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Research Article

Investigating Strategies to Enhancement the Use of Earned Value Management (EVM) on Performance Evaluation of Construction Projects: A Case Study of Sidama Region, Ethiopia

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A B S T R A C T

The construction industry in Ethiopia is one of the major sectors that considering the rapid growth, where public and private sectors are investing substantial amount of resource. However, the performance of construction projects is no optimum due to inapplicability of management tools like Earned value management. The construction Projects in Sidama region project are monitored and tracked by using traditional way, which does not leave room for the implementation of Earned value management as a system. The projects in the region have low performance and progress with regard of cost and time. That led to the study of this paper. Based on of the objectives, this study used both qualitative and quantitative data collection which is analysis by descriptive analysis. A structured questionnaire survey, interview and case study were performed to collect data. The data then has been analyzed by using SPSS, correlation of RII by STATISTI and EXCEL. The validity of data and reliability/consistency checked by Cronbach's alpha and respondent agreement level checked by Spearsman correlation coefficient. This study examines the applicability of Earned Value Management technique in measuring the performance projects, identify and determine the hindering factor for implementation Earned Value Management, assesses the integration of Earned Value Management with other tool and finally investigates the best methods to enhance the application of Earned Value Management. The study result indicates the application of Earned Value Management is minimum. There are hider factors to its applicability, the three top factors are; inadequate knowledge, not required by client and current situation of the construction industry in the country. In assessing the integration EVM with other management tool is like that of implementation of Earned Value Management which is low. Therefore, for sure enhancement of Earned Value Management is mandatory and the best techniques to adopt it implementation is by integration of Earned Value Management with other management tool.

Keywords: Earned value management; Project progress; Performance; Integration of Earned; Value Management; Enhancement of Earned Value Management

Introduction

1.1 Background of the study

The construction sector in Ethiopia is vigour in the economy of the county. Indeed, development of these areas features heavily become the nation's Second Growth and Transformation Plan (GTP II)[1]. The construction industry trend for the past 10 years shows a yearly growth rate of 12.43 and this shows a share of 5.3% of the country's GDP. However, the performance and progress of the industry is not well developed with application of project management. It is said to be inadequate in its delivery system and processes[2].

Ethiopian construction project management practices and identify the major issues regarding challenges reveal the level of construction project management procedures, project management functions, tools & techniques to be unsatisfactory. Especially, the level of practice in terms of safety, risk and time management was found to be very low. Mostly project schedules vary with in the range of 61-80% and at the same time cost and other variable like, risk, quality, resources utilization and safety deviates slippage ranges 21-40% from the anticipated beginning of the project[3].

The inefficiencies in the construction sector are due to lack of proper planning, execution and monitoring of projects guidelines of construction management that attribute to the lack of trained personnel, non-appreciation of the importance of proper planning and monitoring schemes to improve performance and the lack of appropriate guidelines in the managing processes[4].

In developing nations like Ethiopia, the construction of large-scale projects is not finished on time and within the budget allotted. This impacted in, loss of a lot of money, opportunities for employment, and other economic and social benefits as a result of these issues. In order to develop a national mechanism for minimizing time and cost overruns in such mega projects and in the construction industry generally, it is imperative to understand the primary factors that contribute to such problems[5].

Managing construction costs entails planning, estimating, gathering and analyzing cost data, and eventually putting corrective actions into action. Cost management is used to balance a project's scope, expectations of quality, and budget during the planning, design, and construction phases[6]. The main reason that initiated this research is the cost variation and significant time delay in the construction projects. Especially the mega project in the region is face cost overturn and time delay which inspired this research. This research identifies the problem behind construction project cost overturn and time delay and finds a solution.

Earned Value Management (EVM) is one of the most relevant techniques used to measure the performance and progress as well as give feedback tools for managing projects. It enables managers to close the loop in the plan-do-check-act management cycle. EVM has been called "management with the lights on", because it can help clearly and objectively illuminate where a project is and where it is going as compared to where it was supposed to be and where it was supposed to be going. (PMI, 2005)Earned Value Analysis (EVA) is a tool used to monitor and control construction projects by integrating cost, time and scope[6].

EVM is a concept that used to adopt project visibility and accountability by forces upfront planning and a disciplined to accomplish management standards. EVM is related to the premise of comparing work completed against efforts and resources spent that need visibility and accountability of value of money spent till date and assesses the most efficient approach to future spending[7].

Naderpour & Mofid, schedule and technical performance. It allows the calculation of cost and schedule variances and performance indices and forecasts the project cost and schedule duration. The Earned Value concept was conceived by industrial engineers working in American factories over a century ago. This concept improved by the time and in July 1998, the Earned Value Management System became the American National Standards Institute (ANSI/EIA argue that Earned Value project management is management system that integrates cost, schedule and technical performance. It is used to calculation of cost and schedule variances and performance indices and forecasts the project cost and schedule duration by Comparing the EV to the plan value and actual cost, so that a project manager can identify whether a project is ahead or behind schedule and over budget or under budget at any time[7]. This study assesses the application EVM, identifying factors affecting the application EVM, assess the integrating EVM with other performance evaluating tool to enhance its application and choose the best method to enhance the usage of EVM in construction projects.

Finishing projects on time, within budget, meeting end product specifications is the desire of customer needs & objectives as while as for PM. However, Ethiopian construction companies usually have no well-developed in monitoring and control projects, Project control is not prioritized and problems are solved as when it is occurring rather than by controlling the project to avoid problems. This led to several problems in the Ethiopian projects that could have been avoided if an efficient project control were conducted[8]. Construction projects are significant contributors to the national economy and strengthen national and regional development[9]. And also he describe that current construction projects show significant cost variation due to of traditional method of which affect the overall performance of construction projects[9].

