and Practice of the organization,
- Identifying the factors affecting the applications of Earned Value Management,
- To explore the relationship of Earned Value Management System and the success of projects in the firm.

## **1.6 Significance of the Study**

This study will shed further light on the idea of project management control, especially with regard to earned value management, one of the applied control methodologies. The existing understanding of early warnings to construction project failure owing to cost overrun, time delay, and poor performance will advance with the creation of a relationship between earned value management and project success. The role of EVM will be uncovered, emphasized, and closely examined through the thorough examination of this study in the organization. This study will also clarify how awareness of and utilization of earned value management affect its potential future use.

With this study, construction project clients will become more aware of earned value management as a preventive measure against project distress and failure and will be more likely to use it. Earned value management may be viewed by the construction industry as a preferable substitute instrument. By establishing a connection between the two variables, earned value management and project success, the organizations' present understanding of how to improve project performance in terms of cost and time will be expanded. Even though this study will specifically help RAMA Construction PLC., newly formed construction companies can use it to determine when and why they should use earned value management. Experienced

construction companies may also examine their existing project control technique in light of the findings of this study.

Furthermore, the study's analysis will provide important data for future studies that examine the advantages of project management control, particularly with reference to earned value management. A thorough explanation of the connections between the variables examined in this study could be used as a tool in future research to improve the current construction industry trend. A more in-depth examination could result from the overview's desire for new paradigms, which will be useful for discussions of the cost and time management principle in the future.

### **1.7 Scope of the Study**

As identified in the PMBOK® Guide (2017), project management involves five process groups namely: project initiation, project planning, project execution, project monitoring and control and project closure. This study is limited to the practice of project schedule and cost control, specifically the system and practice of earned value management (EVM) and its relationship with project success. As the aim of this study is to assess the perception of EVM in a construction firm called Rama Construction PLC. it is limited to the organization only. To contact the respondents for the study, email and social media platforms are used. From April 2023 through May 2023 in-depth one-on-one interviews and questionnaires are employed. The findings are be described, explained and relationship among variables is emphasized.

### **1.8 Limitation of the Study**

The measurements of the project's scope aren't taken into account in this study despite the fact that it is well known that Earned Value Management (EVM) is a time-phased, integrated performance management baseline that takes into account measurements of the project's scope, schedule, resources, and risk to evaluate performance and progress against a baseline. This is because there aren't enough studies and articles about the interactions between EVM and project scope. Without quality control, project managers cannot consider the success of their projects. EVM, on the other hand, is weak in the area of quality control due to its intense focus on project schedule and cost control. These two restrictions reduce the study's capacity to be generalized.

### **1.9 Organization of the Study**

This study includes five chapters. The background of the study and the organization to be studied, the problem statement, the research questions, the study's objective, its importance, its

scope, and its limitations are all included in the first chapter which is the study's introduction. The second chapter examines a review of pertinent literature on project management's control system, particularly the Earned Value management and how it enhances projects to reach into success. The third chapter of the paper discusses the methodology and research design. It covers the research strategy, the sample and sampling methods, and the sources and tools used for data collection. The fourth chapter will summarize and interpret the study's findings and results. The final chapter will include a summary of the results, conclusions, and suggestions.

### **1.10 Definition of Terms**

**Construction Projects:** The organized process of constructing, remodeling, refurbishing, retrofitting, or adapting a structure, or other built asset such as a tunnel or bridge (The Construction Wiki, 2022).

**Project control mechanism:** A managerial function that involves tracking progress toward an objective, determining what has to be done next, and taking the necessary corrective action to meet or surpass the goal (Kerzner, 2017).

**Earned Value Management:** A time-phased, integrated performance management baseline that takes into account measurements of the project's scope, schedule, resources, and risk to evaluate performance and progress against a baseline (Vanhoucke, 2009).

**System:** A set of principles, designs, policies, documents, manuals and procedures according to which something is done.

**Practice:** The actual frequency, discipline and intensity of application or use of a method, as opposed to theories relating to it.

**EVM Metrics:** Are standards for measuring or evaluating the performance and progress of a project (Vanhoucke, 2009).

**Variance:** The distinction between the planned value and actual value of schedule and cost.

**Indices:** Are measurements of how far a project is from the anticipated schedule and cost.

**Forecasting:** The estimation of duration and total cost it is going to take to complete a project at the current status date.

# Chapter Two

## 2 Review of Related Literature

This chapter reviews related literatures regarding Earned Value Management (EVM) System. The basic key metrics in earned value management, the recent researches focused on the time and cost aspect of EVM are elaborated. Evaluation of project controlling effect on the success of the construction industry and its features, and EVM and its practice in the Construction Industry are discussed.

### 2.1 Theoretical Review: Fundamentals of EVM

#### 2.1.1 Project, Project Management, Project control

##### 2.1.1.1 Project

A project is a series of connected tasks that have a single objective and certain due date to be completed within the allocated resource and designed quality (Wysocki, 2019). In addition, Nicholas & Steyn (2020) described a project as a group of tasks that come together to form a singular, transient process that makes use of the skills and abilities of various organizations and professions to accomplish a single, clearly stated objective.

Projects exist to produce deliverables and these deliverables are to be achieved through the application of scientific guidelines mixed with a practical experience which are supported by tools and techniques. These tools and techniques are designed to make better use of management of existing resources by getting work to flow horizontally as well as vertically within the organization structure (Kerzner, 2017).

##### 2.1.1.2 Project Management

According to Wysocki (2019), project management entails creating plans, assigning roles, obtaining suitable tools and materials, creating and managing schedules, communicating information, fostering good communication, reaching milestones, and displaying strong leadership skills to ultimately resolve and complete the project by the specified deadline.

Despite having clearly defined objectives, projects' scope is gradually developed by project managers over the course of the project life cycle from high-level information into specific plans. They establish procedures to keep changes handled and under control while anticipating change (Lewis, 2023). Maintaining the project's deliverables, staff, and processes all on schedule is the aim of project management. Being more predictable, increasing chances of

success, delivering the right products at the right time, resolving problems and issues, responding to risks in a timely manner, maximizing the use of organizational resources, identifying, recovering, or terminating failing projects, managing constraints, and balancing the impact of constraints on different aspects of a project are all made possible by effective project management (Ebrahim, 2017).

Missed requirements, missed deadlines, cost overruns, poor quality, rework, waste, uncontrolled expansion of the project, loss of reputation for the organization, dissatisfied stakeholders, and/or failure to achieve the project's goals are all consequences of poorly managed or controlled projects, or the absence of project management.

Project Management Process Group is a logical grouping of project management inputs, tools and techniques, and outputs where the activities of project management are congregated. The process groups of project management and their definitions are presented in table 2-1 and figure 2-1.

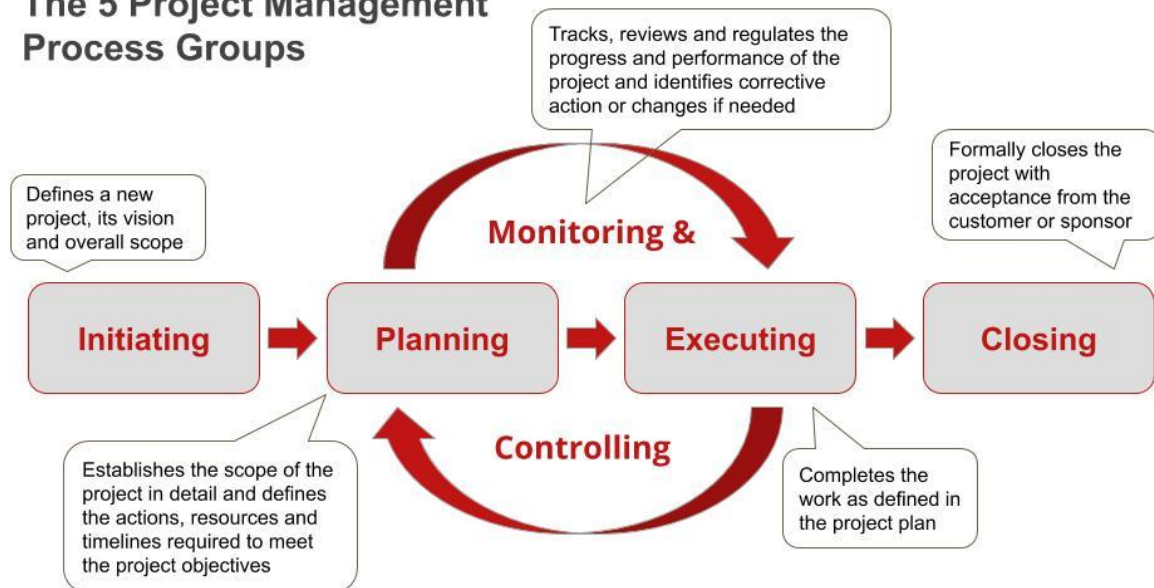
*Table 2-1 Project Management Process Groups*

	<b>Process Group</b>	<b>Definition</b>
A	Initiating	The actions taken to establish a new project or a new phase of an ongoing project by securing permission to begin the project or phase
B	Planning	The procedures necessary to determine the project's scope, refine its goals, and specify the course of action to be performed in order to fulfill the goals that the project was started with
C	Executing	The actions taken to finish the tasks outlined in the project management plan in order to meet the project's requirements
D	Monitoring and controlling	The procedures needed to keep tabs on, evaluate, and manage the project's performance; spot any areas where the plan has to be changed; and start the necessary modifications
E	Closing	Procedures carried out to formally end or close the project, phase, or contract

*Source: (Kerzner, 2017; PMI, 2023; Wysocki, 2019)*

Figure 2-1 Project Management process groups

## The 5 Project Management Process Groups

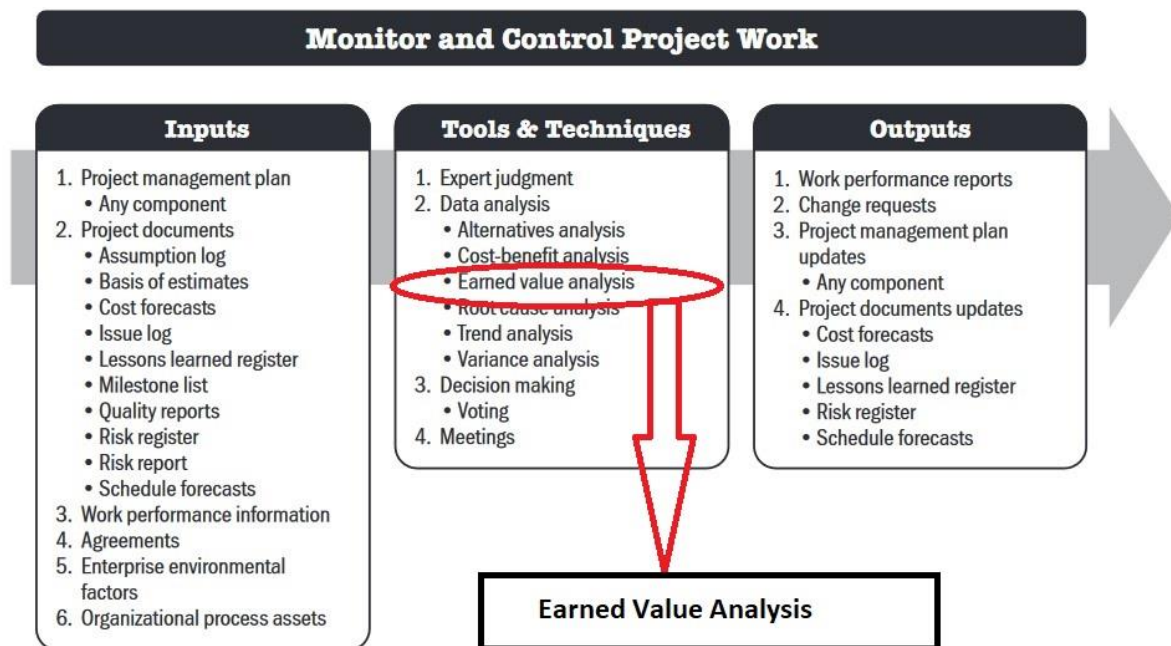


Source: *The 5 project management process groups [project management fundamentals]* (Iliyana Stareva, 2020)

### 2.1.1.3 Project Monitoring and Controlling

Project managers' primary responsibility is to oversee and manage projects as they evolve using established procedures (Maylor, 2022). The Monitoring and Controlling Process Group, according to PMI (2023), comprises of the procedures needed to monitor, evaluate, and control the project's performance, as well as to spot any areas where the plan has to be changed and to start the necessary modifications. While controlling entails contrasting actual performance with planned performance, analyzing variances, identifying trends to affect process improvements, weighing available options, and recommending the necessary corrective action as needed, monitoring entails gathering project performance data, producing performance measures, reporting and disseminating performance information. This process of monitoring and control is performed throughout the project lifecycle to generate a successful output with the help of different tools and techniques. The tools and techniques used to convert inputs into outputs are shown in figure 2-2.

Figure 2-2 Project Monitoring and Control inputs, tools and techniques and outputs



Source: *Process Groups: A Practice Guide* (PMI, 2023)

Kerzner (2017) named controlling as one of the management functions that entails a three-step process of assessing what needs to be done next, measuring progress toward an objective, and implementing the required corrective action to meet or exceed the objectives. The three steps are presented and described in table 2-2 below.

Table 2-2 Functions of Project Control

	Control Functions	Definition
A	Measuring	Determining through formal and informal reports the degree to which progress toward objectives is being made
B	Evaluating	Determining cause of and possible ways to act on significant deviations from planned performance.
C	Correcting	Taking control action to correct an unfavorable trend or to take advantage of an unusually favorable trend.

Source: *Project management a systems approach to planning, scheduling, and controlling* (Kerzner, 2017)

Project managers should concentrate on two kinds of information in order to manage projects. These information are “where you should be” and “where you actually are” (Lewis, 2023). You are instructed where to be by the plan. Your project information system including a well-

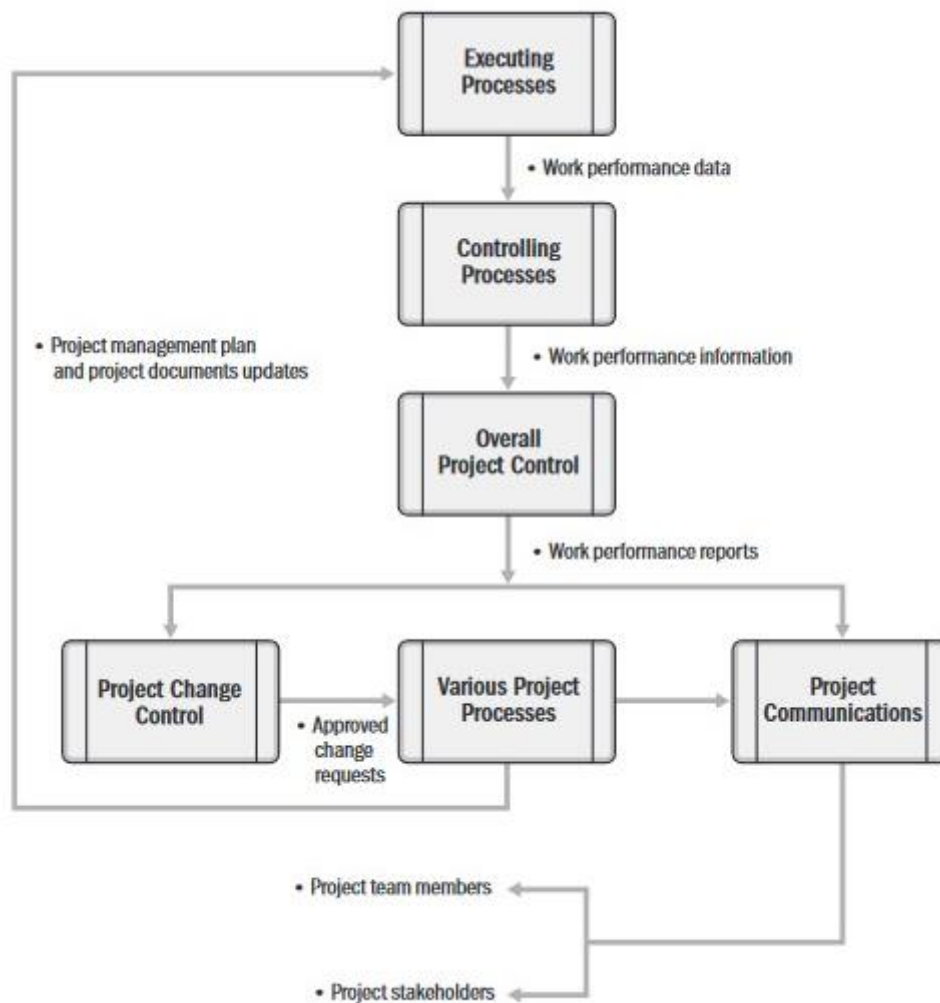
managed flow of data, information and reports as shown in figure 2-3, which in many organizations is nonexistent, tells you where you are. Cost, Time, Scope, and Performance are the four project constraints among the two kinds of information that this system must detail. The following formula indicates their relationship to one another:

$$C = f(P, T, S)$$

where *P* is performance, *T* is time, *S* is scope, and *C* is cost. (And *f* means function.)

If project managers want to know the true status of the project, there should be a clear flow of information and they must be aware of the costs incurred thus far, whether the work meets the functional and technical requirements (i.e., performance), whether the work is on schedule, and whether the scope of the work is at the desired level.