The reasons that stand behind the adoption of this research work are; EVM has been the most effective method used currently for measuring the performance and progress of projects at construction stages of the project. Yet it is not well adopted as the concept in most of construction projects, so this study asses the applicability of EVM, identify impeding factors for the applicability of EVM in the construction project and also Assessing the integration of EVM with other management tool enhance it applicability, and identify the best technique for the enhancement of EVM in construction project. Therefore, the main objective of this study is to enhance application of EVM, after examine the applicability of EVM in the performance in construction projects.

It also achieves the following specific objectives: To assess the application of EVM in construction project in Sidama region, to identify and determine factors affecting application of EVM in construction project. To assessing the Integration of construction management tools with EVM to enhances its applicability. And to investigate the best techniques (methods) to enhance the usage of EVM in construction Project.

2 Methodology

2.1 Study area

In southern Ethiopia, there is a regional state called Sidama Region. Due to the 98.52% acceptance percentage for further

autonomy in the Sidama referendum of 2019, the Sidama Zone was changed from the Southern Nations, Nationalities, and Peoples' Region on June 18. The name Sidama is used to refer to both the Sidama people and their native region. The Oromia Region is bordered on the south by Sidama, the west by the Bilate River, which separates it from the Wolayita zone, and the north and east by the Oromia Region. A few of the towns in Sidama include Yirgalem, Wondogenet, Chuko, Hula, Bona, Bursa, Bensa, and Aleta Wendo in addition to Hawassa, the nation's capital. Sidama had 3.2 million populations in 2017 who were Cushitic-speaking (**Figure 1**).
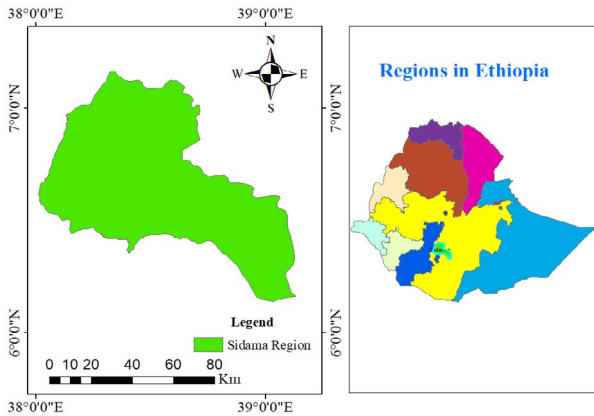

Figure 1: location of the study area.

2.2 Research Design

(Sekaran. (2003)) the research design shows the characteristics of the study with regard to its goal, type of investigation, and level of researcher involvement, as well as the measurements and measures, unit of analysis, sample design, data gathering method, and data analysis.

In this study, both quantitative and qualitative research methods were utilised. All quantitative data have been based on qualitative assessments because every qualitative data may be characterized and numerically manipulated to arrive at findings and make recommendations. The data was gathered through questionnaire surveys, interviews, and project document reviews. The information received in a large sample population for this study, which is employed in comprises measuring variables and establishing frequencies or correlations between variables. However, this study will address each specific target utilizing a methodology that is suited for that purpose in order to address the research problem. The (**Figure 2**) below shows the flow chart.
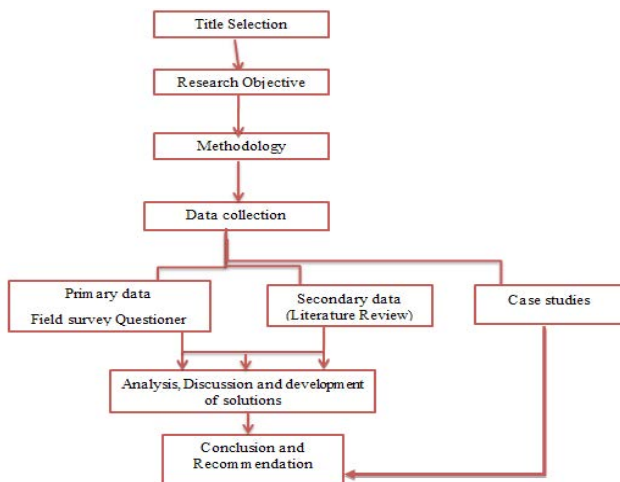

Figure 2: Research Methodology Flow Chart.

2.3 Population and Sampling

The study population in this paper is the mega construction projects Sidama region. The professionals with the projects include contractors, consultants, clients. closed questions have been sent to project offices and sites. The Samples are accurate reflect the free from bias in order for the data to be considered reliable otherwise, the trustworthiness of future generalization could be impacted by the chosen sample.

This study concentrated on Sidama region ongoing mega construction projects. Projects in Sidama region were used to create the study population. There are more than 480 outgoing projects in the region, this paper focus on the mega projects in the region. This is due to; time constraints to complete the project work limited, the availability of data, and the scope of the study used to representative construction project in the region.in the region there are 35 mega projects. The number of sample size is 105 form Equation3.2. The sites received questionnaires, which was made available to all client, consultants and contractors.

2.4 Methods of Data Collection and Source of Data

Both primary and secondary sources of used to gather data that are more comprehensive and in-depth, interviews, field observations, and questionnaire surveys were undertaken. Specifically designed structured questionnaires was used to gather primary data for this investigation. Additionally, secondary data such as a review of previous research projects, published journals, reference materials, conference papers, working papers, etc. was gathered using the internet, research papers, journals, magazines, and numerous articles in public materials. In order to better understand the problem, and were used as criteria for developing and analyzing the primary data.

2.5 Method of Data Analysis

Annual, 2015) states that analysis is a collaborative process in which findings are checked to see if they are applicable to each research issue. Statistical Package for Social Sciences (SPSS) and Excel were used to analyze the data in this study. This program was chosen since it is frequently used in academic studies. In addition to being widely used, they are appropriate for statistical data analysis. The quantitative data were analyzed using descriptive statistics (mean, frequency, and percentage).

3. Data Analysis and Discussion

3.1. Introduction

The findings of the study and analysis are reported in this section outline the findings of interview, questionnaire survey, and case study about the usage of Earned value management (EVMs) in construction projects in Sidama region and opinions of key participants, including contractors, consultants, and clients.

3.2 Questionnaire Analysis and Rate of return

The survey's formal questioner distribution to client employee, contractor and consultant had a target sample size of 105. Out of the 105 questionnaires that were distributed 89 (84.76%) were returned and analyzed; 16 (15.24%) of these were not returned. After gathering the questionnaire's raw data, the information was loaded into computers SPSS and Excel tools were used to evaluate the data. The results and discussion that follow are divided into four categories in accordance with the objectives of this study and the parts of the questionnaire to

pursued one goal at a time with the use of these divisions. The objective of the first section is to present the results of assessing the application of EVM. The responses to the questions targeted to ascertain factor that would affect the applicability of EVM could be identified are discussed in the second part of the results and discussion. The third portion assesses the integration of EVM with other tool based while; the fourth section presents the results of the questions asked about the best ways to improve the adoption EVM.

3.2.1 Profile of the Respondent

3.2.1.1 Educational Background of the respondent

The results of the study are shown in (**Table 1**) out of the 89 retuned respondents, 57.3% responded contractors, 23.6% stated consultants, and 19.1% are clients. This indicate that the three top body Contractor, consultant and client in the construction sectors are involved which is important to assess the application of EVM every parties.

Table 1: The respondent positions in the stockholders.

Category of the respondent	Frequency	Percentage (%)
Contractor	51	57.3
Consultant	21	23.6
Client	17	19.1
Total	89	89

3.2.1.2 Position of respondents' jobs

Project team members make up the majority of survey respondents 52.8%, followed by Portfolio manager 32.6%, project managers 7.9% and other specific responders 6.7% as indicated in the (**Table 3.2**) below. This implies the respondent involvement related to the issue EVM.

Table 2: Position of respondents' jobs.

Category of the respondent	Frequency	Percentage (%)
Project manager	7	7.9
Project team member	47	52.8
Portfolio manager	29	32.6
Others specify	6	6.7
Total	89	100.0

3.2.1.3. Education level of the respondents

The general profile of the respondents suggests that the majority have a level of education that is sufficient for experience in construction firms. This signifies that all of the questionnaire's items could be answered by the respondents with the necessary knowledge. That is verified by (**Table 3**), as shown in the table below.

Table 3: Level of education of the respondent.

Level of education of the respondent	Frequency	Percentage (%)
Bachelor's degree	38	42.7
Master's degree	5	5.6
Diploma	25	28.1
PM Certificate.	21	23.6
Total	89	100.0

3.2.1.4 Experience of the Respondent

The respondents' work experience in construction firms was evaluated, and it discovered that 46.1 % had three to five years of experience, 37.1 % had one to three years of experience 5.6

% of them had more than ten years of experience and 11.2 % had five to ten years of experience. (**Table 4**) below, implies the respondent experience in the construction that used to assess the adoption of using the EVM system.

Table 4: Work experience of the respondent.

Work experience of the respondent	Frequency	Percentage (%)
0-3 year's	33	37.1
3-5 years	41	46.1
5-10years	10	11.2
More than 10 years	5	5.6
Total	89	100.0

The overall respondent profile of the questioner was discussed in the above Table are summarized in the (**Figure 1**) below that is used to set a base for the other objective to earn the required that data.
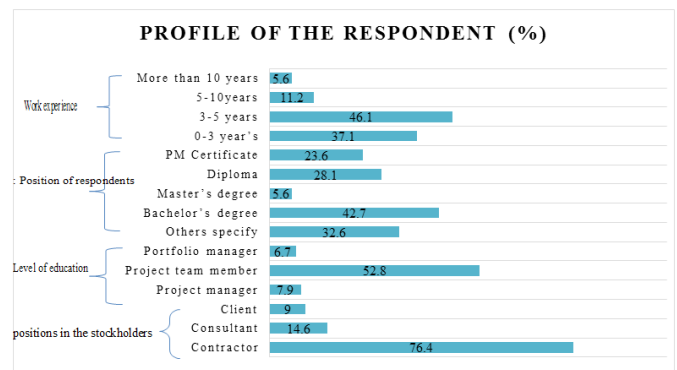

Figure 1: Profile of the respondent projects.

Results of the Cronbach's Alpha test for the reliability of the questioner

Table 5: Cronbach's Alpha for sections 2 of the questionnaire.

Questioner section	Cronbach's Alpha (α)
Factor affecting the application of EVM	0.81
The cost performance factor affecting the application of EVM	0.856
The time performance factor affecting the application of EVM	0.887
The safety related Factors affecting the applicability of EVM	0.773
The quality related Factors affecting in the applicability of EVM.	0.81

The results of reliability statistics are shown in the (**Table 5**) shows the results of Cronbach's Alpha are 0.81, 0.856, 0.887, 0773 and 0.81. In this **Table** the output of reliability statistics Scores for the Cronbach's alpha coefficient are over 0.7, this demonstrates significant internal consistency and proving the validity of the survey. The range is typically regarded as high, which ensures the validity of each questionnaire component.