Figure 2-3 Flow of data and information for project monitoring and controlling



Source: *Effective Project Management: Traditional, Agile, Extreme, Hybrid* (Wysocki, 2019)

## *Purposes of project Controlling*

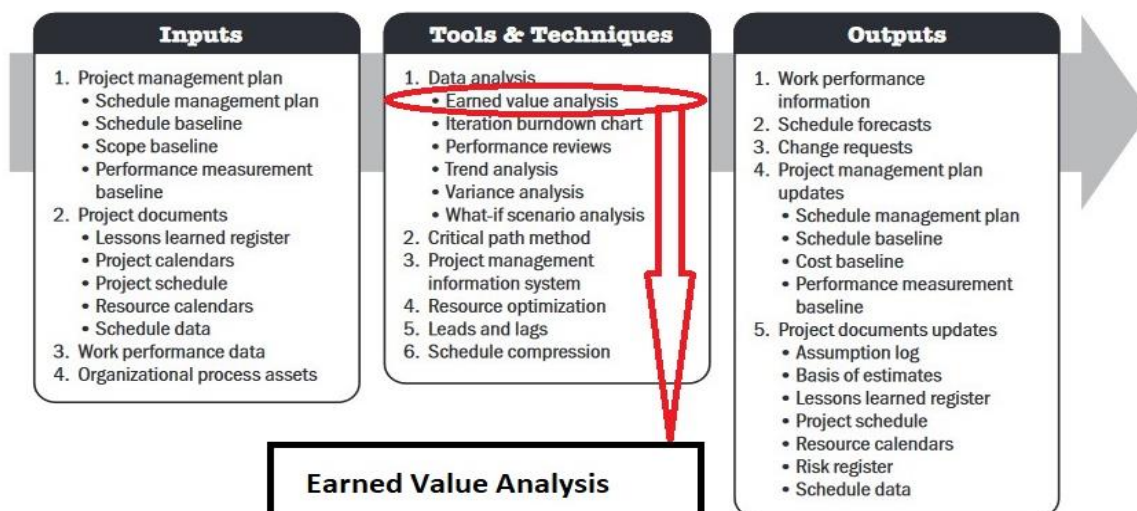
Erne (2022) proposed two purposes of project control: When actual performance to date is compared to the predetermined plans and standards laid out in the planning phase, the first purpose of control is verified. The comparison demonstrates that the performance standards have been successfully translated from the objectives. The second purpose of controlling is decision-making. Management must have access to three useful reports in order to make timely and effective decisions: the timeline, budget, and project plan created during the planning phase; a thorough comparison of the resources used thus far with those planned; and a forecast of the resources needed to carry out the program.

## *Project Schedule Control*

Project schedule control is the process of tracking of project progress to detect and monitor deviation from the planned timeline, update the project schedule and managing changes (Lewis, 2023). The fundamental advantage of this method is that the project's baseline timeline is always followed. Throughout the project, this procedure is used. The inputs, methods, and results of Schedule controlling are depicted in Figure 2-4.

Knowing the actual performance to date is necessary for controlling and updating the timetable model. According to Wysocki (2019), the schedule controlling concerns include determining the project schedule's current status, influencing the variables that affect it, reevaluating the need for schedule reserves, determining whether the project schedule has changed, and managing the actual changes as they happen.

*Figure 2-4 Project schedule Control inputs, tools and techniques and outputs*



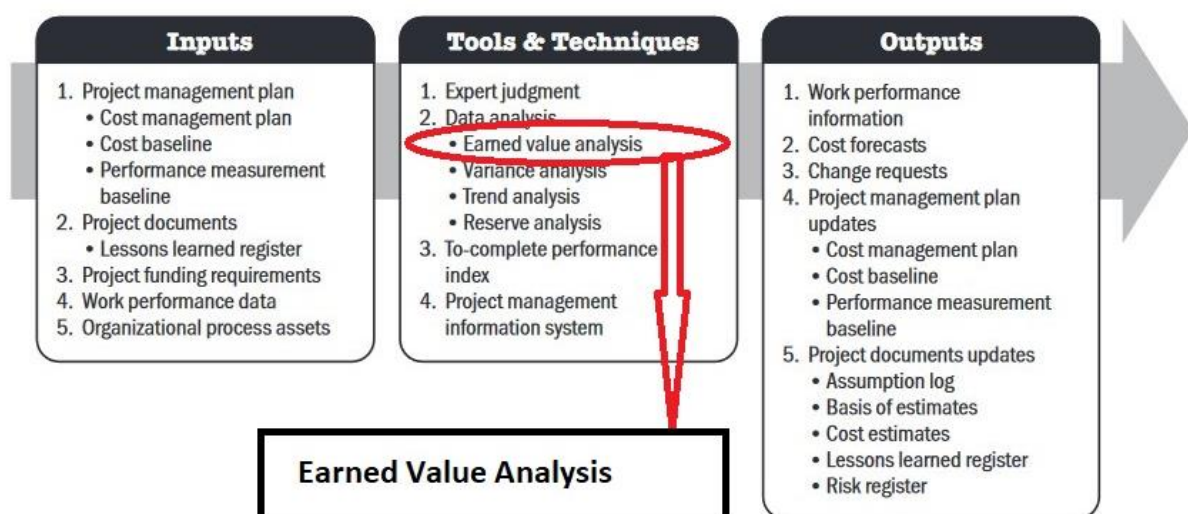
Source: *Process Groups: A Practice Guide (PMI, 2023)*

## Project Cost Control

Controlling costs involves keeping track of the project's progress in order to update project costs and manage modifications to the cost baseline established (Wysocki, 2019). The fundamental advantage of this method is that the project's cost baseline is kept constant. Analysis of the connection between the use of project budgets and the work being done for such expenditures is a significant portion of the effort involved in cost management. The management of the agreed cost baseline is essential for efficient cost control (Lee et al., 2006). Throughout the project, this procedure is used. The inputs, methods, and results of cost controlling are shown in the Figure 2-5.

Influencing the variables that result in changes to the permitted cost baseline; ensuring that every change request is handled quickly; coordinating the real changes as they happen; ensuring that project costs are not incurred in excess of the permitted financing by time, by WBS component, by activity, and overall; tracking cost performance in order to identify and comprehend deviations from the established cost baseline; comparing labor performance to the amount of money spent; preventing unauthorized changes from being accounted for in reported resource or expense utilization; notifying the proper parties of all approved changes and their associated costs; and bringing anticipated cost overruns under control are aspect of project cost control (PMI, 2023).

Figure 2-5 Project cost Control inputs, tools and techniques and outputs



Source: *Process Groups: A Practice Guide* (PMI, 2023)

### **2.1.2 Earned Value Management (EVM)**

The Project Management Institute (PMI) adopted the earned value management (EVM) method as a standard tool for project performance measurement after it had evolved from its origins as the C/SCSC cost schedule control system developed by the U.S. Department of Defense (DoD) in the 1960s (Sutrisna et al., 2020). This method is currently in use throughout many nations and goes by a variety of names, including EVA (Earned Value Analysis), EVM (Earned Value Management), EVMS (Earned Value Management System), and EVT (Earned Value Technique).

There is no consensus as to whether the Earned Value Management (EVM) technique is a project performance measuring tool or a project management control methodology, despite the fact that it is employed in many nations. Planning and control tools like EVM have been around for a while (Devaux, 2014; Fleming & Koppelman, 2010; PMI, 2017). EVM is regarded as one of the most suitable methodologies to simultaneously control project cost and time while providing early warning signals of potential problems, leading to an effective management of the project performance (Araszkiewicz & Bochenek, 2019; Fleming & Koppelman, 2010; Rose, 2011; Vanhoucke, 2009; Wysocki, 2019)..

EVM was described by Vanhoucke (2009) as an approach for integrating the three essential components of project management (scope, schedule, and cost management) as well as for measuring and communicating the actual physical progress of a project. By assessing project progress in monetary terms, it considers the work performed, the time required, and the money incurred to finish the project. This helps to analyze and control project risk.

Wysocki (2019) also described earned value analysis (EVA) as a project performance monitoring technique that compares actual work completed with planned and budgeted effort expressed in these equivalents by using the monetary value of the job as a metric. In situations when the project manager does not directly handle the project budget, resource person hours/day might be utilized as an alternative to the monetary value.

As per Project Management Institute, PMI (2023), EVM is a methodology that integrates scope, schedule, and resource measures to evaluate project performance and progress. They made a distinction between performance and progress in terms of measurement. Performance is assessed by comparing the earned value, or budgeted cost, of the job completed with the actual cost, or real cost, of the work completed. While the earned value is contrasted with the planned value to determine progress. Cost and schedule deviations, as well as the schedule

performance index and cost performance index, can all be tracked by continuously comparing these variables (Sutrisna et al., 2020). The estimated completion date, estimated completion cost, and estimated completion cost can then be calculated.

Devaux (2014) raised a reversing concept and argued that in spite of its name, EVM is not about value but rather about cost. Nonetheless, the author defined EVM as a well-known project management technique that places an emphasis on controlling project cost performance and duration which enables trends to be identified during execution and notifies the project manager of variances that may affect the project so they can take the necessary corrective action.

### 2.1.2.1 *Earned Value Management Terminologies*

The general health of a project is measured and assessed using a set of often used metrics by the Earned Value Management system (EVMS). These metrics act as warning signs that can be used to quickly identify project issues or take advantage of project possibilities (Vanhoucke, 2009). According to Wysocki (2019) these measures are also utilized to calculate schedule and cost variances for both the present period and the total amount incurred.

Earned Value Management (EVM) is divided into two categories of terminologies, according to (Araszkievicz & Bochenek, 2019; E. Kim et al., 2003; PMI, 2023): key metrics (parameters) of EVM, including Planned Value (PV), Earned Value (EV), and Actual Cost (AC); and EVM performance and progress measures, including variances, indices, and forecasts. Tables 2-3 and 2-4 below presents the summarized terminologies, their equations and interpretation.

*Table 2-3 Metrics of EVM*

<b>A. Metrics</b>		
Are standards for measuring or evaluating the performance and progress of a project (Vanhoucke, 2009)		
<b>Indicator</b>	<b>Interpretation</b>	<b>Source</b>
Budgeted cost of work scheduled (BCWS) / Planned value (PV)	The sum of the budgeted cost of the task that needs to be done and the quantity of effort that has to be put in during a specific time frame	(Araszkievicz & Bochenek, 2019; Batselier & Vanhoucke,

Budgeted cost of work performed (BCWP) / earned value (EV)"	The budgeted cost for completed work which also should include the degree of effort or allotted effort activity that was done within a specified time frame	2017; Fleming & Koppelman, 2010; Kerzner, 2017; Vanhoucke, 2009; Wysocki, 2019)
Actual cost of work performed (ACWP) / Actual Cost (AC)	The amount reported as actually spent in doing the work within a specific time period	

Table 2-4 Performance and Progress Measures

<b>i. Variance</b>			
The distinction between the planned value and actual value of schedule and cost (Vanhoucke, 2009)			
<b>Indicator</b>	<b>Equation</b>	<b>Interpretation</b>	<b>Source</b>
Schedule Variance (SV)	$SV = EV - PV$	The discrepancy between the schedules for what was completed and what was anticipated	(Kerzner, 2017; PMI, 2023; Wysocki, 2019)
Cost Variance (SV)	$CV = EV - AC$	The discrepancy between the cost of what was completed and what was anticipated to cost	
<b>ii. Indices</b>			
Are measurements of how far a project is from the anticipated schedule and cost (Vanhoucke, 2009)			
<b>Indicator</b>	<b>Equation</b>	<b>Interpretation</b>	<b>Source</b>
Schedule Performance Index (SPI)	$SPI = \frac{EV}{PV}$	A timeline performance Index that gauges how closely the project is following the real timeline for completion of tasks	(Fleming & Koppelman, 2010; Kerzner, 2017; Vanhoucke, 2009; Wysocki, 2019)
Cost Performance Index (CPI)	$CPI = \frac{EV}{AC}$	Measures how close a project is to spending what was anticipated on the job completed	

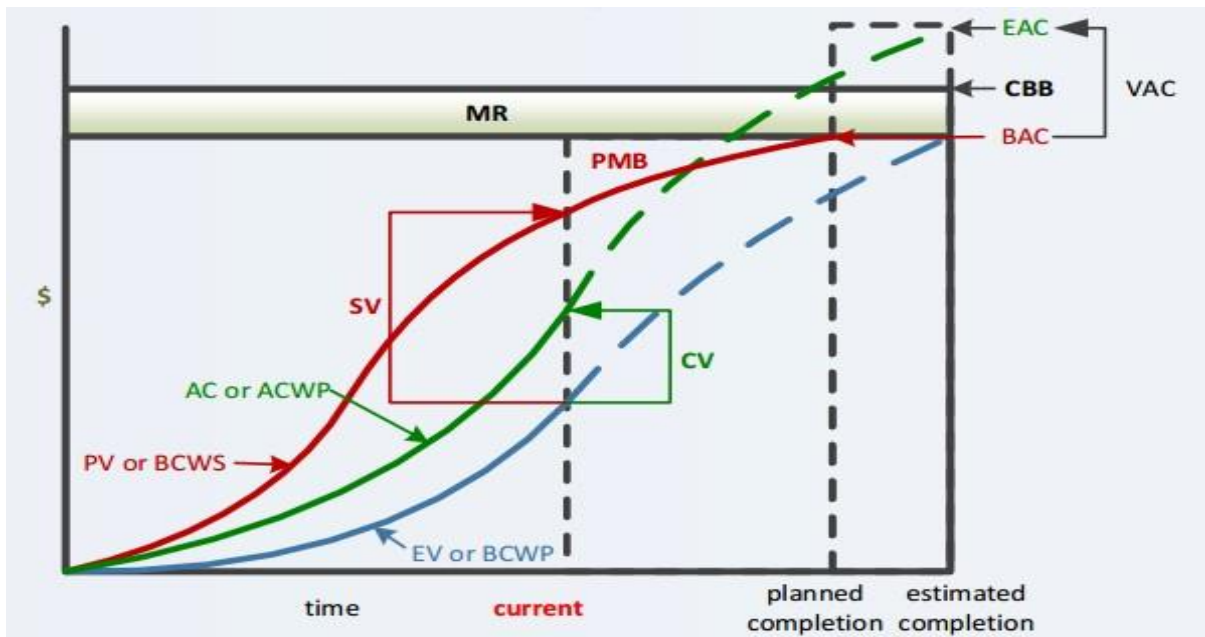
### iii. Forecasting

The estimation of duration and total cost it is going to take to complete a project at the current status date (Vanhoucke, 2009)

Indicator	Equation	Interpretation	Source
Budget at Completion (BAC)		BAC represents total budget at completion; at completion PV = BAC	(Huang et al., 2014; Kerzner, 2017; Wauters & Vanhoucke, 2015; Wysocki, 2019)
Estimate at Completion (EAC <sub>t</sub> )	$EAC_t = \frac{BAC/SPI}{BAC/months}$	The estimated completion time for the project if the work continues at the current rhythm	
Estimate to Complete (ETC)	ETC = BAC - EV	Cost to complete the project if all packages remain achieving the goals of time and cost, irrespective of what happened to EV	
Estimate at Completion (EAC)	EAC = AC + BAC - EV	Final cost of the project based in the original budget. The optimistic scenario assumes that all remaining work will be performed just with what remains on the initial budget	
Variation at Completion (VAC)	VAC = BAC - EAC	Cash balance at completion	
To-complete Performance Index (TCPI)	$TCPI = \frac{BAC - EV}{BAC - AC}$	CPI to recover cost variances from the moment EV and AC are evaluated up to project completion	

Figure 2-6 below presents the graphical illustration of the terminologies of EVM.

Figure 2-6 S-curve: Terminologies of EVM

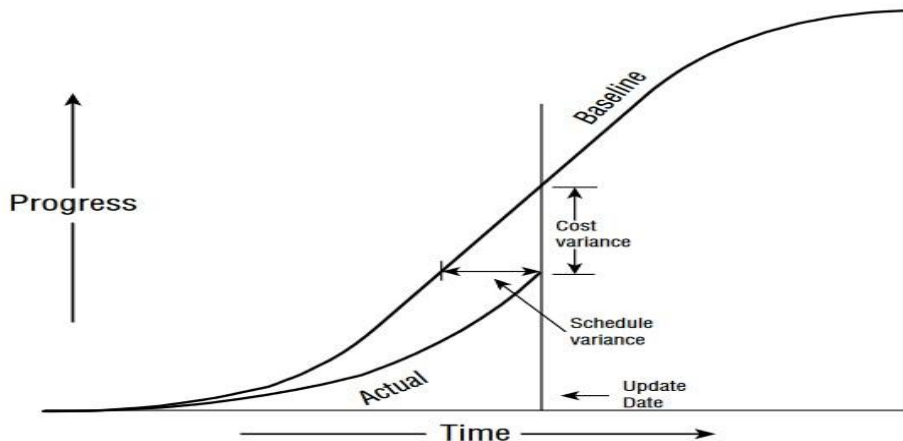


Source: *Earned Value Method (EVM) for Construction Projects: Current Application and Future Projections* (Proaño-Narváez et al., 2022)

### ***Project Baseline***

Baseline in project management is the starting point of the plan where the performance and progress of work packages is compared against. Because it is intuitive and relatively easy to equate each index to a baseline of 1, this type of analysis is typically preferred. Any value below 1 is undesirable, whereas any value above 1 is preferable. As shown in figure 2-7 the baseline progress curve for the first project plan is shown as a S curve reference point. In other words, it can be used to assess how well the project is progressing by comparing actual progress to date with the curve. Progress may be measured in terms of dollars or person hours/day. The difference between the actual progress made and the projected advance can be noticed by adding the actual progress curve to the baseline curve (Wysocki, 2019).

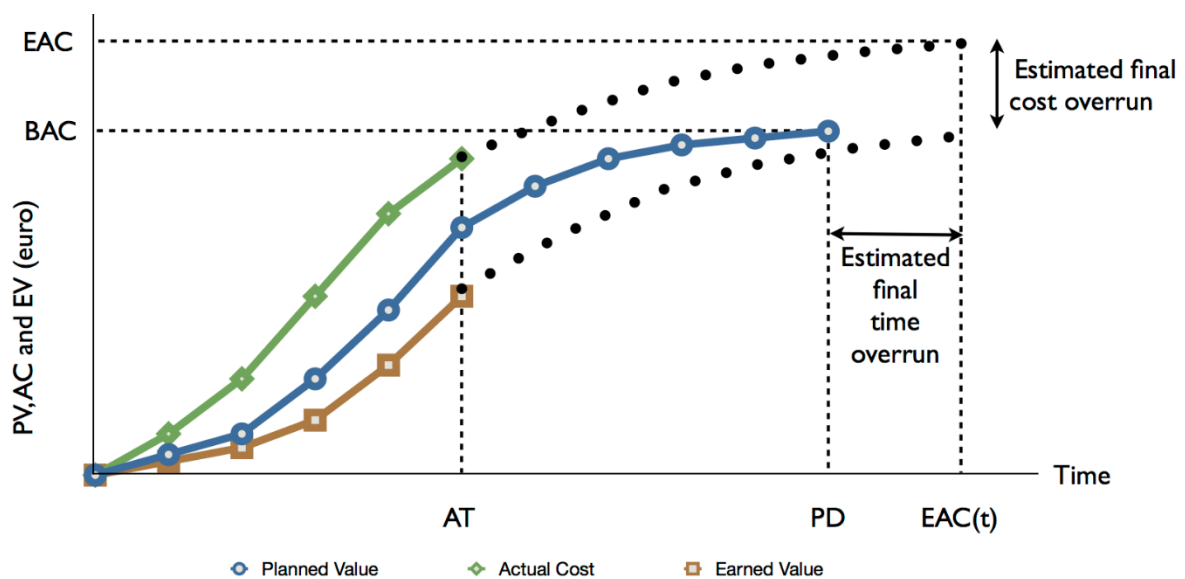
Figure 2-7 S-Curve: Baseline versus actual cost illustrating schedule variance



Source: *Effective Project Management: Traditional, Agile, Extreme, Hybrid* (Wysocki, 2019)

Figure 2-8 displays the three key metrics, Planned Value, Actual Cost and Earned Value of a project at a certain current moment in time AT. Since the EV and PV are equal at project's end, it is possible to predict when they will be equal by using the current EV (which indicates that the project is behind schedule). The EAC(t) predicts the overall project length in the figure, indicating that the project is anticipated to be delayed. The current real expenses are also more than the EV, indicating a budget overrun at this time. The EAC displays an anticipated final cost overrun because the AC is anticipated to increase at the same pace until the project is anticipated to be completed.