Implementation of EVM on construction

Figure 3.2 Shows the response for the question asked "How do you track and monitor Project Progress", 48.3% of the responded use by comparing planned costs against actual costs, 33.7% of the respondents use integration of EVM, while the rest 7.9% and 10% use other method (PERT and S-curve) and Earned value management methods respectively. This demonstrates the application of EVM low compared to the adoption other methods in the construction sector; therefore, EVM usage is rather underutilized and poorly applied (**Figure 2**).
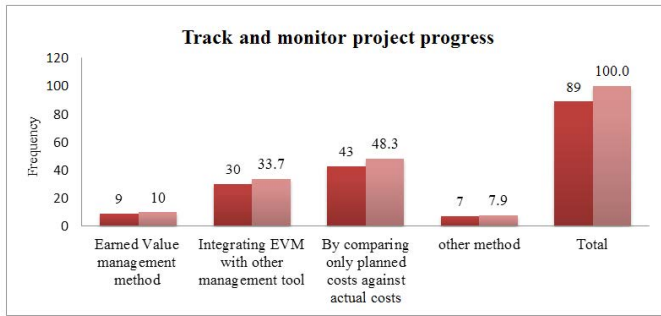
Figure 2: Respondents track and monitor Project Progress.

3.4.1. Knowledge of EVM in construction

Figure 3 below, explained response for the question asked "How knowledgeable are you about EVM", the respondent's knowledge about the term Earned Value Management (EVM) for the question has been presented as, and 53.9% were familiar about EVM while 21.3% were knowledgeable with the concept of EVM. The rest 19.1% are not familiar while 5.6 % were expert form the respondents.
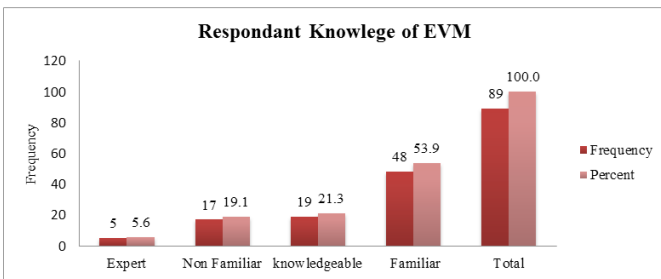

Figure 3: Respondent Knowledge on EVM.

3.4.2. The Positively influence of EVM Deliver construction project

The respondent's experience regarding the EVM positively influenced the successful deliveries of the past projects represented, As shown in (**Figure 4**) below, As presented below, the respondents answered 73% for EVM positively influencing projects, 19.1% have never used EVM, 4.5% of the respondent have neutral opinion of using EVM while the rest 3.4% believe counterproductive. This implies the most of respondent believe EVM application have a positive impact on project progress.
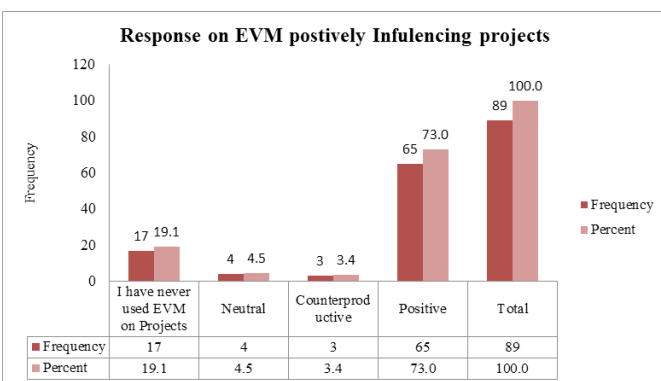
Figure 4: Respondent Response on EVM positively influencing Projects.

3.4.3. The value of EVM in the construction project

(**Figure 5**) below, Shows the response for the question asked "What is your opinion of the value of EVM?", 47.2% for extremely valuable for all projects, 25.8% for useful for large projects, 14.6 % for Neutral and the rest 3.4 % for using EVM not worth of the effort. This indicates the respondent's opinion

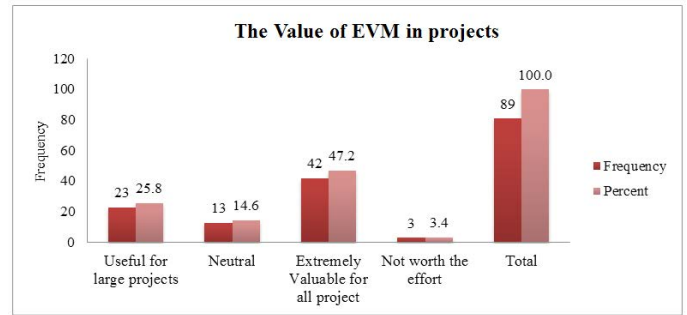regarding value of EVM which is extremely valuable cover half of the respondent.

Figure 5: Respondent Response on EVM positively influencing Projects.

3.4.4. The reason why EVM is used in the construction projects

The respondent's opinion of "usage EVM in the organization and if used identify the reasons of using of EVM?" is presented as shown in (**Figure 6**) below, the result represented that 56.2% don't use EVM ,22.5% voluntary use in their company ,12.4% use EVM if it required by Client and 9% use EVM if it Required by consultant. This implicated that number of respondents that apply EVM voluntary is low and the application of EVM most likely not required by the clients.
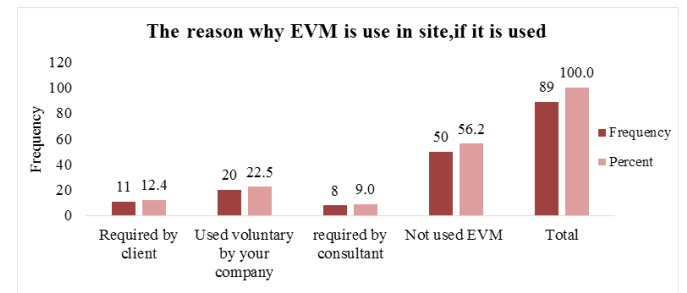

Figure 6: Respondent Response on Why EVM is use in site.

3.4.5. How often EVM is used in construction projects

(**Figure 7**) below shows, answer for the question "How often EVM techniques is used in the construction project", Out all the respondent 56.2% have never used EVM, 22.5 % frequently apply EVM ,12.4 % rarely apply EVM while 9 % apply EVM in the construction projects. This Implies the half of the respondent have never used EVM and on the other hand in parities applying EVM apply frequently, this is due to impact stockholders in its applicability especially the client.
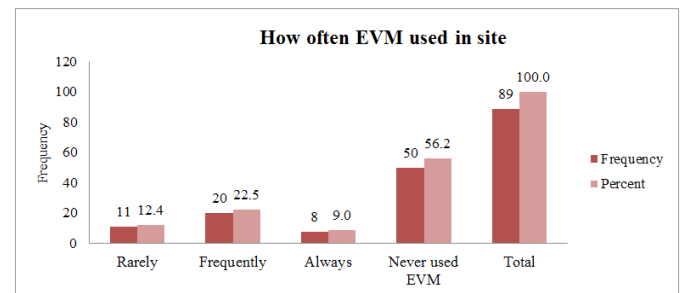

Figure 7: Respondent Response on How often EVM techniques is used in site.

3.5. Factor affecting EVM application

The findings suggest that the "In adequate knowledge of EVM"," Not required by stakeholder (clients) " and" Current situation of construction "are the most significant factors

variables with the RII index of 0.892, 0.81 and 0.78 respectively which affecting the implementation of EVM in construction industry's management performance. All other variables were significantly ranked based on the respondent responses on (**Table 6**)

Table 6: Factor affecting the application of EVM.

NO	Factor affecting the application of EVM	mean	RII	Rank
1	In adequate knowledge of EVM	4.46	0.892	1
2	Lack of suitable EVM industry, computer material and software.	3.08	0.613	10
3	Inadequate work breakdown structure (WBS) to apply EVM	3.18	0.632	9
4	Inaccurate data of cost and schedule	3.66	0.730	5
5	Tedious report and complicated and burdensome paper work procedure	3.6	0.721	6
6	prior experience in the use of other techniques	3.75	0.755	4
7	There are no well-developed procedures, guidelines and standards for project management	3.2	0.638	8
8	Earned value procedures seem too complicated	2.95	0.587	13
9	Lack of modern scheduling techniques planning and evaluation	3.32	0.656	7
10	High cost for implementation	2.99	0.604	11
11	EVM not suitable for all types of projects	2.99	0.598	12
12	Not required by stakeholder (clients)	4.04	0.811	2
13	Current situation of construction (inflation, politics, corona pandemic)	3.88	0.784	3

3.5.1. The cost related factors affecting the application of EVM

The cost related factors affecting the application of EVM are presented below, as shown in Table 3.6 The three primary cost related factors with high RII values of 0.923, 0.815, and 0.804 correspondingly are lack of communication between parties, escalation of material price, and the high cost of transportation which has an impact on the construction industries in using of EVM (**Table 7**).

Table 7: The cost related factor affecting the application of EVM.

No	The cost performance related factor affecting the application of EVM	RII	RANK
1	Lack of communication among parties	0.923	1
2	High transportation cost	0.804	3
3	Change in material specification	0.748	9
4	Fluctuation in money exchange rate	0.768	7
5	High cost of machinery	0.784	4
6	Delay in material procurement	0.773	6
7	Change of scope of the project	0.761	8
8	Escalation of material price	0.815	2
9	Unforeseen ground condition	0.779	5
10	Mistakes during construction	0.705	10

3.5.2 Time related Factor that Affects the Application of EVM

Table 7 displays, below is a presentation of the Time related Factor that Affects the Application of EVM. lack of communication between parties, fluctuations of price of

material in site and Poor site management have significant RII values of 0.856, 0.82, and 0.759 respectively influencing cost performance, which has an impact on the construction industries in using of EVM.

Table 8: The Time related Factors affecting the application of EVM.

No	The Time related Factors affecting the application of EVM	RII	RANK
1	Delay in obtaining permits from governmental agencies and Bureaucracy in tendering method	0.74	5
2	Frequent changes in design	0.714	6
3	Fluctuation of prices of materials on site	0.82	2
4	Delay in progress payment by owner and Slow decision-making by owners	0.705	7
5	Lack of modern Equipment	0.678	8
6	High quality of work required	0.588	14
7	Financial difficulties faced by contractors	0.674	11
8	Economic instability	0.748	4
9	Mistakes during construction	0.644	12
10	Difficulties on importing equipment's and materials	0.678	8
11	Shortage of materials	0.676	10
12	Additional work by the owner's request	0.608	13
13	Poor site management	0.759	3
14	Lack of communication between parties	0.856	1

3.5.3 The safety related factors affecting the application of EVM

The safety related factors affecting the application of EVM are presented below, as shown in (**Table 8**). The three top factors with high RII values of 0.840, 0.829, and 0.822 correspondingly are the Inadequate PPE at work regulation, Lack of communication between manger and worker, and Workers are not likely to report incidents. The top two are under are the category of in terms of management explained the table below, that have high impact lead to low implication of EVM.

Table 9: The safety related Factors affecting the application of EVM.