Figure 2-8 Metrics of indicators for EVM forecasting



Source: *Earned Value Management: An overview of project performance scenarios* (Vanhoucke, 2015)

### 2.1.2.2 Standard for Earned Value Management Systems

The National Defense Industrial Association's (NDIA) Integrated Program Management Division (IPMD) developed the standard for earned value management system to give information on how EVM is used. The manual can be used by the government or any other sector to document how an earned value management system complies with other systems and also adds more context to discussions of the EVMS process to make them easier to comprehend and put into practice. The EIA-748 Standard organize the 30 guidelines into five process categories. These guidelines are the activities a project management team should practice in order to claim the practice of earned value management system and analysis. The process categories and guidelines with brief description are presented in table 2-5.

*Table 2-5 EVM standard process categories and guidelines*

<b>A. Organization and Scope</b>		
<b>1</b>	Define Work Scope (WBS)	Define the authorized work elements for the program
<b>2</b>	Define Project Organization Structure (OBS)	Identify the program organizational structure
<b>3</b>	Integrate Processes	Integrate the company's planning, scheduling, budgeting, work authorization and cost accumulation processes with each other
<b>4</b>	Identify Overhead Management	Identify the company organization or function responsible for controlling overhead (indirect costs)
<b>5</b>	Integrate WBS/OBS to Create Control Accounts	Integrate the program work breakdown structure and the program organizational structure in a manner that permits cost and schedule performance measurement by elements of either or both structures as needed
<b>B. Planning, Scheduling, and Budgeting</b>		
<b>6</b>	Schedule with Network Logic	Schedule the authorized work in a manner which describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program
<b>7</b>	Set Measurement Indicators	Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress

<b>8</b>	Establish Budgets for Authorized Work	Establish and maintain a time-phased budget baseline, at the control account level, against which program performance can be measured
<b>9</b>	Budget by Cost Elements	Establish budgets for authorized work with identification of significant cost elements (labor, material, etc.) as needed for internal management and for control of subcontractors
<b>10</b>	Create Work Packages, Planning Packages	To the extent it is practicable to identify the authorized work in discrete work packages, establish budgets for this work in terms of dollars, hours, or other measurable units
<b>11</b>	Establish Overhead Budgets	Establish overhead budgets for each significant organizational component of the company for expenses which will become indirect costs
<b>12</b>	Identify Management Reserve and Undistributed Budget	Identify management reserves and undistributed budget

### **C. Accounting Considerations**

<b>13</b>	Record Direct Costs	Record direct costs in a manner consistent with the budgets in a formal system controlled by the general books of account
<b>14</b>	Summarize Direct Costs by WBS Elements	When a work breakdown structure is used, summarize direct costs from control accounts into the work breakdown structure without allocation of a single control account to two or more work breakdown structure elements
<b>15</b>	Summarize Direct Costs by OBS Elements	Summarize direct costs from the control accounts into the contractor's organizational elements without allocation of a single control account to two or more organizational elements
<b>16</b>	Record/Allocate Indirect Costs	Record all indirect costs which will be allocated to the program consistent with the overhead budgets
<b>17</b>	Identify Unit and Lot Costs	Identify unit costs, equivalent unit costs, or lot costs when needed
<b>18</b>	Track and Report Material Costs and Quantities	Full accountability of all material purchased for the project including the residual inventory

### **D. Analysis and Management Reports**

<b>19</b>	Calculate Schedule Variance	Comparison of the amount of planned budget and the amount of budget earned for work accomplished
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<b>20</b>	Calculate Cost Variance	Comparison of the amount of the budget earned and the actual (applied where appropriate) direct costs for the same work.
<b>21</b>	Identify Significant Variances for Analysis	Identify, at least monthly, the significant differences between both planned and actual schedule performance and planned and actual cost performance, and provide the reasons for the variances in the detail needed by program management
<b>22</b>	Analyze Indirect Cost Variances	Identify budgeted and applied (or actual) indirect costs at the level and frequency needed by management for effective control, along with the reasons for any significant variance
<b>23</b>	Summarize Variance Information for Management	Summarize the data elements and associated variances through the program organization and/or work breakdown structure
<b>24</b>	Implement Corrective Actions	Implement managerial action taken as the result of earned value information
<b>25</b>	Revise Estimate at Completion (EAC)	Develop revised estimates of cost at completion based on performance to date, commitment values for material, and estimates of future conditions

#### **E. Revisions and Data Maintenance**

<b>26</b>	Incorporate Changes in a Timely Manner	Incorporate authorized changes in a timely manner, recording the effects of such changes in the budgets and schedules
<b>27</b>	Reconcile Current to Prior Budgets	Reconcile current budgets to prior budgets in terms of changes to the authorized work and internal replanning in the detail needed by management for effective control
<b>28</b>	Control Retroactive Changes	Control retroactive changes to records pertaining to work performed that would change previously reported amounts for actual costs, earned value, or budgets
<b>29</b>	Prevent Unauthorized Revisions	Prevent revisions to the program budget except for authorized changes
<b>30</b>	Document PMB Changes	Document changes to the performance measurement baseline.

*Source: National Defense Industrial Association Integrated Program Management Division 2014*

### 2.1.2.3 EVM: An overview of project performance scenarios

A project's time and cost performance can be assessed by contrasting the three crucial EVM parameters. Two Time variance measures, SV and SV(t), as well as one Cost variance measure, CV, can be computed using these three metrics (Wauters & Vanhoucke, 2015). Nine alternative scenarios for project performance are available given the two dimensions (time and cost) and their potential variances (zero, positive, or negative). There are four scenarios left after excluding the "on time" and/or "on budget" scenarios as shown in figure 2-9.

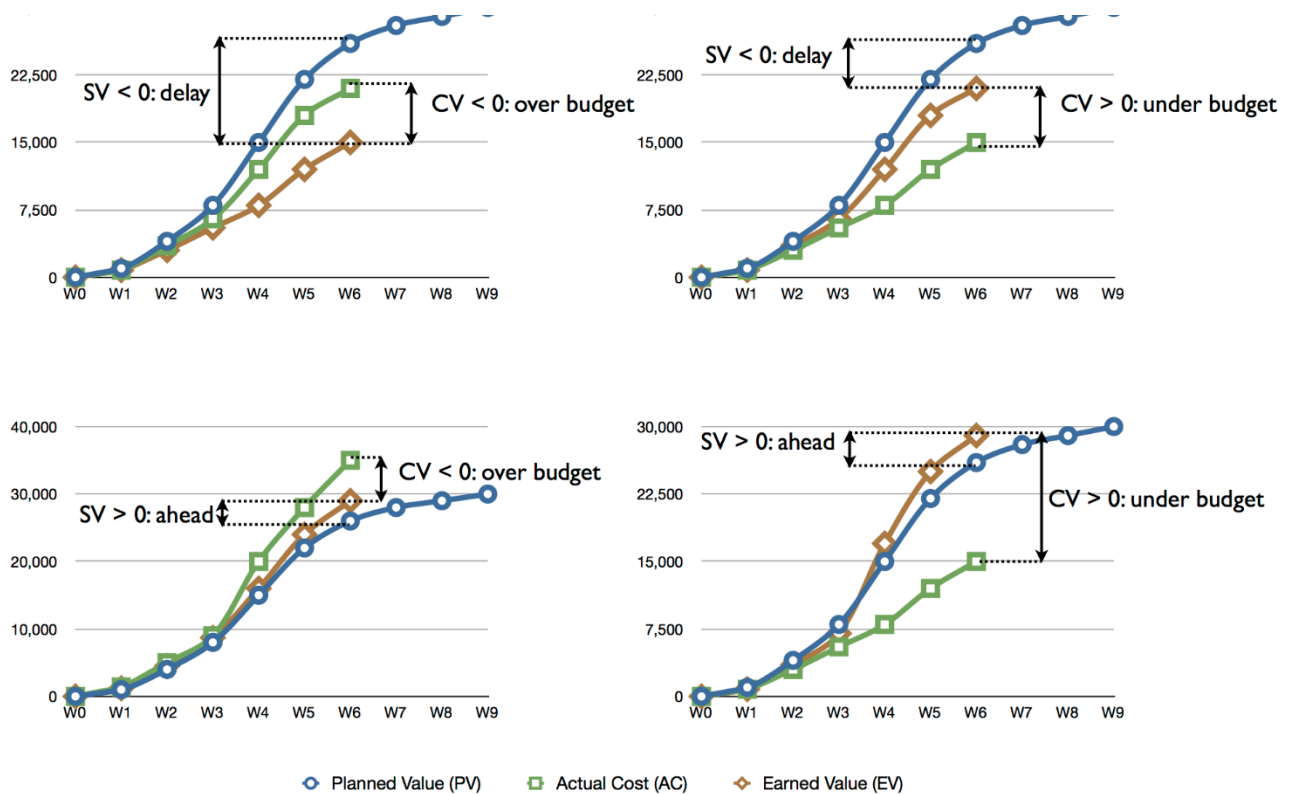
Scenario 1: late project, over budget

Scenario 2: late project, under budget

Scenario 3: early project, over budget

Scenario 4: early project, under budget

Figure 2-9 EVM: Project performance scenarios



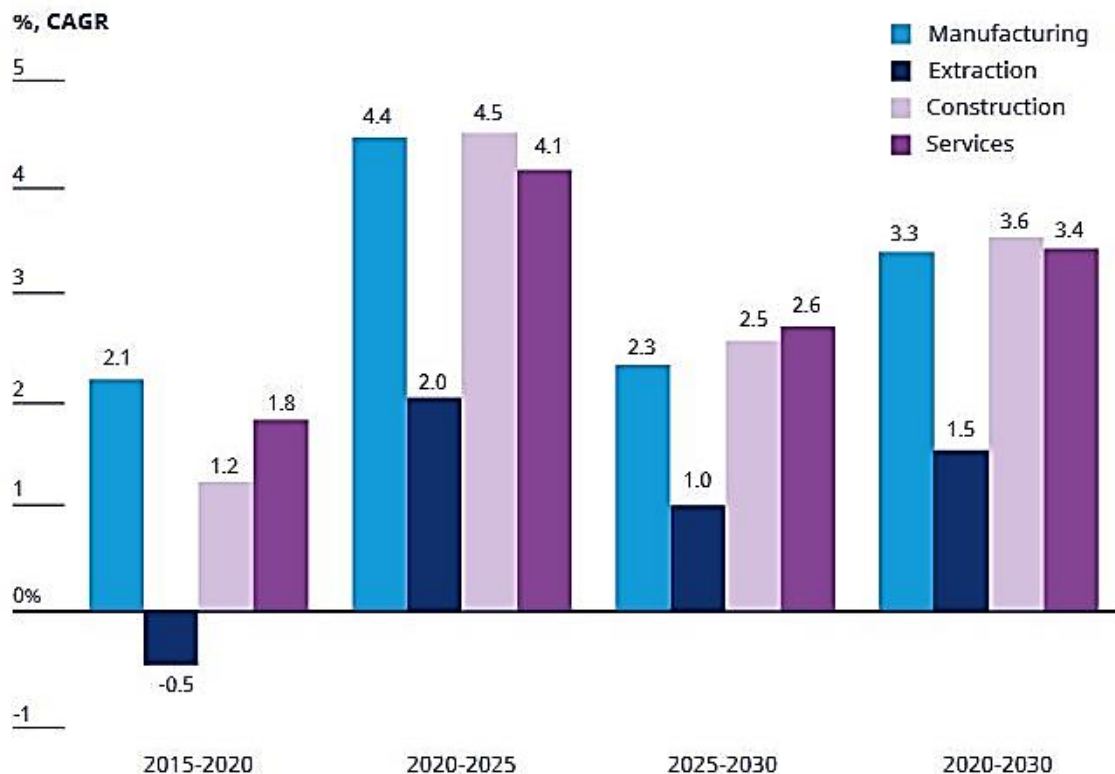
Source: *Earned Value Management: An overview of project performance scenarios* (Vanhoucke, 2015)

## 2.1.3 The Construction Industry

### 2.1.3.1 Overview of the Construction Industry

Regardless of their level of economic growth, almost all countries in the globe, according to The Economy Watch (2023), have a significant construction sector. Over the medium term, construction will be a key driver of economic growth, with growth of 4.4% on average between 2020 and 2025, outpacing that of both manufacturing and services. Construction output will continue to be a significant source of growth for the global economy between 2020 and 2030, averaging close to 3.5% annually. Figure 2-10 shows the global sector growth where construction will continue to grow faster than manufacturing and slower than services between 2025 and 2030 (Oxford Economics, 2021).

Figure 2-10 The global sector growth between 2015-2030



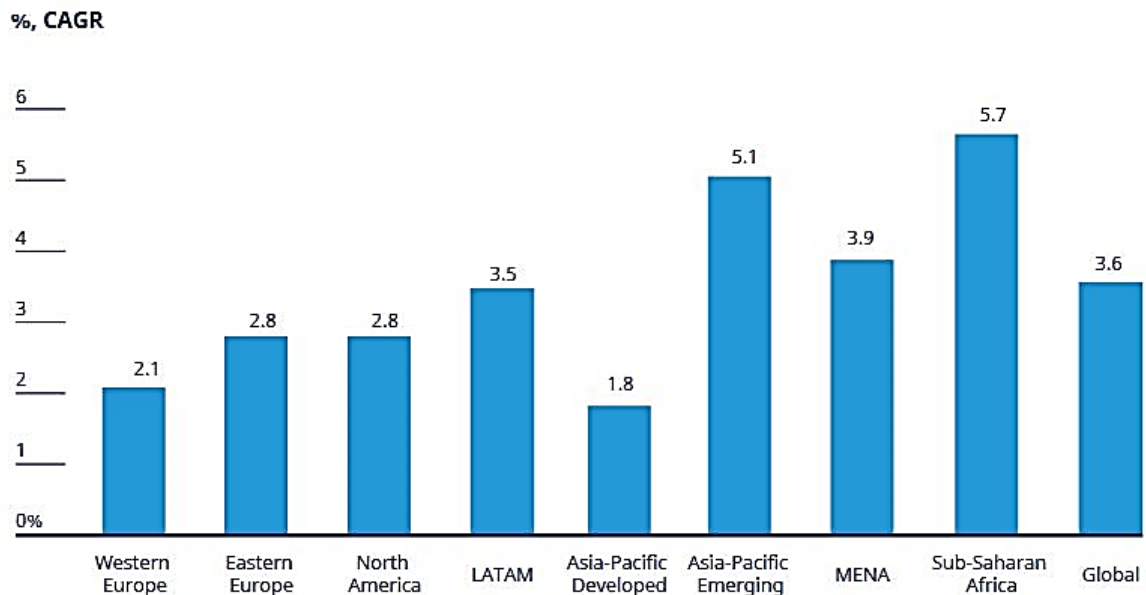
Source: *Global Construction Futures* (Oxford Economics, 2021)

According to The Economy Watch (2023), despite the COVID-19 pandemic, China's second half of 2020 showed solid growth of 1.3% year over year. This helped to support the global construction industry's recovery. In contrast to the building sector in Western Europe, which fell by 7% in 2020, the US construction market shrank by just 1.9%. With output decreases in construction of 14.1% and 14.4%, respectively, the UK and France did worse. In comparison to a contraction of 2.7% in 2009 during the global financial crisis, when there was a protracted

and far slower recovery, the worldwide construction production fell by 4.3% in 2020 (The World Bank, 2023).

The increase in construction output is anticipated to reach US\$1.75 trillion between 2020 and 2023. Beyond market recovery, additional support in the form of sizeable stimulus programs will support growth starting in 2022 (The World Bank, 2023). Emerging Asia will experience substantial construction growth through 2030, Western Europe will experience poor growth, Sub-Saharan Africa is predicted to experience the fastest regional growth - this is because East Africa and West Africa will see the strongest growth influences from population increase and rapid urbanization (Oxford Economics, 2021). The overall regional growth rate of the construction industry is shown in figure 2-11.

Figure 2-11 The overall regional growth rate of the construction industry, 2021-2030



Source: *Global Construction Futures* (Oxford Economics, 2021)

Up until 2030, South Africa would grow slowly, whereas the faster-growing sub-Saharan African nations of Uganda, Kenya, Ethiopia, and Nigeria will drive regional growth (The World Bank, 2023). The eastern portion of Africa continues to be the most potential region for construction (Statista, 2023). Ethiopian construction has experienced consistent double-digit growth over the past five years and is currently in a high growth phase. Much of the recent growth has been fueled by government spending on social housing programs, but over the anticipated period, the source of funding is anticipated to gradually shift to the private sector.

As the nation experiences a wave of new urbanization, there is tremendous opportunity for new homebuilding (Africa Union, 2023; Oxford Economics, 2021).

### ***2.1.3.2 EVM System for Construction Projects***

Project management has made a name for itself as an established, multi-disciplined profession that continues to expand thanks to its unique tools and management methods. These tried-and-true methods and technologies have been created expressly to help project managers keep track of and manage project activities at any given time (PMI, 2023). However, dealing with construction projects involves a number of variables that add to the already complicated process of completing these projects. Continuous demands are frequently made for a variety of occasionally conflicting objectives, such as time, cost, and quality control, health and safety, sustainability, and so forth (Sutrisna et al., 2020).

The construction industry has grown increasingly competitive in recent years as more and more contractors compete to stand out and complete their projects. Cost overruns and schedule delays, however, are ongoing issues in the construction sector that can have serious consequences (Picornell et al., 2017).

Variations in time and cost are a common issue in both developed and developing countries, according to assessments in the studies undertaken by (Alemayehu, 2018; Arega, 2018; Przywara & Rak, 2021; Sutrisna et al., 2020). As an example, a sample of 290 projects in India had an average cost rise of 73%. Additionally, about 40% of the projects reported performance issues. In Nigeria, cost overruns on projects ranged from 5% to 80% more than the initial cost estimate. In Colombia, more than 50% of projects ran over budget and more than 80% experienced delays of 30 to 80 days or more. It has been observed that many projects, even in industrialized nations like the United Kingdom with a variety of approaches and cutting-edge software for project control, nonetheless fall short of expectations in terms of time and cost.

From the discussion of the above-mentioned worldwide changing landscape, it appears that the Ethiopian construction sector has a genuine need to adapt its methods of operation and reposition itself in the cutthroat construction market. Improvements in the construction sector will have a significant positive impact on the Ethiopian economy (Africa Union, 2023). Although implementation has been slow and gradual, the idea of project management in general and the EVM in particular have reportedly gained recognition for their ability to manage and deliver construction projects (Alemayehu, 2018; Mulugeta, 2017).

Earned Value Management (EVM) has become a powerful tool in supporting project managers in dealing with turbulent, complex, uncertain, and dynamic situations. It is regarded as one of the major project management tools that embodies the most fundamental project management principles in use in the construction industry (Araszkievicz & Bochenek, 2019; Cândido et al., 2014; Picornell et al., 2017; Sutrisna et al., 2020).

In the past, physical progress and the associated expenses have been used to gauge progress in the building sector. To keep track of the physical and financial status of the estimated construction work under progress, Gantt charts are sufficient (Cândido et al., 2014). The Earned Value Management Technique (EVM) was a different development. In order to inform stakeholders and compel their response to avoid delays and cost overruns improve performance, EVM concentrates on measuring variances and indices; and estimating and forecasting the ultimate costs and project duration (Lester, 2021).

#### **2.1.4 Steps to successful EVM implementation**

In the literatures, different factors affecting the implementation of the EVM indicators were verified. Valle et al., (2004) conducted a case study and identified the factors: *“top level organization commitment with EVM; Education and training of the people in the project in EVM; Scope well defined, detailed and identified; proper WBS and work packages; Schedule and budget organized according to the WBS; Project Responsibility descriptions; flowchart of activities and relationship with the main participants; Cost/Schedule Control System with database and data collection procedures; Suitable reports related to EVM, well planned, analyzed and distributed; Procedures to consistency analysis and validation of information; and Lessons Learned - continuous improvement process”*.

A number of crucial success variables were also found by Kim et al. in their (2003) survey. The corporate executives' support, EVM training, organizational culture, and organizational maturity in project management were among the most important ones to be recognized. Vargas (2003) recognized the following as the three most important crucial aspects in a case study involving three construction companies: managerial support, planning team training, and specification of scope.

The party (owner or contractor) taking the greatest risks under any contract will naturally be the one with a greater interest in the best methods of project control; these risks heavily depend on the contractual payment methodology (Fleming & Koppelman, 2010; Gransberg et al., 2022). The most common contract payment approaches are cost-reimbursable, lump-sum, and

unit prices (Forbes & Ahmed, 2010; PMI, 2017). Table 2-6 presents the payment approaches and the party interested in the best methods of project control.

*Table 2-6 Construction Project payment approaches*

Approaches	Definition	Risk Taker	Controlling tools	
			Interest	
			Client	Contractor
<b>A</b> Cost Reimbursement	The client reimburses a contractor for all actual, legal expenses spent as well as an additional payment fee	Client	High	Low
<b>B</b> Lump-Sum or Fixed-Price	The client pays the contractor a predetermined amount regardless of the actual costs incurred	Contractor	Low	High
<b>C</b> Unit-Price	The client pays periodically to the contractor according to preset (contractual) unit rates that are applied to the actual measured quantities	Client Contractor	High	High

*Source: Implementation of Earned Value Management in Unit-Price Payment Contracts (Picornell et al., 2017)*

#### **2.1.4.1 Critical Factors of EVM**

From the above literatures and the review made by Morad & El-Sayegh (2018) to find the critical factors of EVM table 2-7 is derived. The table summarizes the critical factors to the implementation of EVM into eight variables and their reference is also listed.

Table 2-7 Critical Factors of EVM

No	Factors	Reference
1	Lack of Organizational Resources – Expertise, Cost, Time	Webb, 2003; Lukas, 2008; Storm, 2008; Vargas, 2003
2	Organization culture to implement control tools	Storm, 2008; Webb, 2003; Janagan, 2009; Vargas, 2003;
3	Project Scope Definition	Fleming and Kopperlman, 2009; Webb, 2003; Lukas, 2008; Janagan, 2009; Vargas, 2003
4	Organization’s Project control Policy and intensive Procedures – Plan, Report, Paper Work	Webb, 2003; Lukas, 2008; Vargas, 2003; Janagan, 2009; Fleming and Kopperlman, 2009
5	Difficulty in calculating progress	Webb, 2003; Lukas, 2008; Janagan, 2009
6	Lack of top management support	Webb, 2003; Lukas, 2008; Janagan, 2009; Vargas, 2003
7	High implementation cost	Webb, 2003; Janagan, 2009; Vargas, 2003
8	Project payment methodology	Fleming & Koppelman, 2010; Gransberg et al., 2022

Source: Reviewed Literatures

## 2.1.5 Role of EVM in Project Success

### 2.1.5.1 Project Success

A never-ending stream of project successes is what project management is ultimately meant to achieve. This is possible as long as each initiative has a clear definition of what "success" means. Customers and contractors have been working toward various definitions of success for years. The customer was more focused on the quality of the deliverables than the contractor, who saw revenues as the only determinant of success. All of it started to alter as project management developed (Kerzner, 2022).

"Success Is Measured by the Triple Constraints" (PMI, 2004). The only criteria utilized to determine project performance were the three constraints (Prabhakar, 2009). The three sides of this triangle, as shown in figure 2-12, represents time, money, and performance (which could

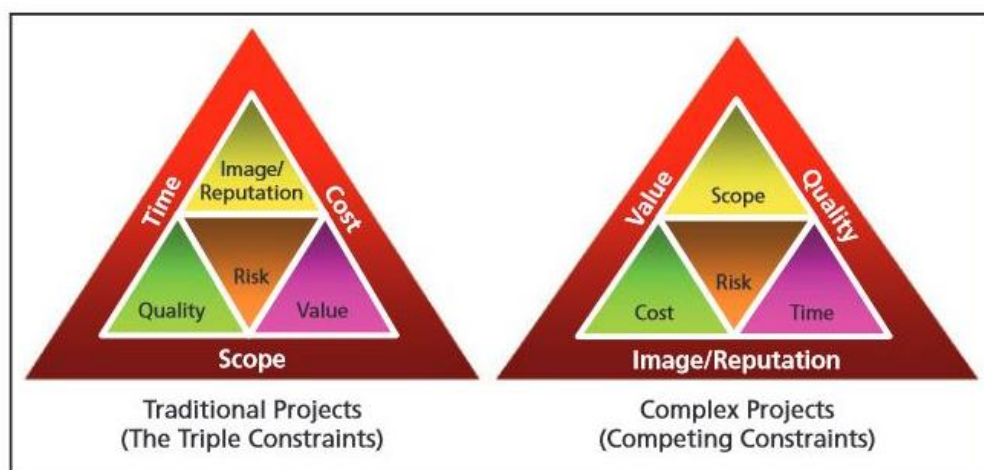
also include quality, scope, and technical performance. During the early stages of project management, this served as the foundation for defining success.

Sadly, even if all of the deliverables are finished on schedule and within budget, the project may still be a failure for such reasons as: if there is no market demand for the goods or services produced; the goods and services created did not meet the needs of the customers; the goods and services seemed to meet the needs of the customers but the customers were dissatisfied with the performance of the deliverables; the benefits outlined in the business case were not realized; and the financial value of the project was not as expected (Herath & Chong, 2021).

The customer must be happy with the finished product in order for project management to be successful (Wysocki, 2019). Even if a contractor meets the triple constraints, the customer may still be dissatisfied with the project's outcome. Both clients and contractors have the ability to start a variety of scope adjustments. Due to these modifications, time and cost were the only two criteria applied to projects. However, post project business, which was a byproduct of customer satisfaction, was used to measure success (Kerzner, 2022).

The management of construction resources can be challenging. However, with the right resource management techniques, productivity can be increased and resource disputes can be avoided. Construction resource management involves strategically allocating resources to the project while taking into account important variables like time and money (Kerzner, 2022). The outcome of this strategy is project success.

*Figure 2-12 Triple constraints of success factors versus competing constraints*



*Source: Project Management Metrics, KPIs, and Dashboards: A Guide to Measuring and Monitoring Project Performance (Kerzner, 2022)*

### 2.1.5.2 Role of EVM

A thorough study by Fleming and Koppelman (2010) found that after you're 20% into a project, you can use your current performance to estimate the project's future with a plus or minus 10% variation. EVM is one of the strongest project cost control measures accessible because of its strong predictive capability. EVM provides information for proactive management action, links technical, time, and cost performance, and gives managers a summary of successful decision-making. It also aids in providing the basis for evaluating work progress against a baseline plan.

EVM offers more data than standard project tracking does. By responding to the query "*Have we reached where we want to be in the project?*" it goes one step further and "*When will this project be completed?*" it makes it easier to pinpoint the current position in the project and determine when it will be successfully completed.

In order to respond to problems early on and keep the project on schedule, the value-added strategy helps create greater visibility and control over the project operations. It promotes project visibility and accountability and enables clear communication of the tasks involved. Table 2-8 summarizes the role of EVM to bring projects to success.

Table 2-8 Role of EVM

No	Role	Description
1	Realistic Project Planning	Defining the project baseline, including the timeline, budget, and scope, is necessary before integrating EVM into the planning process. This baseline can be used as a benchmark by managers to gauge how well a project is performing over time. EVM offers a clear picture of where your project is now compared to where it ought to have been according to plan. Additionally, it displays the actual work done in comparison to the planned timeline. In order to enable project managers, assess if the original plan was feasible and take proactive action, EVM offers actionable insights.
2	Gain real-time visibility of centralized information	The project manager needs whole enterprise visibility to monitor project performance in real time. Managers can track performance metrics using effective management tools with the aid of EVM. It incorporates schedules and budget into the system and offers actionable insights on reporting and analytics using Gantt charts. Therefore, earned

- 
- value management aids in measuring development at each stage and milestone. Once project execution has started, EVM also assists in highlighting our errors based on task dependence priorities.
- 3** Measure schedule and budget accuracies

Throughout the course of a project, unanticipated events can happen at any time. Project scope modifications, client priorities, and unexpected hurdles are all possible. As a result, the project plan may differ from the schedule and budget. Every milestone should be measured to help limit losses. Taking preventative actions to reduce the variation level to zero is maintained through EVM.
  - 4** Anticipate risks and intervene early

Project stakeholders are informed of issue areas that could endanger the project throughout its life cycle as part of the EVM process. Additionally, it aids in preventing the recurrence of issues that obstruct advancement. When issues arise, earned value management assists in identifying them. It also makes it possible to foresee dangers related to the project's budget and schedule. In light of this, managers can step in and take proactive measures before experiencing any setbacks.
  - 5** Enhances accountability and motivation

Earned value analysis helps project managers respond to problems sooner because it gives them more visibility into and control over the activities involved. Employees are required to track their time as part of EVM and report their improvement in comparison to the baseline. It pushes those who are lagging to step up the pace and match their coworkers' productivity, and it inspires top performers to continue putting in the extra effort.

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*Source: Critical factors and Benefits in the use of Earned Value Management in construction (Netto et al., 2020)*

## 2.2 Empirical Review

Numerous studies on project control and its components in relation to project success have been done. According to Y.-W. Kim and Ballard (2010), EVM is not well matched to the variability and uncertainty of some projects, such as those in the construction industry. Picornell et al., (2017) noted the difficulties in combining EVM with unit-price approaches but did not offer any specific advice. Xu (2009) adopted the conventional formulation in partial applications of EVM to unit-price contracts, but failed to account for the contractor's need to control production independently of costs.

According to Sunarti et al., (2018), 52% of respondents utilized EVM in their projects; of these, 6% used it for minor projects, 28% used it for important and crucial activities, and 18% used EVM as an organizational standard for all project control types. On the other hand, just 48% of respondents didn't use EVM in their projects. The study by E. Kim et al., (2003) looked into how managers and directors of building projects in the public and commercial sectors around the world responded to the EVM application. They discovered that 82% of respondents approved the use of EVM, with 52% belonging to the public sector. The majority of them believed that both big and small projects can benefit from EVM.

In order to understand how public project managers in Colombia perceive and use EVM as a performance evaluation system and to assess the effects of its use on project success, Proaño-Narváez et al., (2022) reviewed a survey of public project managers in the region of Latin America. The findings showed that just roughly 33% of EVMs were used; progress reports and other conventional ideas were more popular. Because they hadn't established control procedures, about 19% of managers didn't use any performance measurement systems in many instances. Respondents to the literature review by Sunarti et al., (2018) identified three major obstacles to deploying EVM: Lack of expertise and experience was identified by 14% of respondents, while top management support and motivation were cited by 12% and 11% found EVM challenging to implement due to the tedious process of data collection.

Mahmoudi et al., (2021) discussed the restrictions on the usage of EVM, including the high implementation costs, the assessment of the percentage completion on-site, the potential restrictions posed by the contract type, and the difficulty in collecting integrated data on time and cost. This shows that the technique's widespread adoption as a project management tool for construction is constrained by the lack of familiarity with it. The study by Netto et al.,

(2020) recommended educating project participants, defining work rules, and using software for data capture as solutions to overcome obstacles to the deployment of EVM.

B. C. Kim and Reinschmidt (2011) stated that discipline in data collection and information management in terms of costs and duration is required for the application of the method to be effective. However, this implies an increase in operating costs over the contracted amount, but this is offset by the benefits that result.

In a study by Skaik & El-Hawary (2014), three construction projects in the United Arab Emirates were subjected to EVM. They discovered that cost analysis had good outcomes for situations in which EVM was employed from the start and at 45% of progress at three stages of the life cycle. However, some delays allowed for corrective actions for issues relating to physical progress; in addition, reviewing the project's status after completion added value to the project and the management of the company.

A case study by Valle et al., (2004) revealed that the use of EVM had a significant impact on cost control for the project, which was completed on schedule and within budget. Three factors that contributed to its success were emphasized: a proper work breakdown structure by packages that is consistent with a chart of accounts, attention to performance indexes to discuss changes and bargain with suppliers, and a proper debugging of the data that feeds the analysis.

The success of the method during the project, despite the alerts provided by the performance indicators, depended primarily on the decisions of the project directors or managers to implement timely measures and maintain the project's cost and schedule, according to López et al., (2019) application of EVM to a building project in Colombia.

The study by Rezouki & Mortadha (2020) revealed how construction experts view the variables that affect the implementation of EVM; these variables are connected to a project's development and have a big impact on it. The value of the supplied product, risk associated with project execution, safety, and even the social environment are all taken into account in this technique, which also evaluates costs and timelines. This component needs to be handled carefully because making decisions on time will depend on the project manager's financial resources at any given time.

In a similar case, According to Aramali et al., (2021), the EVM approach can be a useful management tool for overseeing a project. However, putting this methodology into practice can be very dependent on a number of variables; among experts, having an organizational

culture that promotes the active participation of project stakeholders is thought to be the most important component. Implementing an efficient EVM methodology can help processes like planning, scheduling, and change control by generating early warnings for potential cost deviations or delays.

In contrast to other authors, Nizam et al., (2020) came to the conclusion that using EVM as a project management tool is ineffective since there is a significant discrepancy between the efforts made to adopt it and what is actually accomplished. Conclusions indicate that the project type and the project team members' cautious choice of the measurement baseline affect the utility of the tool. It is compared to other projects to ascertain cost and schedule variances, which makes it extremely sensitive to evaluation criteria.

Studies, not many, were conducted in Ethiopia regarding the practice of project control system and the tools and techniques implemented. (Abebe, 2018) assessed the effect of project change control on the success of the project and concluded that the overall project Monitoring and Controlling process groups have strong impact on project success and even though there is good project monitoring and controlling practice, there is weak project change control process practiced. Recommendation suggests that organizations must focus on project monitoring and controlling practice especially on the project progress follow up and project change control area as they have significant impact on the project success.

(Alemayehu, 2018) assessed the current construction controlling tools and techniques implemented by grade one contractors with respect to the tools and techniques described in PMBOK. The findings of this study show that there is lack of usage of different construction controlling tools and techniques especially EVM, but among practiced project management software is used more often. The researcher recommends that the contractors to practice different controlling techniques that best fit their construction projects.

(Betru, 2021) has identified the effect of project Cost Management on Project Success and concluded that a positive and statistically significant effect does exist between the Project Cost Management processes and Project Success. Similarly, (Nega, 2020) identified the practice and effect of controlling practice for the success of projects and concluded that the controlling practice is weak even though project control has high significance for the success of projects.

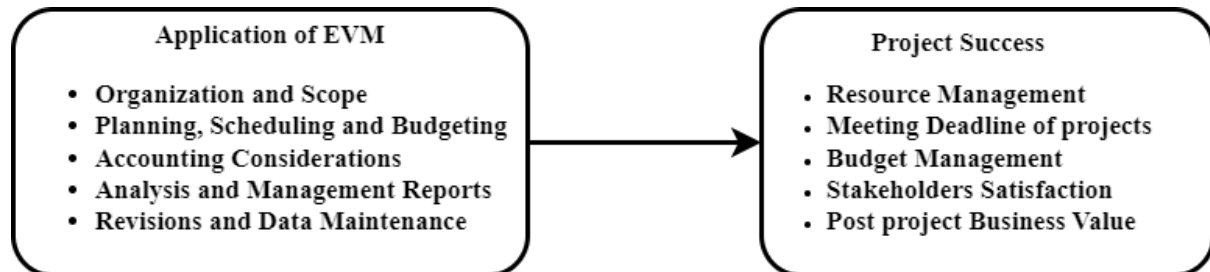
(Mulugeta, 2017) demonstrated the practice of EVM and computed project variance, efficiency and forecast indicators and compared the effectiveness of EVM approach against the traditional

method. The author suggested that the construction company can enhance the performance of projects by practicing EVM.

The studies conducted in Addis Ababa are mostly of the practice of project monitoring and controlling. The current project control systems and practices solely, the factors affecting the implementation of earned value management at project control mechanism and the application of earned value management to influence project success were not assessed. This scarcity of contributions highlights the room for research in this topic.

### 2.3 Conceptual Framework

The following conceptual framework illustrating the relationship between the dependent variable and independent variables is proposed based on the literatures reviewed.