NO	Category of the factors	The safety related Factors affecting the applicability of EVM	RII	RANK
1	In terms of management	Absence of safety and health committee	0.8	4
2		Lack of communication between manger and worker	0.829	2
3		Inadequate PPE at work regulation	0.840	1
4	In terms of culture	Decision making does not involve all organization	0.74	5
5		Workers are not likely to report incidents	0.820	3
6		No regular supervision at least once a week	0.701	7
7		Rick assessment is not practicable at workplace	0.714	6
8	Level of awareness	Not well educated	0.685	8
9		Lack of accident records and official safety data	0.678	9
10		No safety briefing meting	0.622	10

3.5.4. The quality related factors affecting the application of EVM

The quality related factors affecting the application of EVM are presented below, as shown in (**Table 9**). The three top quality related factors with high RII values of 0.842, 0.826, and 0.815 correspondingly are the Material fluctuation, Lack of communication between parties, and Poor site management.

Table 10: The quality related Factors affecting in the applicability of EVM.

No	The quality related Factors affecting in the applicability of EVM.	RII	RANK
1	Lack of modern Equipment	0.8	4
2	Material fluctuation	0.842	1
3	Lack of communication between parties	0.826	2
4	Fluctuation of prices of materials on site	0.741	5
5	Poor site management	0.815	3
6	Shortage of materials	0.714	6
7	Frequent changes in design	0.705	7
8	Financial difficulties faced by contractors	0.685	9
9	Mistakes during construction	0.698	8
10	Change in material specification	0.622	10

3.6. The integration of EVM with other software

(**Figure 8**) shows that 42.7% don't use EVM on construction site, this indicate use of EVM in construction is not well practices Even though the respondents are familiar with the concept,28.1 % integrates EVM with other management tools, and the rest 23.6 %, 5.6% don't know EVM and use EVM respectively. This makes obvious clearly that EVM needs to be practiced because it is still not used quite enough.
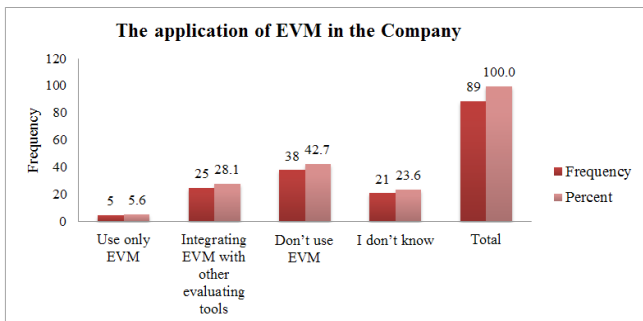
Figure 8: Respondent Response on the application of EVM in the company.

The respondent's applicability of EVM with other management tools is explained in (**Figure 9**) below. EVM is integrated with MS Project by 18% of users, Integration with Primavera by 10.1%, integration with other tools by 6.7% and the remaining 65.2 % do not implement EVMs in their construction site due to application other methods. This implies the respondent that integrate EVM use mostly MS projects.
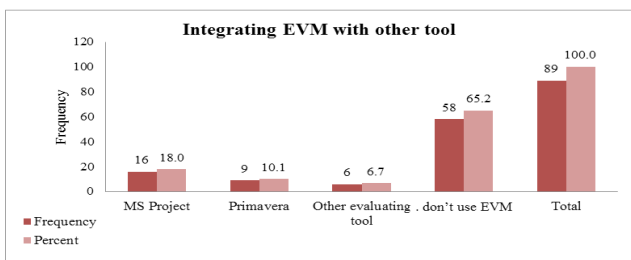
Figure 9: Respondent Response on integrating EVM with other management tool.

As shown in (**Figure 10**) below, the respondent's answer regarding the integration EVM with other tool for enhancement,43.8% for increase it applicability, 24.7% for don't know how EVM works while the remaining 20.2 %,11.2% don't use EVM and do the task EVM can't do respectively. This implies the respondents use EVM with other tool believes integration increase it adoption in the site.
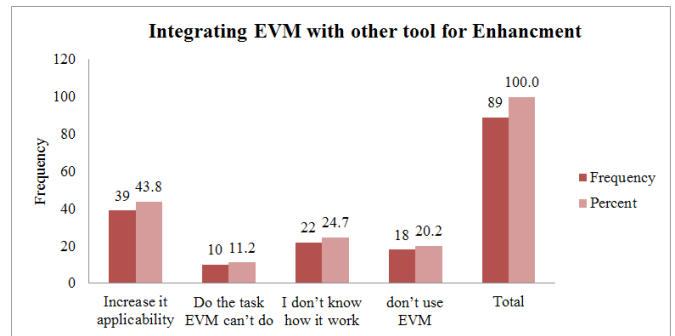

Figure 10: Respondent Response on integrating EVM with other tool for Enhancement.

"Do you believe that integrating EVM with other assessing tools has disadvantages" was the question posed to the respondents and the answer of the respondent Presented below in (**Figure 3.11**) 57.3% of respondents think there are no disadvantages to using EVMs,23.6 % think it is expensive, 10.1% don't know how to integrate it, and the remaining 9% think adopting EVM is not necessary. This implies the more than half the respondent believes there is no disadvantage in using of EVM, which is important to develop the concept of EVM, which is useful in Enhancement of EVM.
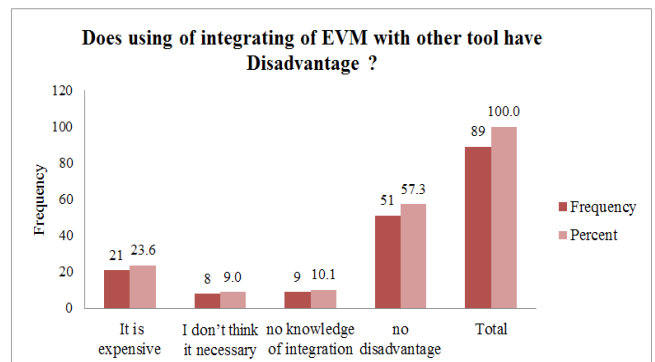

Figure 11: Respondent Response on integrating of with another tool have disadvantage or not.