*Source: Earned Value Analysis, Implementation Barriers, And Maturity Level in Oil & Gas Production (Zhan et al. 2019)*

# Chapter Three

## 3 Research Methodology

Through the use of scientific methods, research aims to find answers to open/close-ended questions. Finding the truth that is concealed and undiscovered as of yet is the major goal of research studies. Discussions on the research methodology used to carry out the study are the focus of this chapter. Besides the research design, the independent and dependent variables are identified. This chapter also defines and explains the types of data and their sources used to carry out the study. Additionally, the study's target audience, the sampling strategy used, and how the sample size was decided upon using the number of samples are all described. The data gathering instrument, the variables' measurement parameters, and the data analysis method are also discussed. Validity and reliability tests are also reflected to check for quality of the information gathered and the methods used to gather this information.

### 3.1 Research Design

#### *Purpose*

The crucial stage in planning a research study is conceptualizing the purpose of the research. A research design's primary purpose is to describe how the research topic will be answered (Kothari, 2004). The choice of a suitable study design is essential for any investigation in order to reach reliable results and conclusions. An investigation's logical framework is its research design. The specified research topic or hypothesis, as well as the kind of evidence needed to convincingly address the issue or test the theory, make up the essence of the research design. Because it helps ensure that multiple research processes run well, research design is crucial.

There are numerous research design methods accessible (Deb et al., 2019; Dubey & Kothari, 2022; Kothari, 2004). The first design is exploratory research design, which is used to analyze a problem situation, evaluate alternatives, and discover new ideas. The second design is called descriptive research design, and it focuses on people, groups, institutions, procedures, and materials in order to describe, contrast, categorize, and interpret the things that have happened in different domains of inquiry. It is also a study that qualifies as formal research because its goals are well defined. In this type of design, a researcher obtains information regarding every facet of a problematic scenario which can help understand a topic and lead to causal analysis;

The third sort of design is inferential research design, which identifies the correlation and/or cause-and-effect connection between variables under the hypothesis testing research studies. It is the process of figuring out how one variable is related to or affects the changes in another variable that follow.

When starting a research process, it is crucial for the researcher to choose a specific research design for carrying out the investigation. The purpose of this particular study is to describe and correlate variables where procedures, and tools are used in order to explain, contrast, categorize, identify frequency of happening, rank and interpret the things that have happened within different domains and create linear relationship among variables.

The two research methods (descriptive and correlation) are ideal for determining characteristics, frequencies, trends, and categories as well as understanding how various groups relate to a given tools and techniques (role EVM and project success for this study). The goal of this study is observing and measuring without manipulating variables, which make descriptive and correlation research method supreme.

### ***Empirical and Time Scope***

Researchers employ two study methodologies when conducting research: case studies and surveys. In a case study, a person, a group, or a particular situation is investigated. In contrast, in a survey, data is collected from a relatively wide sample of the population or the entire population in order to comprehend opinions on a certain topic (Marczyk et al., 2005). This study is a case study with surveying instruments since it aims to describe the EVM system and practice in a specific construction company.

On the basis of how frequently they are distributed, surveying instruments can be categorized into three basic types. An observational research technique known as a cross-sectional survey examines data on variables that were gathered at one specific moment across a sample population or a pre-defined subgroup. Surveys that assist researchers make an observation and gather data over a long period of time are known as longitudinal surveys. Researchers might also use the third type of survey, retrospective surveys, to acquire information on past experiences and beliefs of people by asking respondents to describe prior events.

It is critical that the researcher comprehends what the respondent is feeling at a specific point in time in order to systematically respond to the research questions of this study. Therefore, cross-sectional surveys are used to measure opinions in a particular situation.

## *Approach*

Any new knowledge is found through the process of research. Research enables us to put this new knowledge into a coherent body, a collection of concepts that explain past events and forecast future ones. There is a process that must be followed when conducting research. The precise procedures and sequencing depend somewhat on the type of inquiry. Depending on whether a study uses a quantitative or qualitative method, the steps change slightly. While qualitative research is focused on attributes of the subjective evaluation of characteristics, reasons, opinions, wishes, preferences, behavior, etc., quantitative research is based on the measurement or quantification of variables of the phenomenon under study (Dubey & Kothari, 2022).

The research questions are loomed through quantitative approach. This is due to the goal to determine and predict the relationship between variables within a population, and to focus on numeric and unchanging data by adopting convergent reasoning to generate variety of ideas about the research problems in a spontaneous and free-flowing manner.

The research questions are also assessed through qualitative approach. This is due to the eager to create a brainstorming session and embark on solving the problem of project control system practice. Another rationale for the using qualitative approach is the issue of deliberate falsification, in which respondents willfully fake the answers to personal and delicate questions. Therefore, it becomes challenging to get into the respondent's subconscious thought in order to gather factual data unless this approach is used. Thus, the study has employed mixed-type of research approach.

### **3.2 Description of Variables**

In scientific studies, a researcher must first identify a set of variables, which must include an outcome of interest, before surveying to explain, explore, formulate theories or test for potential relationships between these variables. The variables being tested for an association are the independent variables, while the outcome is referred to as the dependent variable (Project success for this study) in case of correlational studies (Marczyk et al., 2005).

- **Project Schedule Control** - The availability and practice of schedule control system is measured through the aggregate frequency of adopting tasks such as: determining the project schedule's current status, handling the variables that affect project schedule, reevaluating the need for schedule reserves, determining whether the project schedule has changed, and managing the actual schedule changes as they happen

- **Project Cost Control** - The availability and practice of cost control system is measured through the aggregate frequency of adopting tasks such as: handling the variables that result in changes, handling cost change request, coordinating the real changes as they happen, ensuring that project costs are not incurred in excess, tracking cost performance, comparing labor performance to the amount of money spent, preventing unauthorized changes from being accounted, notifying the proper parties of all approved changes, and bringing anticipated cost overruns under control.
- **Factors affecting the implementation of EVM** - This variable is measured through the significance of organizational resources, organizational culture, project scope definition, organization's project control policy and procedures, measuring the current progress of projects, commitment of top management, cost required for implement, and project payment methods adopted in order to practice EVM.
- **EVM Application** - This variable is measured through the frequency of implementing the following variables: defining organization and scope, planning, scheduling, and budgeting, accounting considerations, analysis and management reports and revisions and data maintenance.
- **Role of EVM** - This variable is measured through the significance of other five variables which promote projects to success. The five variables are: realistic project planning, gaining real-time visibility of centralized information, measuring schedule and budget accuracies, anticipating risks and intervene early, and enhancing accountability and motivation.
- **Project Success** - This variable is measured through success factors of projects. These factors include: effective resource management, meeting deadline of projects, effective budget management, stakeholders' satisfaction, and creating post project business value.

### 3.3 Description Of Study Area and Target Population

By determining the target population of the study and the samples, a researcher must execute a systematic sampling in order to provide relevant and trustworthy data and make conclusions. The entire number of things for which information is sought is referred to as the population. As opposed to sampling, which is the process of selecting a subset of the universe from which a generalization or assessment of the population is made. The sample must be accurately and

completely reflective of the characteristics of the population (Dubey & Kothari, 2022; Kothari, 2004).

Lack of proper project control system is an ongoing issue in the construction sector with serious consequences. These issues should be identified, understood and solved. The study area chosen in order to come across this issue is an organization called RAMA construction PLC. which is a grade one construction company located in Addis Ababa, Ethiopia.

The researcher was also able to determine target population by looking into employees of the organization who have a close relationship with the study's focus point, the project control system - EVM. Senior managers, entire project management staff, construction/office engineers, and other functional managers and their team who have at least graduating level of educational background are the target population of the study accounting for a total number of 204. These individuals and groups are the ones responsible to gather and record data and information in order to understand the status of the project by computing the indicators of EVM.

### **3.4 Sampling technique/methods and sample size**

#### **3.4.1 Sampling Method**

Sampling is the practice of learning information about a population as a whole by looking at just a small portion of it (Dubey & Kothari, 2022). The authors also claimed that the typical strategy in the majority of research projects and surveys is to generalize about or draw conclusions about the characteristics of the population from which the samples are gathered.

In this study the sample will be chosen from the target population using a non-random sampling method called purposive sampling. This is because purposive sampling is considered more appropriate when the population happens to be small and a known characteristic of it is to be studied intensively. The researcher wanted to choose cases that are very instructive and identify significant people and thoroughly gather information from them which also make purposive sampling method more appropriate. Participants that are representative of the population were chosen using expert judgment and knowledge (past experience) of jobs within the construction industry.

#### **3.4.2 Sample Size**

The number of items to be chosen from the entire universe to make up a sample is referred to as the sampling size. An optimal sample that satisfies the criteria for effectiveness,

representativeness, dependability, and flexibility is chosen. As a general guideline, it may be said that the sample ought to be of an ideal size, meaning that it shouldn't be either too big or too little (Dubey & Kothari, 2022). Technically, the sample size must be sufficient to provide a confidence interval with the specified width; as a result, the sample size must be determined by some logical process prior to the collection of the sample from the universe.

By using a non-random sampling method called purposive sampling 80 participants were chosen using expert judgment, knowledge (past experience) and the structure of the organization in accordance with the educational background and staff skill. Managing director, planning and programming team and coordinator, evaluation and control team and coordinator, road projects team and coordinator, building projects team and coordinator, resource management team and head, maintenance management team and, finance manager and human resource manager are the participants chosen based on the selected sampling method.

### **3.5 Data Collection – Source, Types, Instruments**

Both primary and secondary data were used as the sources of data for this investigation. The researcher used secondary data to define the research topic, define research questions, and generate new ideas that can then be verified by primary research. Secondary data is also used as a benchmark for evaluating the validity and accuracy of the source data. The sources of secondary data include articles, websites, trade associations, journals and books. In order to be thorough and prevent data shortage, primary data are gathered directly from respondents by adopting a survey research method like interviews and questionnaires.

For this research, both quantitative and qualitative data were collected. For quantitative surveys, closed-ended or multiple-choice questions are utilized. In contrast, qualitative surveys use open-ended interview questions that are verbally answered to by a respondent. The study combines complementing quantitative and qualitative methodologies to produce comprehensive and in-depth findings. Simply expressed, quantitative data are utilized to gather the facts necessary to support the research's major general conclusions. Qualitative data provided the depth and specifics needed to fully comprehend their implications.

Questionnaires and interviews were employed as the data collecting instruments, or tools and methods, to obtain and record information for the study project. It might be challenging to create instruments for data collecting that are both clear and consistent. As a result, using the research objectives and questions, the measuring instrument is evaluated for validity and reliability.

The information acquired directly through questionnaire to address the research topic under consideration is gathered through closed-ended questions. A structured interview was served to the head of planning and monitoring department to understand the philosophy of schedule and cost control and the policies and system of EVM the organization adopts in order to fill the gap of data that was not covered by the designed questionnaire.

The practice of project schedule and cost control, evaluation of factors affecting EVM, Application of EVM and the role of EVM in project success are the four objectives of the questionnaire that was distributed to the respondents. A five scale Likert scale is employed in the questionnaire to evaluate the respondents' expressed attitudes.

The questionnaire that was sent through google form and hardcopy to the respondents is divided into two sections: Section one is deemed to collect the demographic characteristics of the target population i.e., the age, sex, level of education, work experience and company position. Meanwhile the second section is divided into four sub sections that are composed of ten constructs. Among the ten constructs, the practice of project schedule and cost control, evaluation of factors affecting EVM, application of EVM and the role of EVM in project success are measured through two, one, five and two constructs, respectively.

The practice of EVM falls under the first sub section. The goal of this sub category is to measure the thirty guidelines of the fundamentals of EVM against frequency of practice - which ones are utilized within the organization and which are not. Determining how often the thirty guidelines are conducted is the measure of the existing practice (discipline and intensity) of EVM.

The role of EVM in project success make up the third group. The relationship between the role of EVM and project success by securing efficient resource allocation, meeting project deadlines, allocating planned budgets, achieving stakeholder satisfaction, and generating post-project business value is contrived.

The factors impacting EVM make up the fourth group in section two. The questionnaire is used to evaluate and contrast the eight most typical criteria found in the examined literatures based on respondents' perceptions of their influence on the use of EVM. Additionally, respondents are questioned about any other elements that they believe may affect how the EVM is applied.

### **3.6 Data Analysis – Software, Model, Techniques**

Once the data was gathered the first step that will be conducted is processing operation. The first operation is editing of the data. Examining the acquired raw data to find errors and omissions and correcting them when necessary is the process of editing data. In actuality, editing entails a close examination of the completed questionnaires. Editing is done to make sure the data are correct, compatible with other information acquired, uniformly input, as thorough as feasible, and well-arranged to make coding and tabulation easier.

Coding is the second operation which is the process of labeling replies with numbers or other symbols so that they can be classified into a finite number of categories or classes. These classes ought to be pertinent to the study issue at hand. They must also have the qualities of mutual exclusivity, which states that a certain response can only be entered in one and the same cell in a given category set, as well as exhaustiveness (there must be a class for each data item).

The third and the final operation is tabulation. Tabulation is the process of condensing raw data for further analysis and presenting it in a concise format (i.e., in the form of statistical tables). Tabulation, in a wide sense, is the systematic grouping of data into columns and rows.

The survey results are examined using the Statistical Package for Social Sciences (SPSS) version 27. Descriptive statistics are used to characterize the fundamental properties of the data in a study, while Pearson Product Correlation is used to examine the linear one-to-one relationship between the variables. The data is evaluated to see if it complies with the correlation model's presumptions or not. There are summaries of the sample and the measurements. Along with simple tabular analysis, they form the basis for practically all quantitative data analysis. In order to address the issues raised by the analyses' conclusions, interpretations and any pertinent remarks are offered. The main findings of the study are presented in the end, along with a suggestion based on the data analyzed.

### **3.7 Validity and Reliability**

The process of developing surveys must include pre-testing the questionnaires (Dubey & Kothari, 2022). The data from the poll of testimonies is more reliable and authentic thanks to pretesting. Pretesting surveys should focus on how people are responding to the questions because respondents may go through a variety of diverse processes when they answer the questions. The researcher should also make sure that respondents are answering and interpreting questions in accordance with the study's goals. Through pretesting, the researcher will be able to determine whether respondents understand the questions, possess the relevant

abilities or knowledge, and are capable of completing the tasks. For the majority of items, pre-tests provide the most glaring evidence of the validity of questionnaire data.

Pretesting and Main study are the steps of data collection (Marczyk et al., 2005). Pretesting comprises collecting data from a small selection of participants and those connected to the field of study to assess whether the strategy for acquiring data for the main study is acceptable. This helps the researchers minimize any potential mistakes that could happen during the initial inquiry. Since the researcher derived the measuring instrument from literatures, pre testing was conducted on 36 individuals and the results are discussed as follows.

### **3.7.1 Validity**

Validity refers to both the extent to which a test measures and what it promises to measure (Dubey & Kothari, 2022). This means that the degree to which variances detected by a measuring tool represent actual variations among the subjects of the test is known as validity. Construct validity is a validity test that describes how closely a measurement tool corresponds with and logically connects to the underlying theory. Before they may be related to one another in a questionnaire, variables need to be quantified. Each measurement must, in some sense, validly measure what it is designed to measure for claims of relationship to have any value. In other words, when items are grouped into the same scale in the questionnaire, they should likely to assess something similar. The item-scale correlations provide an evaluation of this. The scale score is then estimated by adding the item scores. This sort of connection is described by a Pearson product moment correlation coefficient. The validity test result of the measuring instrument is shown in annex 3.

### **3.7.2 Reliability**

Dubey & Kothari (2022) defined reliability and identified estimation measurements. They noted reliability as the degree to which the measurement or scale is consistent or dependable. It is considered that, when the outcome of a measuring process is reproducible, then the measuring instrument is reliable. It is also the degree to which the measurements of a particular instrument are free from errors and consistent results are produced. The author used the Cronbach's Alpha ( $\alpha$ ) to estimate reliability of the instrument. The Coefficient alpha may be thought of as the mean of all possible split-half coefficients.

Coefficient alpha varies between 0.00 (no internal consistency) and 1.00 (complete consistency), as with all reliability estimates. As the estimate gets closer to 1.00 it indicates the instrument is highly reliable. Scales with coefficient alpha between 0.8 and 0.95 are considered

to have very good quality, scales with coefficient alpha between 0.7 and 0.8 are considered to have good reliability, and coefficient alpha between 0.6 and 0.7 indicates fair reliability. Table 3-1 shows the coefficient alpha values of the variables measured by using SPSS 27.

*Table 3-1 Coefficient alpha Values*

No	Variables	Cronbach's Alpha	Number of Items	Strength of Association
1	Project Schedule Control	0.764	5	Good
2	Project Cost Control	0.849	9	Very Good
3	Application of EVM	0.964	30	Excellent
4	Factors Affecting EVM	0.885	8	Very Good
5	Role of EVM	0.764	5	Good
6	Project Success	0.806	5	Very Good

*Source: Survey 2023*

### **3.8 Ethical Consideration**

Almost every research involving human subjects has some level of risk. These risks could be anything from mild discomfort or humiliation brought on by slightly intrusive or provocative questions to considerably more serious consequences on participants' physical or emotional health. Thus, the researcher made sure that everyone was treated with dignity and respect, after informing them that participation in the study was entirely voluntary and that declining to do so would not subject them to any form of prejudice.

In addition, the participants received total anonymity. To guarantee that the participants got complete secrecy, identifying codes rather than participant names were issued to the completed surveys. Due to their busy schedules while using the electronic format, the researcher gave respondents enough time during the data collection process to complete and submit the survey questions.

All respondents received the research purpose, objectives, and research questions prior to the data collection process so that they were fully informed of what was expected of their involvement. Since none of their contributions can be linked to any one contributor, it was believed that these precautions would aid in safeguarding their reputation. The information gathered from respondents was only utilized for the study's objectives and was not made available to third parties for any other use.

# Chapter Four

## 4 Results And Discussion

The presentation and interpretation of the study's findings are covered in this chapter. The aim of this study is to evaluate project schedule and cost control practices of RAMA Construction PLC.; assess the earned value management system and practice of the organization; identify the factors affecting the applications of earned value management; and to explore the role of earned value management system in the success of construction projects. Interpretation of the demographic survey, quantitative analysis of the findings is presented in alignment with the findings of literature review and interview.

### 4.1 Questionnaire Response Rate

The percentage of people who complete a distributed survey compared to the total number of respondents is known as the survey response rate (Ramshaw, 2023). The author also indicated that how interested the participants are in the subject matter and how well the questionnaire is presented to them are factors that affect the response rate. This study achieved a 90% response rate as shown in Table 4-1 below. The table presents the summary of the survey response status of this study.

*Table 4-1 Survey Response Rate*

Response	Total	Remark
Completed Responses	72	
Total Respondents	80	
Response Rate	90%	Excellent

*Source: Survey 2023*

### 4.2 Demographic Characteristics of Respondents

Researchers can learn more about their subjects' backgrounds by including demographic questions in surveys. These inquiries give context to the survey data that have been gathered, enabling researchers to define their participants and do more accurate data analysis. In the survey conducted for this study respondents' gender, age, level of education, work experience in years, and their role in the organization was assessed. The result of the analysis of the demographic data is presented in Table 4-2 below.

Table 4-2 Summary of demographic Data gathered

Demographic Variable	Category	Frequency	Percent (%)
Gender	Male	44	61.1
	Female	28	38.9
Age	21-30	8	11.1
	31-40	35	48.6
	41-50	20	27.8
	Over 51	9	12.5
Education Level	Certificate	0	0
	Diploma	6	8.3
	Bachelor Degree	44	61.1
	M.Sc./MA	22	30.6
Work Experience	0-5 years	10	13.9
	5-10 years	31	43.1
	10-15 years	27	37.5
	Above 15 years	4	5.6
Organizational Role	Senior Manager	1	1.4
	Construction/Office Engineer	41	56.9
	Project Manager	18	25
	Functional Manager	12	16.7

Source: Survey 2023

### ***Sex Distribution, age and work experience of Respondents***

To ensure a fair and equal representation of the respondents, the study took into account the respondents' sex as a demographic factor. As the results shown in the table above, men made up the bulk of respondents 61.1% while women made up only 38.9% of the respondents. The findings showed that the majority respondents are male and that there is no sex equity, even if more research is needed to determine the causes. This result illustrates how both sexes are portrayed and how poorly sex is represented in this situation.

The survey also took into account the respondents' range in age and work experience. The age range was chosen in order to determine which age group made up the bulk of the construction

team who are directly involved with the system of the organization and the work experience portrays how long they have come across the culture and policies of the company. Higher levels of work experience imply that employees are well-versed in the organization's project management processes and procedures. According to the survey, more than 86% of respondents have work experience spanning more than five years. This is an acceptable figure to make an observation over the company's system. Table 4-3 portrays the findings of the two variables.

*Table 4-3 Work Experience vs. Age Range*

		Age of Respondents			
		21-30	31-40	41-50	Over 51
Work Experience of Respondents	0-5	8	2	0	0
	5-10	0	31	0	0
	10-15	0	0	20	7
	Above 15	0	2	0	2

*Source: Survey 2023*

***Level Of Education of Respondents and Their Role in the Organization***

The highest level of education attained by the respondents was another demographic aspect taken into account in the study. The respondents' education level was crucial in determining their proficiency with and readiness for using the Earned Value Management system. According to the results shown in table 4-2, 30.6% of respondents acquired master's degree, 61.1% hold a bachelor's degree (BA/BSc). The result demonstrates that over 90% of the project team hold higher level of education related to the field of study implying that they know what they are answering.

As presented in table 4-2, 25% and 16.7% of respondents described themselves as project managers and functional managers respectively. These findings confirm that more than 40% of respondents are managers who are actively participating in project decision-making process that forces them to be curious to find out more about the earned value of work packages to measure performance and progress of projects.

Table 4-4 further indicates the various perspectives held by the firm's organizational structure about the application of earned value management. Despite the fact that all structural units contribute to carrying out the EVM processes (guidelines), managers at various levels and in

various functions have varying perspectives. It is clear that office engineers do not frequently use EVM. This might be because only the managers and their staff are in charge of certain control procedures and analysis computations.

*Table 4-4 The application of EVM by Organizational Structures*

	<b>Organizational Role of Respondents</b>			
	<b>Senior Manager</b>	<b>Project Manager</b>	<b>Functional Manager</b>	<b>Office Engineer</b>
Organization and Scope	4.00	3.88	3.62	2.84
Planning, Scheduling and Budgeting	4.00	3.95	3.77	2.88
Account Considerations	4.67	3.80	3.15	2.83
Analysis and Management Report	4.43	4.17	3.83	2.84
Revision and Data Maintenance	4.80	3.80	3.13	2.86
<b>Application of EVM - Mean</b>	<b>4.38</b>	<b>3.92</b>	<b>3.50</b>	<b>2.85</b>

*Source: Survey 2023*

### **4.3 Data Analysis and Interpretation**

Once the questionnaires were returned the gathered data was edited for in valid inputs, errors and omissions. The data was then corrected, uniformly input, and well-arranged to make coding and tabulation easier. The questionnaire was then coded / labeled into constructs with numbers and letters so that it can be classified into a finite number of categories or classes. Finally, the raw data was condensed for further analysis and presenting it in a concise format (i.e., in the form of statistical tables). Annex 4 shows the result of the three steps of editing the data where the frequency, minimum and maximum values and range of variables are weighed.

The aim of this study is to evaluate project schedule and cost control practices of RAMA Construction PLC.; assess the earned value management system and practice of the organization; identify the factors affecting the applications of earned value management; and to explore the role of earned value management system in the success of construction projects.

It is generally agreed that employing quantitative and qualitative methodologies together rather than individually leads to a better understanding of study issues. Methodology triangulation, a

hybrid methodology, aims to fill up any gaps and weak points between the quantitative and qualitative research. The employment of a variety of techniques shows an effort to comprehend and research the phenomenon in order to expand the breadth, depth, and consistency of methodological approaches. The descriptive and correlational analysis and a triangulated interpretation of the results in alignment with the research questions is presented as follows.

### 4.3.1 Descriptive Analysis of Variables

There are more exact ways of representing the form of the distribution of values for a particular variable, despite the fact that frequency tables and histograms give researchers a broad perspective of the distribution. These include metrics of dispersion and central tendency. By computing the mean value and standard deviation values of the responses, the statements studying the same variable were converted into a variable index. According to Marczyk et al. (2005), the standard deviation is a measurement of the dispersion (variation) in values from a distribution's mean.

The 5-point Likert scale border is used for this study's purposes. As a result, the dispersion of responses with a sigma value less than one are regarded as consistent, but those with a value greater than one are regarded as inconsistent. Whereas, high mean value expresses a probable high agreement with the assertion after the data have been modified as previously explained, whilst low mean value expresses low agreement to the proposed parameters. Table 4-5 below presents the summary of variable indices and their measured value of central tendency and dispersion.

*Table 4-5 Summary of variable indices*

<b>Variables</b>	<b>Min.</b>	<b>Max.</b>	<b>Range</b>	<b>Mean</b>	<b>Std. Deviation</b>
Schedule Control	1	5	4	3.3	0.65
Cost Control	1	5	4	3.32	0.69
Factors Affecting EVM	1	5	4	3.81	0.72
EVM Application	1	5	4	3.25	0.69
Role of EVM	1	5	4	3.77	0.72
Project Success	1	5	4	3.38	0.74

*Source: Survey 2023*

### ***Project Schedule Control***

Project schedule control is the process of tracking of project progress to detect and monitor deviation from the planned timeline, update the project schedule and managing changes (Lewis, 2023). This part of the study focuses on analyzing the practice of project schedule control from the perspective of its contribution to EVM practice.

*Table 4-6 Descriptive analysis of project schedule control*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Determining the project schedule's current status	3.29	1.11
Handling the variables that affect project schedule	3.76	0.96
Reevaluating the need for schedule reserves	2.81	0.94
Determining whether the project schedule has changed	3.83	1.02
Managing the actual schedule changes as they happen	2.83	0.94
<b>Agg. Mean</b>	<b>3.30</b>	<b>0.65</b>

*Source: Survey 2023*

As table 4-6 presented above shows, the practice of project schedule control is measured through five major constraints/aspects. An aggregate mean score of 3.3 and standard deviation of 0.65 is achieved implying that on average the respondents agree that the practice of schedule control is moderate. Meanwhile, the respondents believe *reevaluating the need for schedule reserves* ( $M= 2.81, SD= 0.94$ ) and *managing the actual schedule changes as they happen* ( $M= 2.83, SD= 0.94$ ) are practiced rarely. Lewis (2023) and Wysocki (2019) noted the amount of time included in the plan to provide for unanticipated delays in the project timeline should be reevaluated regularly in order to keep the project in track. Not only changes in schedule reserve but also changes in actual schedule should be captured and monitored as they happen so that delays can be avoided.

The interviewee mentioned ***Variance Analysis*** is the policy the firm adopts to conducted schedule control. Activities such as: defining schedule baseline and scope baseline; measuring performance against baseline and forecasting (using expert judgement); registering change requests and risks; and defining resource calendar are conducted in order to keep up with the base timeline of the project.

### ***Project Cost Control***

Project cost control is the process of keeping expenses of projects within the allocated budget by estimating, planning, and controlling costs throughout the project life cycle (Kerzner, 2017). This part of the study focuses on analyzing the practice of project cost control from the perspective of its contribution to EVM practice.

*Table 4-7 Descriptive analysis of project cost control*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Handling the variables that result in changes	3.69	1.03
Handling Cost Change Request	2.57	0.98
Coordinating the real changes as they happen	3.69	1.03
Ensuring that project costs are not incurred in excess	2.75	0.90
Tracking cost performance	3.83	1.02
Comparing labor performance to the amount of money spent	2.81	0.82
Preventing unauthorized changes from being accounted	3.29	1.11
Notifying the proper parties of all approved changes	3.83	1.02
Bringing anticipated cost overruns under control	3.39	1.21
<b>Agg. Mean</b>	<b>3.32</b>	<b>0.69</b>

*Source: Survey 2023*

As table 4-7 presented above shows, the practice of project cost control is measured through nine major constraints/aspects. An aggregate mean score of 3.32 and standard deviation of 0.69 is achieved implying that on average the respondents agree that the practice of cost control is moderate. Meanwhile, the respondents believe *handling cost change request* ( $M= 2.57, SD= 0.98$ ), *ensuring that project costs are not incurred in excess* ( $M= 2.75, SD= 0.90$ ) and *comparing labor performance to the amount of money spent* ( $M= 2.81, SD= 0.82$ ) are practiced rarely. Kerzner (2017) and Wysocki (2019) stated that improper handling of changes is likely to cause the projects to be delayed and results in significant cost increases. Such faults arise from lack of communication among clients and contractors. Huang et al. (2014) noted that project managers are also responsible to incur costs at the right time for the right task and Mahr(2022) pointed that evaluating how much output a firm can realistically expect from its employees can help the firm to set milestones that are achievable and in doing so cost overruns are reduced.

The interviewee mentioned *Variance Analysis* is the policy the firm adopts to conducted cost control as well. Activities such as: defining cost baseline and funding requirements; measuring performance against baseline and forecasting; and registering risks related to cost overrun are conducted in order to keep up with the planned budget of the project.

### ***Application of EVM***

The EIA-748 Standard organized thirty tasks as guidelines of practice of EVM. These guidelines are divided into five process categories: organization and scope; planning, scheduling, and budgeting; accounting considerations; analysis and management reports; and revisions and data maintenance. These guidelines are the activities a project management team should practice in order to claim the practice of earned value management. This part of the study focuses on analyzing the guidelines in order to claim whether EVM is practiced or not.

#### ***Organization and Scope***

EVM is an integrated performance management baseline which takes several constraints of a project into account. Among these constraints definition of organization and scope are analyzed in this part of the study.

*Table 4-8 Descriptive analysis of definition of organization and scope*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Defining Work Breakdown Structure (WBS)	3.72	1.05
Defining Project Organization Structure (OBS)	3.68	1.02
Integrating Processes - planning, scheduling, budgeting	2.78	0.92
Identifying Overhead Management	2.75	0.90
Integrating WBS/OBS to Create Control Accounts	3.31	0.85
<b>Agg. Mean</b>	<b>3.25</b>	<b>0.75</b>

*Source: Survey 2023*

As table 4-8 presented above shows, defining the organization and scope of a project is measured through five activities. An aggregate mean score of 3.25 and standard deviation of 0.75 is achieved implying that on average the respondents agree that organization and scope are defined moderately. Meanwhile, the respondents believe *Integrating Processes - planning, scheduling, budgeting* ( $M= 2.78, SD= 0.92$ ) and *identifying overhead management* ( $M= 2.75, SD= 0.90$ ) are practiced rarely. A project manager benefits from integrating processes of a

project as it promotes continuous track of activities, real-time budget management and enhances scheduling and resource allocation capabilities Wysocki (2019). Effective tracking and control of overhead expenses is crucial since they have a big impact on a project's profitability and cash flow. The project can be kept under control and the performance can be improved by periodically defining, reviewing, and improving the overhead management (Lester, 2021).

### ***Planning, Scheduling, and Budgeting***

A project manager should develop a resource-loaded schedule so that the budget can be determined. This time phased and resource-loaded schedule is the focus of the second category of the standard and it's analyzed in this part of the study.

*Table 4-9 Descriptive analysis of planning, scheduling and budgeting*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Scheduling with Network Diagrams	3.72	1.05
Setting Measurement Indicators – Milestone, Goals	3.69	1.03
Establishing Budgets for Authorized Work	3.07	1.10
Budgeting by Cost Elements	3.19	0.94
Creating Work Packages, Planning Packages	3.72	1.05
Establishing Overhead Budgets	2.96	0.91
Identifying Management Reserve and Undistributed Budget	2.83	0.96
<b>Agg. Mean</b>	<b>3.31</b>	<b>0.81</b>

*Source: Survey 2023*

As table 4-9 presented above shows, the prominent activities of a project - planning, scheduling and budgeting, are measured through seven activities. An aggregate mean score of 3.31 and standard deviation of 0.81 is achieved implying that on average the respondents agree that planning, scheduling and budgeting are performed moderately. Meanwhile, the respondents believe *establishing overhead budgets* ( $M= 2.96, SD= 0.91$ ) and *identifying management reserve and undistributed budget* ( $M= 2.83, SD= 0.96$ ) are practiced rarely. Effective planning of *undistributed budget* – the amount within the total performance measurement baseline that has scope but has not been detail planned to the control account level, and *management reserve* - developed to provide budget coverage for the contract statements of work, help you set long-

term financial goals, prevents from overspending, makes retirement saving easier and helps managers to be prepared for emergencies (Hunter et al., 2014).

### *Accounting Considerations*

The way actual expenditures are recorded must be in line with how work is planned and budgeted. It is necessary to explain the importance of choosing the right time to allocate a crucial project resource, material, and to accurately accumulate performance data. This part of the study analyzes the third category of the standard, which is a procedure for recording real expenses spent on project work effort.

*Table 4-10 Descriptive analysis of accounting Considerations*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Recording Direct Costs	3.44	0.96
Summarizing Direct Costs by WBS Elements	3.44	1.02
Summarizing Direct Costs by OBS Elements	2.56	0.90
Recording/Allocating Indirect Costs	2.75	0.90
Identifying Unit and Lot Costs	3.39	1.01
Tracking and Reporting Material Costs and Quantities	3.33	1.06
<b>Agg. Mean</b>	<b>3.15</b>	<b>0.89</b>

*Source: Survey 2023*

Table 4-10 presented above shows the six prominent activities of capturing costs incurred (actual cost) and their analysis. An aggregate mean score of 3.15 and standard deviation of 0.89 is achieved implying that on average the respondents agree that actual costs are captured moderately. Meanwhile, the respondents believe *summarizing direct costs by OBS elements* ( $M= 2.56, SD= 0.90$ ) and *recording/allocating indirect costs* ( $M= 2.75, SD= 0.90$ ) are practiced rarely. To ensure that the direct costs are reported and examined at higher levels of the organizational structure, direct costs from the control accounts are summarized into the organizational components (Mcgregor, 2018). The same author also indicated that in order to prevent projects from going over budget, all indirect expenses should be correctly and consistently allocated to the applicable contract and at the level where overhead budgets are established.

### *Analysis and Management Reports*

Project managers gather all relevant project data at this point, identify cost and schedule discrepancies, describe their causes, effects, and corrective actions, and establish a revised estimate at completion (EAC). The fourth category of the standard—a method for determining variance, indices, and forecasting, is examined in this section of the study.

*Table 4-11 Descriptive analysis of analysis and management reports*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Calculating Schedule Variance	3.64	1.09
Calculating Cost Variance	3.28	1.15
Identifying Significant Variances for Analysis	3.69	1.03
Analyzing Indirect Cost Variances	2.75	0.90
Summarizing Variance Information for Management	3.83	1.02
Implementing Corrective Actions	2.81	0.82
Revising Estimate at Completion (EAC)	3.50	1.15
<b>Agg. Mean</b>	<b>3.36</b>	<b>0.78</b>

*Source: Survey 2023*

Table 4-11 presented above shows the prominent activities of the progress and performance analyses conducted in EVM and are measured through seven activities. An aggregate mean score of 3.36 and standard deviation of 0.78 is achieved implying that on average the respondents agree that progress and performance are measured moderately. Meanwhile, the respondents believe *analyzing indirect cost variances* ( $M= 2.75, SD= 0.90$ ) and *implementing corrective actions* ( $M= 2.81, SD= 0.82$ ) are practiced rarely. Management must identify the budgeted and actual applied indirect costs at the level and frequency necessary for successful control, as well as the causes of any noteworthy deviations (Mcgregor, 2018). The same author also noted that reviewing performance measurement data, putting corrective action management plans into place, and utilizing the data for decision-making are all parts of EVM.

### *Revisions and Data Maintenance*

To be able to evaluate the work completed for each reporting period, a baseline schedule and budget must be established and maintained. When there is a baseline that is continually changing, the Revision and Data Maintenance portion is essential for proactive, effective earned value management. Revision and data maintenance is analyzed in this part of the study.

Table 4-12 Descriptive analysis of revision and data maintenance

Questionnaire Statement	Mean	Std. Deviation
Incorporating Changes in a Timely Manner	3.39	1.01
Reconciling Current to Prior Budgets	3.33	1.06
Controlling Retroactive Changes	3.28	1.10
Preventing Unauthorized Revisions	3.33	1.06
Documenting Performance Measurement Baseline Changes	2.50	0.90
<b>Agg. Mean</b>	<b>3.17</b>	<b>1.01</b>

Source: Survey 2023

Table 4-12 presented above shows the analysis of the five prominent activities of revision and data maintenance conducted in EVM. An aggregate mean score of 3.17 and standard deviation of 1.01 is achieved implying that on average the respondents agree that revision and data maintenance are conducted moderately. Meanwhile, the respondents believe *documenting performance measurement baseline changes* ( $M= 2.50$ ,  $SD= 0.90$ ) is practiced rarely. To facilitate efficient decision-making, the DOD strategic intent stated that a transparent performance measurement baseline change should be established throughout internally and externally affected systems and reports.