3.7 Enachment of EVM in construction project

The respondent answer for the question," For enhancing of EVM in project, which method do think is the best" presentenced in the (**Figure 12**) shows below, 43.8% believe integrating EVM with other evaluating tool enhance the application of EVM. 34.8% believe providing training enhances EVM, 18.8% believe awareness creation for all stockholders enhance EVM while the remaining 3.4% prefer other methods for enhancement of EVM. the implication of this resultant is that for the adoption of the EVM, integration of EVM with other management tool in the best method that can enhance the EVM application which is low.

3.8. Case study

3.8.1. Case study 1

About 40 kilometers south of Hawassa and 260 kilometers south of Addis Abeba, in the south-central Sidama Region,

is where find the Yirgalem Integrated Agro-Industrial Park (Yirgalem IAIP). It is managed by the Sidama Industrial Parks Development Corporation. The Park Located on 294.5 Hectares. There are Six Rural Transformation Centers (RTCs) that can be found within a 100-kilometer radius of the park in the towns Dilla, Yirgachefe, Bule, Daye, Aletawondo, and Hawela Tula. Yirgalem IAIP launched with the budget of 1.4 billion ET birr. Buildings, infrastructure, sheds, and roads were among the several constructions included in the project, which was given to four different contractors. (Afro-Tsion construction; Yirgalem construction; Zamera construction; and Nasew building). Recently the project head with Afro-Tsion construction and Yirgalem construction, the other two contractors were terminated. This project is taken as one of the case studies to depict the implementation EVM mega project and also the versatility of construction inside enables to find more information from different contractor and different exposer with one site.
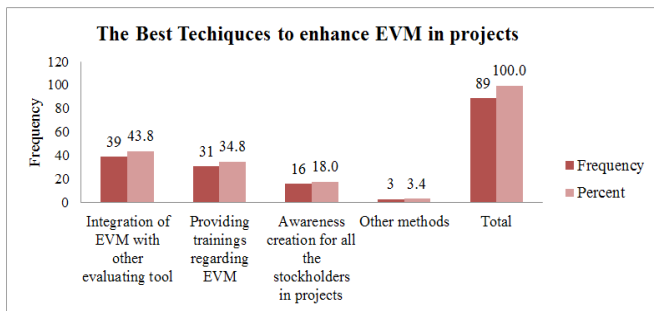
Figure 12: Respondent Response on Best techniques to enhance EVM in Construction.

3.8.1.1. Project status indicator

I. Analysis of Actual Project State

Assessment of the actual state of the project shall cover all activities of the project; Yirgalem IAIP project almost 48 % the work is completed. The project was intended to complete with 2012 EC year, yet due to cost overrun and delay the project is not able to be completed.in the beginning of the project there were sign of application of EVM which did not last for months that cost and led the project behind its schedule. Construction project tracking via earned value management is helpful in identifying the project's risk factors and in predicting any issues that may arise in order to complete the remaining project work. On the other hand, there is no application of EVM in this project that, the project goes another way, this is show in cost and time analysis of 2021GC work handled by Afro-Tsion construction the Figures below. Cost variance (CV) is a measurement of the difference between the anticipated and actual costs of work completed up until the date progress was recorded in monetary terms. If it's negative, it means the project's budget has been exceeded.in this case study CV value is negative that indicate the project is over the budget the whole year 2021EC.this certain the response of the respondent of not using EVM in the construction project. This explained in the (**Figure 3.13**) below;

Measure of the difference between the actual progress and the expected progress is called the assessment of time variances. If the difference between the planned cost of the work that has been completed and the planned cost of the work that was anticipated to be completed negative, it indicates a delay in this project schedule variance (SV) is negative this explains in the (**Figure 14**) below.
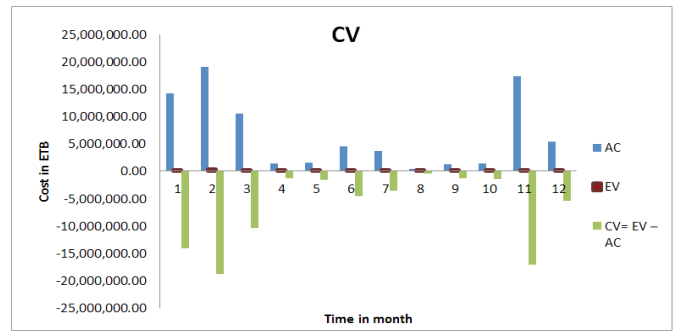

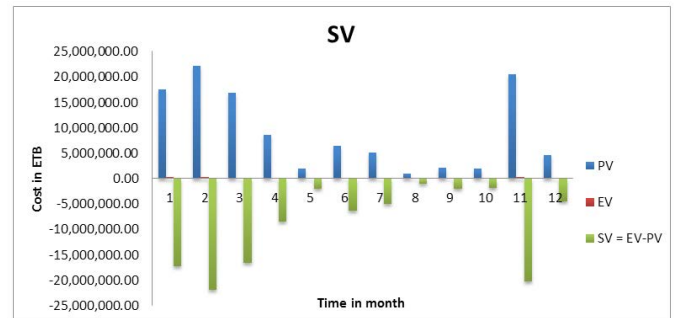**Figure 13:** Cost Analysis for case study one, year 2021.