The interviewee identified *Data analysis, Variance Analysis, Expert Judgement and Earned Value Analysis (in pilot projects)* as the firm’s tools and techniques to control project schedule and cost. The respondent also indicated that the organization doesn’t have both EVM status measuring metrics and development plan to define existence of the EVM system. Trainings are given on the activities to control projects (delay and cost overrun) but not on the tools and techniques.

### ***Factors Affecting EVM***

A number of obstacles could prohibit Earned Value Management from being properly implemented. Several impediments that could prevent the success of the EV (earned value) concept were analyzed in this part of the study.

Table 4-13 Descriptive analysis of factors affecting EVM

Questionnaire Statement	Mean	Std. Deviation	RII	Rank
Organization's control Policy and Procedures	4.26	0.79	0.614	1
Organizational Culture	3.83	1.02	0.552	2
Cost required for Implementation	3.81	0.94	0.548	3
Organizational Resources	3.78	0.92	0.544	4
Measuring the current progress of Projects	3.75	1.07	0.54	5
Project Scope Definition	3.69	1.03	0.532	6
Commitment of Top Management	3.69	1.03	0.532	7
Project Payment Method Adopted	3.69	1.03	0.532	8
<b>Agg. Mean</b>	<b>3.82</b>	<b>0.72</b>		

Source: Survey 2023

Table 4-13 presented above shows the evaluation of eight critical factors which prohibit EVM from being implemented. An aggregate mean score of 3.82 and standard deviation of 0.72 is achieved implying that on average the respondents agree that the significance of the eight impediments that could prevent EVM from implementation is high. This is supported by the result as the factors scored a mean value of 3.69 and above discretely. Relative importance index was used to rank the factors based on their significance level. On average the respondents think *the organization's project control policy and procedures* is the most significant factor when compared to the other seven factors and *project payment method adopted* scored the least. Morad & El-Sayegh (2018) found that *cultural resistance* was the most significant factor and *cost required to implement the tool* was the least weighted.

The interviewee listed several challenges behind the practice of EVM such as: the tool requires intensive paper work, several information and data transfer activities among stakeholders which makes it costly and time taking to implement; lack of expertise, difficulties to forecast due to unpredictable variation of cost and inflation of goods, and the characteristics of the projects under consideration.

### ***Role of EVM***

EVM is one of the strongest project schedule and cost control measures accessible because of its strong predictive capability and its information for proactive management action, links

technical, time, and cost performance, and gives managers a summary of successful decision-making (Vanhoucke, 2009). This part of the study focuses on analyzing the role of EVM from the perspective of project management.

Table 4-14 Descriptive analysis of role of EVM

Questionnaire Statement	Mean	Std. Deviation	RII	Rank
Measure schedule and budget accuracies	3.83	1.02	0.552	1
Gain real-time visibility of centralized information	3.81	0.94	0.548	2
Realistic Project Planning	3.78	0.92	0.544	3
Anticipate risks and intervene early	3.75	1.07	0.54	4
Enhances accountability and motivation	3.69	1.03	0.532	5
<b>Agg. Mean</b>	<b>3.77</b>	<b>0.72</b>		

Source: Survey 2023

Table 4-14 presented above shows the evaluation of the five contributions of EVM to project management. An aggregate mean score of 3.77 and standard deviation of 0.72 is achieved implying that on average the respondents agree that the contribution of EVM in the multidimensional aspects of a project is high. This is supported by the discrete results of the items which scored a mean value of 3.69 and above. Relative importance index was used to rank the categorical roles based on their contribution level. On average the respondents think when compared to the other four roles, the primary role of EVM in project success is *measuring schedule and budget accuracies*. Whereas *enhancing accountability and motivation* is the least contribution of EVM to project success.

The interviewee listed several opportunities behind the practice of EVM such as: Reduce cost overrun and delay; effective and efficient resource management; alignment of scope and budget; maintain progress and performance; enhances the planning process; promotes a precise definition of the work scope; defines clearly who is responsible for the work effort; integrates technical, schedule, and cost performance; and offers early analysis and warning of potential earned value issues.

## *Project Success*

Project managers' top priority throughout project planning is producing successful results that please the stakeholders. The benchmarks stakeholders use to assess whether the project achieves their expectations in terms of budget, schedule, and value are referred to as success criteria (Kerzner, 2022). This part of the study focuses on analyzing the success of projects in the firm.

*Table 4-15 Descriptive analysis of project success*

<b>Questionnaire Statement</b>	<b>Mean</b>	<b>Std. Deviation</b>
Resource Management	2.86	0.98
Deadline of projects	3.69	1.03
Budget Management	3.69	1.03
Stakeholders Satisfaction	3.83	1.02
Post project Business Value	2.81	0.82
<b>Agg. Mean</b>	<b>3.38</b>	<b>0.74</b>

*Source: Survey 2023*

Table 4-15 presented above shows the evaluation of the successful completion of projects using five parameters. An aggregate mean score of 3.38 and standard deviation of 0.74 is achieved implying that on average the respondents agree that the successful completion of projects is moderate. Meanwhile, the respondents believe success with respect to *resource management* ( $M= 2.86$ ,  $SD= 0.98$ ) and *post project business value* ( $M= 2.81$ ,  $SD= 0.82$ ) is low. As per Kerzner (2022), the right resource management techniques will enhance productivity and resource disputes can be avoided helping projects to become successful. The author also noted projects may still be a failure for such reasons as: if there is no business value (market demand) for the goods or services produced.

### **4.3.2 Correlation Analysis**

For the purpose of calculating the degree of relationship between two or more variables, correlation analysis examines the joint variation of the two or more variables. The degree and direction of the linear link between variables are both described via correlation analysis. The most common technique for determining how closely two variables are related is to utilize Karl Pearson's coefficient of correlation, also known as simple correlation. (Kothari, 2004).

Karl Pearson's correlation coefficient is also known as the product moment correlation coefficient. The value of 'r' is between -1 and +1. Positive values of 'r' show positive correlation, which means that changes in both variables follow the direction of the statement, whereas negative values of 'r' indicate negative correlation, which means that changes in the two variables follow the opposite directions. There is no relationship between the two variables if 'r' has a value of zero. A high degree of correlation between the two variables is indicated by a r value that is closer to +1 or -1. The table presented below shows the values in order to interpret output of Pearson correlation analysis.

$$\text{Karl Pearson's coefficient of correlation (or } r) = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{n \cdot \sigma_X \cdot \sigma_Y}$$

*Table 4-16 Measuring parameters of Pearson Correlation*

Measured Parameter	Value	Description
Strength (r)	Strong	0.7-1
	Moderate	0.3-0.7
	Weak	Less than 0.3
Nature	Positive	Greater than 0
	Negative	Less than 0
Significance	Significant	P-value < 0.05
	Insignificant	P-value > 0.05

*Source: Research methodology: methods and techniques (Kothari, 2004)*

#### **4.3.2.1 Correlation test assumptions**

Karl Pearson's correlation coefficient assumes that the two variables have a linear relationship; casually related, which means that one of the variables is independent and the other is dependent; and data from both variables follow normal distribution.

One of the assumptions of Karl Pearson's correlation coefficient is the data from both variables follow normal distribution. Therefore, this part of the study measures whether the distribution of the data from both sides is normal or non-normal. Both the numerical output - Skewness and Kurtosis Z-values; and the visual output - Histogram plots are investigated for this test. Table 4-17 and plots in Annex 5 below show the result of normality test. From the table it can be seen that Z-values are between  $\pm 1.96$  and the visual inspection of the histogram plots shows that the variables are approximately normally distributed. As a result, the assumption is satisfied and

Pearson's correlation coefficient can be measured in order to assess the degree of linear relationship between application of EVM and Project Success.

*Table 4-17 Skewness and Kurtosis test result*

		Statistic	Std. Error	Z-Value
Organization and Scope	Skewness	0.138	0.283	0.489
	Kurtosis	-0.292	0.559	-0.522
Planning Scheduling and Budgeting	Skewness	0.012	0.283	0.042
	Kurtosis	-0.543	0.559	-0.972
Accounting Consideration	Skewness	0.051	0.283	0.181
	Kurtosis	-0.558	0.559	-0.997
Analysis and Management Reports	Skewness	-0.058	0.283	-0.206
	Kurtosis	-0.667	0.559	-1.193
Revision and Data Maintenance	Skewness	-0.065	0.283	-0.229
	Kurtosis	-0.492	0.559	-0.880
Project Success	Skewness	0.026	0.285	0.093
	Kurtosis	-0.563	0.563	-1.001

*Source: Survey 2023*

#### **4.3.2.2 Correlation Analysis Result**

EVM provides managers with real-time insights into project progress and performance, enabling them to make better decisions and produce effective results. This part of the study focuses on analyzing the linear relationship of application of EVM with project success; and role of EVM in project success.

Table 4-18 presented below shows the result of the analysis of correlation. The result is discussed as follows:

- A. Pearson Product correlation of *organization and scope* was found to be strongly positive and statistically significant ( $r = 0.770$ ,  $p < 0.05$ ). This shows that defining organization and scope more often would lead to higher project success rate;
- B. Pearson Product correlation of *planning, scheduling and budgeting* was found to be strongly positive and statistically significant ( $r = 0.767$ ,  $p < 0.05$ ). This shows that

planning, scheduling and budgeting more often would lead to higher project success rate;

C. Pearson Product correlation of *accounting consideration* was found to be moderately positive and statistically significant ( $r = 0.606$ ,  $p < 0.05$ ). This shows that recording actual expenditures more often would lead to better project success rate;

D. Pearson Product correlation of *analysis and management reports* was found to be strongly positive and statistically significant ( $r = 0.919$ ,  $p < 0.05$ ). This shows that identifying cost and schedule discrepancies, describing their causes, effects, and corrective actions, and establishing a revised estimate at completion more often would lead to higher project success rate;

E. Pearson Product correlation of *revision and data maintenance* was found to be moderately positive and statistically significant ( $r = 0.522$ ,  $p < 0.05$ ). This shows that revising the work completed for each reporting period and performing maintenance measures more often would lead to better project success rate;

Table 4-18 Result of correlation analysis

		OS	PSB	AC	AMR	RDM
Organization and Scope (OS)	Pearson Correlation	1				
Planning, Scheduling and Budgeting (PSB)	Pearson Correlation	.926**	1			
Accounting Consideration (AC)	Pearson Correlation	.428**	.469**	1		
Analysis and Management Reports (AMR)	Pearson Correlation	.793**	.818**	.611**	1	
Revision and Data Maintenance (RDM)	Pearson Correlation	.432**	.396**	.887**	.517**	1
Project Success (PS)	Pearson Correlation	.770**	.767**	.606**	.919**	.522**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Source: Survey 2023

# Chapter Five

## 5 Summary, Conclusions and Recommendations

The summary of key findings is outlined in this chapter, and conclusions are drawn based on the findings. On the basis of the findings, suggestions are also made for improving the system and practice of EVM to enhance project success in respect to the literature that has been studied. The research limitations and suggested areas for additional investigation are then provided.

### 5.1 Summary of Findings

The primary objective of this study was describing and explaining the earned value management system and practice of RAMA Construction PLC. and understanding the relationship between EVM and project success. The project schedule and cost control mechanisms were also studied in order to comprehend the fundamentals of EVM within the firm. The factors affecting the application of EVM in the firm were also identified and rated for their significance. This part of the study summarizes major findings of the analysis and result.

The first research question that was analyzed is the practices of schedule control within the firm. An aggregate mean score of 3.3 and standard deviation of 0.65 is achieved implying that on average the respondents agree that the practice of schedule control is moderate. Among the aspects *reevaluating the need for schedule reserves* and *managing the actual schedule changes as they happen* are practiced rarely. The interviewee also mentioned that defining schedule baseline and scope baseline; measuring performance against baseline and forecasting; registering change requests and risks; and defining resource calendar are conducted. Variance analysis is the policy the firm adopts in order to keep up with the base timeline of the project.

The second research question that was analyzed is the practices of cost control within the firm. An aggregate mean score of 3.32 and standard deviation of 0.69 is achieved implying that on average the respondents agree that the practice of cost control is moderate. Among the aspects *handling cost change request*, *ensuring that project costs are not incurred in excess* and *comparing labor performance to the amount of money spent* are practiced rarely. The interviewee also mentioned that defining cost baseline and funding requirements; measuring performance against baseline and forecasting; and registering risks related to cost overrun are conducted. Variance analysis is the policy the firm adopts in order to keep up with the planned budget of the project.

The third research question that was analyzed is the practices of earned value management system within the firm. The thirty guidelines of EIA-748 Standard were branded into five categories so that analogous aspects are studied together. An aggregate mean score of 3.25 and standard deviation of 0.69 is achieved for the general application of EVM in the firm. The results of each category are summarized as follows:

An aggregate mean score of 3.25 and standard deviation of 0.75 is achieved for organization and scope category implying that on average the respondents agree that organization and scope are defined moderately. Among the guidelines of this category *integrating Processes - planning, scheduling, budgeting* and *identifying overhead management* are practiced rarely. An aggregate mean score of 3.31 and standard deviation of 0.81 is achieved for planning, scheduling and budgeting category implying that on average the respondents agree that planning, scheduling and budgeting are performed moderately. Among the guidelines of this category *establishing overhead budgets* and *identifying management reserve and undistributed budget* are practiced rarely.

An aggregate mean score of 3.15 and standard deviation of 0.89 is achieved for accounting consideration category implying that on average the respondents agree that actual costs are captured moderately. Among the guidelines of this category *summarizing direct costs by OBS elements*) and *recording/allocating indirect costs* are practiced rarely. An aggregate mean score of 3.36 and standard deviation of 0.78 is achieved for analysis and management reports category implying that on average the respondents agree that progress and performance are measured moderately. Among the guidelines of this category *analyzing indirect cost variances* and *implementing corrective actions* are practiced rarely.

An aggregate mean score of 3.17 and standard deviation of 1.01 is achieved for revisions and data maintenance category implying that on average the respondents agree that revision and data maintenance are conducted moderately. Among the guidelines of this category *documenting performance measurement baseline changes* is practiced rarely.

The interviewee noted that tools and techniques such as; data analysis, variance analysis, expert judgement and earned value analysis are used to control project schedule and cost. Both EVM status measuring metrics and development plan to define existence of the EVM system aren't defined and trainings aren't given to employees about EVM as well.

The fourth research question that was analyzed is the factors affecting the practices of EVM within the firm. An aggregate mean score of 3.82 and standard deviation of 0.72 is achieved

implying that on average the respondents agree that the significance of the eight impediments that could prevent EVM from implementation is high. The proportionate contribution each factor makes was measured and *the organization's project control policy and procedures* is the most significant factor when compared to the other seven factors and *project payment method adopted* scored the least. The interviewee added “the tool requires intensive paper work, several information and data transfer activities among stakeholders which makes it costly and time taking to implement; lack of expertise, difficulties to forecast due to unpredictable variation of cost and inflation of goods, and the characteristics of the projects under consideration” as challenges behind application of EVM.

The fifth research question that was analyzed is the role of EVM in project success. Role of EVM and project success were first analyzed discreetly so that the correlation of application of EVM and project success can be determined. The role of EVM resulted an aggregate mean score of 3.77 and standard deviation of 0.72 implying that on average the respondents agree that the contribution of EVM in the multidimensional aspects of a project is high. Whereas an aggregate mean score of 3.38 and standard deviation of 0.74 is achieved for project success implying that on average the respondents agree that the successful completion of projects is moderate. Among the parameters to measure project success, *resource management* and *post project business value* were found to be low.

Pearson Product correlation of Project Success and *organization and scope; planning, scheduling and budgeting; and analysis and management reports* were found to be strongly positive and statistically significant Whereas Pearson Product correlation of Project Success and *accounting consideration, and revision and data maintenance* were found to be moderately positive and statistically significant.

## **5.2 Conclusion**

Based on the results of the survey and literature review, the researcher reached a number of conclusions regarding the earned value management system and practices of RAMA construction PLC. and its relationship with project success. The researcher's primary conclusions are presented below.

The practice of schedule control, cost control and earned value analysis are interlinked. The firm's practice of schedule and cost control was found to be moderate. The fact that the firm adopting variance analysis for both schedule and cost control and conducting activities such as: defining performance baseline and scope baseline; measuring performance against baseline

and forecasting; and registering change requests and risks paves the way for the ease practice of EVM.

In addition to the firm's controlling activities and policies, challenges including lack of a defined EVM policy and system, lack of discipline and consistency, lack of status measuring metrics, and lack of a development plan all hinder the use of EVM. It is also clear from the application of EVM test results that the company is committed to using EVM only in pilot projects. Additionally, there are restrictions on how the EVM standard guidelines are put into reality in the pilot projects that EVM is used to monitor and control.

The unfortunate practice of EVM arose from poor functionality of some of guidelines within the organization. These guidelines include integrating project management processes, identifying overhead management, establishing overhead budgets, identifying management reserve and undistributed budget, summarizing direct costs by organization breakdown structure, recording/allocating indirect costs, analyzing indirect cost variances, implementing corrective actions, and documenting performance measurement baseline changes. Most of these are failed due to poor organizational structure and lack of overhead management.

Understanding the contribution of EVM for successful completion of projects is vital. From the result of the correlation analysis, project success is positively related to the general implementation of EVM with respect to the five categories under which the thirty guidelines of the standard of EVM application are included. The five crucial benefits of EVM - realistic project planning, real-time visibility of centralized information, schedule and budget accuracies, anticipating risks and enhanced accountability and motivation, bring projects to success by improving budget management, resource management, preventing delays and facilitating stakeholder satisfaction.

Generally, it can be concluded that the EVM system is under developed in the organization and the practice is at moderate stage which lacks frequency, intensity and discipline. Even though top management understands the factors affecting the implementation of EVM and the role of EVM to complete projects within schedule, under budget and satisfied customer, the organization lacks policies, documents, procedures and standards to an effective implementation of EVM.

### **5.3 Recommendation**

The researcher recommends that:

- The organization should focus much on improving the practice of reevaluating the need for schedule reserves and managing the actual schedule changes as they happen to enhance their project schedule control practice.
- In order to enhance its project cost control practice, the organization should also focus on developing the practice of budget management in key areas such as: ensuring that project costs are not incurred in excess and comparing labor performance to the amount of money spent.
- Top management should create a harmonious working culture for employees to conduct earned value analysis by formulating a system (manuals, policies and capacity building). Software should be introduced and frequent trainings should also be given to individuals so that implementation cost and time are reduced while accountability and motivation of staff are enhanced.
- Top management should give special attention to overhead management such as identifying overhead management; establishing overhead budgets; identifying management reserve and undistributed budget; recording/allocating indirect costs; analyzing indirect cost variances; and implementing corrective actions.
- Top management should authorize all adjustments of schedule and cost baselines and document them so that all staff members immediately understand the new baseline and performance can be evaluated from that point forward.

### **5.4 Research Limitation and Areas of Further Research**

#### **5.4.1 Limitation of the Study**

The measurements of the project's scope aren't taken into account in this study despite the fact that it is well known that Earned Value Management (EVM) is a time-phased, integrated performance management baseline that takes into account measurements of the project's scope, schedule, resources, and risk to evaluate performance and progress against a baseline. This is because there aren't enough studies and articles about the interactions between EVM and project scope. Without quality control, project managers cannot consider the success of their projects. EVM, on the other hand, is weak in the area of quality control due to its intense focus

on project schedule and cost control. These two restrictions reduce the study's capacity to be generalized.

#### **5.4.2 Suggestion for future research**

As this study had bounded itself with a single company and limited with geographical boundary, future studies of the Practice of Earned Value Management and its Relationship with project success could include:

- Practice of EVM in construction and other industries in Ethiopia should be studied with wide scale by taking multiple companies into account
- Causal element of the application of EVM on project success could be analyzed
- Assessment of the IT solution (software) to the application of EVM
- Evaluating the maturity level of organizations in EVM

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## Annex 1



### Questionnaire for Senior managers, project Managers and Office Engineer

Abel Demere,

Email: - abelodhd@gmail.com

Addis Ababa

### RE: Request for Participation in a Research Study

Dear Sir/Madam,

I am attending a post graduate program in Project Management at Addis Ababa University School of Commerce (AAUSC). I'm undertaking a research study on "The Relationship Between Earned Value Management Practices and Project Success: The Case of Rama Construction PLC." as a part of my degree requirements.

Therefore, I would appreciate it if you could take a few minutes to respond to the following questions about how projects in your business and your project work benefit significantly from the use of project managing tools like Earned Value Management. Your identity will be maintained with the strictest confidentiality, and all the information you supply will be used solely for academic purposes. I sincerely appreciate your help and say thank you in advance.

Thank you for your cooperation in advance!

Abel Demere

Addis Ababa University

0913498015

**IMPORTANT NOTE:**

Information provided through the questionnaire will be treated with confidentiality and will be exclusively for academic purposes. All answers will be considered right.

**INSTRUCTION:**

- i. Writing your name or phone number is not necessary
- ii. Please read each question carefully.
- iii. Please fill in the following questionnaire on the basis of the facts of your company. Kindly answer all the questions by ticking or filling in the spaces provided.

**SECTION ONE: Background Information**

1. Sex: Male  Female

2. Age:

i) 21- 30 years  ii) 31-40 years   
iii) 41 – 50 years  iv) Over 51 years

3. Level of Education

i. Certificate  ii. Diploma   
iii. Bachelor Degree  iv. M.Sc./MA

v. Other \_\_\_\_\_

4. Work Experience in the organization

i. 0 - 5 years  ii. 5 – 10 years   
iii. 10 – 15 years  iv. Above 15 years

5. What is/was your role in the Organization?

i. Senior Manager  ii. Project Manager   
iii. Construction/office Engineer

Other \_\_\_\_\_

## SECTION TWO:

### **The Relationship Between Earned Value Management Practices and Project Success: The Case of Rama Construction PLC.**

*Earned Value Management System (EVM)* is an approach for integrating the three essential components of project management (scope, schedule, and cost management) as well as for measuring and communicating the actual physical progress of a project. By assessing project progress in monetary terms, it considers the work performed, the time required, and the money incurred to finish the project. This helps to analyze and control project risk. EVM is regarded as one of the most suitable methodologies to simultaneously control project cost and time while providing early warning signals of potential problems, leading to an effective management of the project performance

#### **Questions answered by EVM:**

- Variance** - *The difference between schedule and budget from actual plan*
- Performance Indices** - *Status of project, under or over budget and ahead or behind schedule*
- Value Forecasting** - *The anticipated remaining duration and cost of the project, given the present project performance*

*\*N.B: The software to conduct Earned Value Management system may include EV Manager that works inside MS Project, the Project Team Builder (PTB), Pro Track's assistant, and Deltek Cobra.*

**Please mark with a Tick in the applicable box with regard to the Earned Value Management System used in your organization (Please read the above definition)**

### A. Earned Value Management Practice

How often are the following fundamental functions of Earned Value Management System (EVMs) implemented in your organization? Please Tick on the appropriate one

<b>Application of EVM</b>						
<b>Organization and Scope</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
OS 1	Defining Work Breakdown Structure (WBS)					
OS 2	Defining Project Organization Structure (OBS)					
OS 3	Integrating Processes - planning, scheduling, budgeting					
OS 4	Identifying Overhead Management					
OS 5	Integrating WBS/OBS to Create Control Accounts					
<b>Planning, Scheduling, and Budgeting</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
PSB 6	Scheduling with Network Diagrams					
PSB 7	Setting Measurement Indicators – Milestone, Goals					
PSB 8	Establishing Budgets for Authorized Work					
PSB 9	Budgeting by Cost Elements					
PSB 10	Creating Work Packages, Planning Packages					
PSB 11	Establishing Overhead Budgets					
PSB 12	Identifying Management Reserve and Undistributed Budget					
<b>Accounting Considerations</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
AC 13	Recording Direct Costs					
AC 14	Summarizing Direct Costs by WBS Elements					
AC 15	Summarizing Direct Costs by OBS Elements					

AC 16	Recording/Allocating Indirect Costs					
AC 17	Identifying Unit and Lot Costs					
AC 18	Tracking and Reporting Material Costs and Quantities					
<b>Analysis and Management Reports</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
AMR 19	Calculating Schedule Variance					
AMR 20	Calculating Cost Variance					
AMR 21	Identifying Significant Variances for Analysis					
AMR 22	Analyzing Indirect Cost Variances					
AMR 23	Summarizing Variance Information for Management					
AMR 24	Implementing Corrective Actions					
AMR 25	Revising Estimate at Completion (EAC)					
<b>Revisions and Data Maintenance</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
RDM 26	Incorporating Changes in a Timely Manner					
RDM 27	Reconciling Current to Prior Budgets					
RDM 28	Controlling Retroactive Changes					
RDM 29	Preventing Unauthorized Revisions					
RDM 30	Documenting Performance Measurement Baseline Changes					

## B. Project Schedule and Cost Control

How often are the following aspects of project schedule and cost control are implemented in your organization? Please Tick on the appropriate one

**Application of Schedule and Cost Control**

<b>Schedule Control</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
PSC 1	Determining the project schedule's current status					
PSC 2	Handling the variables that affect project schedule					
PSC 3	Reevaluating the need for schedule reserves					
PSC 4	Determining whether the project schedule has changed					
PSC 5	Managing the actual schedule changes as they happen					
<b>Cost Control</b>		Never	Rarely	Sometimes	Often	Always
		1	2	3	4	5
PCC 6	Handling the variables that result in changes					
PCC 7	Handling Cost Change Request					
PCC 8	Coordinating the real changes as they happen					
PCC 9	Ensuring that project costs are not incurred in excess					
PCC 10	Tracking cost performance					
PCC 11	Comparing labor performance to the amount of money spent					
PCC 12	Preventing unauthorized changes from being accounted					
PCC 13	Notifying the proper parties of all approved changes					
PCC 14	Bringing anticipated cost overruns under control					

### C. Role of EVM

<b>Role of EVM</b>						
<b>Project Management</b>		Very Low	Low	Moderate	High	Very High
How would you rate the significance of EVM in the following areas		1	2	3	4	5
RL 1	Realistic Project Planning					
RL 2	Gain real-time visibility of centralized information					
RL 3	Measure schedule and budget accuracies					
RL 4	Anticipate risks and intervene early					
RL 5	Enhances accountability and motivation					
<b>Project Success</b>		Very Low	Low	Moderate	High	Very High
How would you rate the success of projects in your firm in the following parameters		1	2	3	4	5
PS 6	Resource Management					
PS 7	Meeting Deadline of projects					
PS 8	Budget Management					
PS 9	Stakeholders Satisfaction					
PS 10	Post project Business Value					

### D. Factors Affecting the implementation of Earned Value Management

How would you rate the importance of the following factors affecting the practice of Earned Value Management System (EVMs) in your organization? Please Tick on the appropriate one

<b>Factors Affecting EVM</b>		Very Low	Low	Moderate	High	Very High
		1	2	3	4	5
F 1	Organizational Resources – Expertise, Cost, Time					
F 2	Organizational Culture					
F 3	Project Scope Definition					

F 4	Organization's Project control Policy and Procedures – Plan, Report, Paper Work,					
F 5	Measuring the current progress of Projects					
F 6	Commitment of Top Management					
F 7	Cost required for Implementation					
F 8	Project Payment Methods Adopted – cost-reimbursable, lump-sum, and unit prices					

Other Factors (If there is any you recommend)

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## **Annex 2**

### **Structured Interview for Senior Managers**

1. What are the nature and types of projects handled by the organization?
2. Does your organization have schedule and cost control policy? If yes, please define.
3. What are the activities your company applies to control schedules of projects?
4. What are the activities your company applies to control cost of projects?
5. How do you define the practice of project controlling tools and techniques in your organization as a whole?
6. Does your organization have a written Earned value Management system description? If yes, please describe it.
7. Does your organization have a written Earned value Management system development plan and status measuring metrics?
8. What are the challenges of using Earned value Management System?
9. What are the opportunities of using Earned value Management System?

### Annex 3

*Table A Validity test result of the measuring instrument*

Variable	r
PSC1	.588**
PSC2	.588**
PSC3	.717**
PSC4	.451**
PSC5	.566**
PCC6	.903**
PCC7	.457**
PCC8	.903**
PCC9	.857**
PCC10	.451**
PCC11	.751**
PCC12	.588**
PCC13	.451**
PCC14	.903**
OS1	.667**
OS2	.903**
OS3	.588**
OS4	.857**
OS5	.842**
PSB6	.667**
PSB7	.903**
PSB8	.588**
PSB9	.837**
PSB10	.667**
PSB11	.733**
PSB12	.733**
PS10	.751**

Variable	r
AC13	.662**
AC14	.546**
AC15	.355*
AC16	.768**
AC17	.548**
AC18	.674**
AMR19	.903**
AMR20	.457**
AMR21	.903**
AMR22	.857**
AMR23	.451**
AMR24	.751**
AMR25	.588**
RDM26	.548**
RDM27	.524**
RDM28	.648**
RDM29	.524**
RDM30	.354*
F1	.588**
F2	.451**
F3	.903**
F4	.588**
F5	.647**
F6	.903**
F7	.717**
F8	.903**

Variable	r
RL1	.588**
RL2	.717**
RL3	.451**
RL4	.647**
RL5	.903**
PS6	.588**
PS7	.903**
PS8	.903**
PS9	.451**

## Annex 4

*Table B Result of editing the data and coding*

Variable	Variable Code	Questionnaire Statement	
	Sex	Gender of respondent	
	Age	Age of respondent	
Demographic	Edu_Lvl	Educational Level of respondent	
	Work_Ex	Work Experience of respondent	
	P		
	Org_Role	Organizational role of respondent	
Project Schedule Control	PSC1	Determining the project schedule's current status	
	PSC2	Handling the variables that affect project schedule	
	PSC3	Reevaluating the need for schedule reserves	
	PSC4		Determining whether the project schedule has changed
			Managing the actual schedule changes as they happen
	PSC5	Handling the variables that result in changes	
	PCC6	Handling Cost Change Request	
	PCC7	Handling Cost Change Request	
	PCC8	Coordinating the real changes as they happen	
	PCC9	Ensuring that project costs are not incurred in excess	
	Project Cost Control	PCC10	Tracking cost performance
		PCC11	
		PCC12	Preventing unauthorized changes from being accounted
PCC13		Notifying the proper parties of all approved changes	
PCC14	Bringing anticipated cost overruns under control		
Factors Affecting Implementation of EVM	F1	Organizational Resources – Expertise, Cost, Time	
	F2	Organizational Culture	
	F3	Project Scope Definition	
	F4		Organization's Project control Policy and Procedures – Plan, Report, Paper Work,
			Measuring the current progress of Projects
			Commitment of Top Management
			Cost required for Implementation
	F8	Project Payment Methods Adopted – cost-reimbursable, lump-sum, and unit prices	
Organization and Scope Fundamentals	OS1	Defining Work Breakdown Structure (WBS)	
	OS2	Defining Project Organization Structure (OBS)	
	OS3	Integrating Processes - planning, scheduling, budgeting	

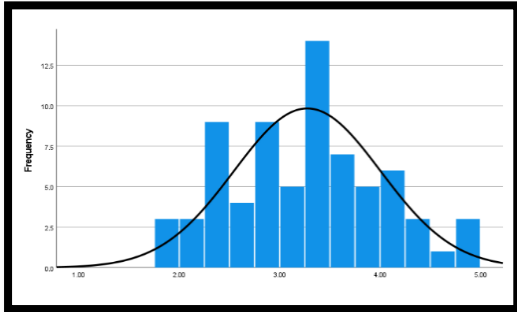
	OS4	Identifying Overhead Management
	OS5	Integrating WBS/OBS to Create Control Accounts
	PSB6	Scheduling with Network Diagrams
	PSB7	Setting Measurement Indicators – Milestone, Goals
Planning	PSB8	Establishing Budgets for Authorized Work
Scheduling and	PSB9	Budgeting by Cost Elements
Budgeting	PSB10	Creating Work Packages, Planning Packages
	PSB11	Establishing Overhead Budgets
		Identifying Management Reserve and Undistributed
	PSB12	Budget
	AC13	Recording Direct Costs
	AC14	Summarizing Direct Costs by WBS Elements
Accounting	AC15	Summarizing Direct Costs by OBS Elements
Consideration	AC16	Recording/Allocating Indirect Costs
	AC17	Identifying Unit and Lot Costs
		Tracking and Reporting Material Costs and
	AC18	Quantities
	AMR19	Calculating Schedule Variance
	AMR20	Calculating Cost Variance
Analysis and	AMR21	Identifying Significant Variances for Analysis
Management	AMR22	Analyzing Indirect Cost Variances
Report		Summarizing Variance Information for
	AMR23	Management
	AMR24	Implementing Corrective Actions
	AMR25	Revising Estimate at Completion (EAC)
	RDM26	Incorporating Changes in a Timely Manner
Revision and	RDM27	Reconciling Current to Prior Budgets
Data	RDM28	Controlling Retroactive Changes
Maintenance	RDM29	Preventing Unauthorized Revisions
		Documenting Performance Measurement Baseline
	RDM30	Changes
	RL1	Realistic Project Planning
	RL2	Gain real-time visibility of centralized information
Role of EVM	RL3	Measure schedule and budget accuracies
	RL4	Anticipate risks and intervene early
	RL5	Enhances accountability and motivation
	PS6	Resource Management
	PS7	Deadline of projects
Project Success	PS8	Budget Management
	PS9	Stakeholders Satisfaction
	PS10	Post project Business Value

*Source: Survey 2023*

## Annex 5

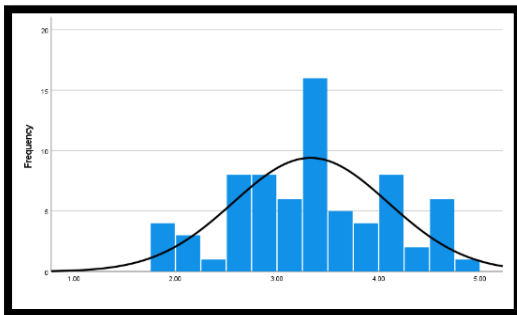
Normality test result of correlation

*Figure A-1 Histogram of Organization and Scope*



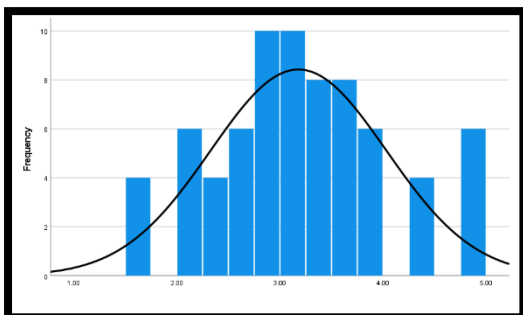
*Source: Survey 2023*

*Figure A-2 Histogram of Planning Scheduling and Budgeting*



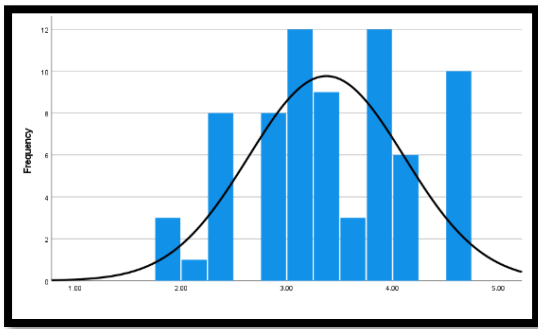
*Source: Survey 2023*

*Figure A-3 Histogram of Accounting Consideration*



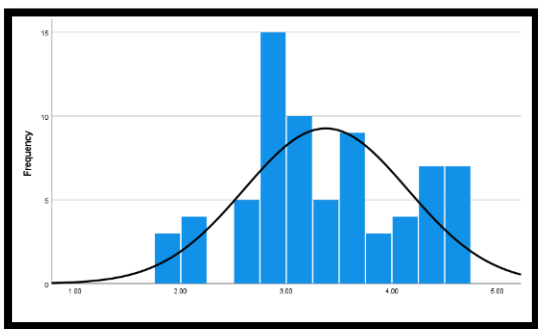
*Source: Survey 2023*

*Figure A-4 Histogram of Analysis and Management Reports*



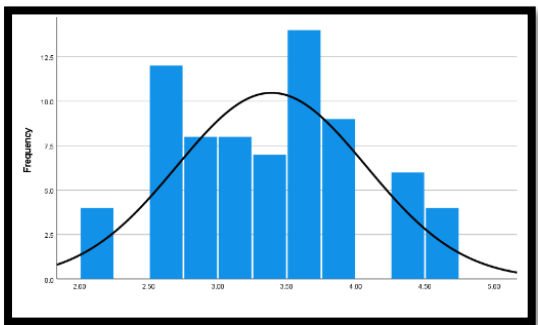
*Source: Survey 2023*

*Figure A-5 Histogram of Revision and Data Maintenance*



*Source: Survey 2023*

*Figure A-6 Histogram of Project Success*



*Source: Survey 2023*