Figure 14: schedule Analysis for case study one, year 2021.

Cost Performance Index (CPI) measures the value of the work completed for each money spent and illustrates how efficiently resources are utilized. In this specific project (Yirgalem IAIP project) CPI is less than one that indicate the project is not using resource (cost) efficiently as planned. This is described in the (**Figure 3.15**) below.
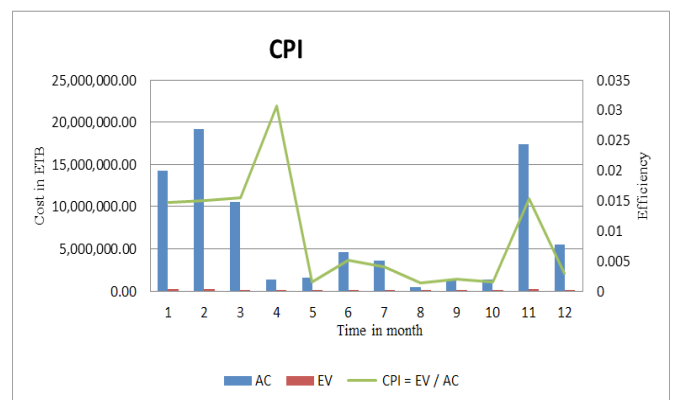

Figure 15: Cost performance Index Analysis for case study one, year 2021.

The efficiency of this project in terms schedule SPI, in this particular project is less than one that indicate the project was not efficiently goes as planned the whole year as schedule. This show in the (**Figure 16**) below.
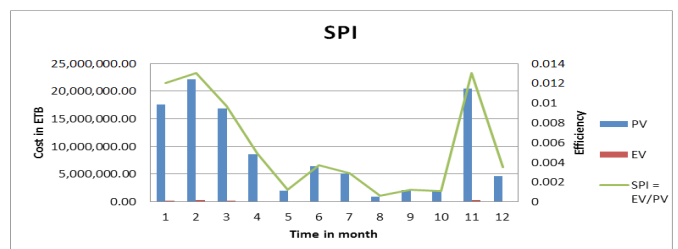

Figure 16: Schedule performance index for case study one, year 2021.

To describe the project health critical ratio (CR) is used; in this case study the overall performance of the project is less than

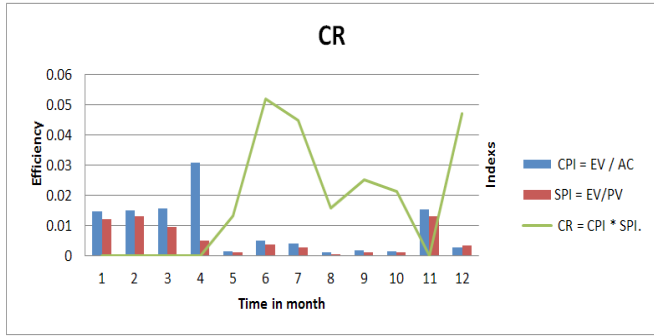one that is shown in (**Figure 17**) explain the performance of the project poor.

Figure 17: Critical Ratio (CR) Analysis for case study one, year 2021.

3.8.1.2. Analysis on the case study one if EVM is implemented

For Case study one if EVM was applied there would have been no suffrage regarding the overall performance of the project, it would have gone as planned. If EVM was applied the project have a chance to be completed within the planned time. This study shows that gap between not applying EVM and using it. The CV, SV, CPI, SPI, CR graph of case study one, if EVM was applied explained in graph below. In the (**Figure 18**) below the cost variance Analysis is explained in the application of EVM. The result indicates, cv value is greater than one that explain the project in not facing cost overturn if EVM was implemented.
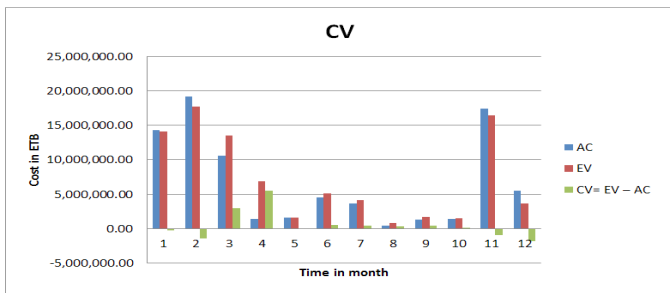
Figure 18: CV Cost Analysis in Implementation of For Case Study One, Year 2021.

In the schedule variance Analysis in the implementation is explained show in the (**Figure 19**), SV value is near to one that far better than the result obtained for not using EVM which negative, therefore in the implementation of EVM implies the project will be finished according to the plan if EVM was used in the project.
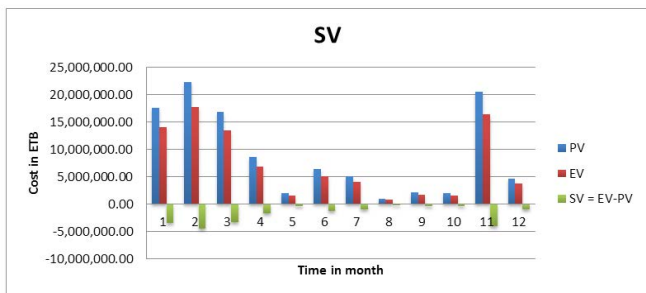
Figure 19: Schedule Analysis in implementation of EVM for case study one, year 2021.

The CPI for the case one in the implication of EVM implies, the project CPI efficiently is one in most of the moths therefore the, project performance is good, this explained in the (**Figure 20**) below.
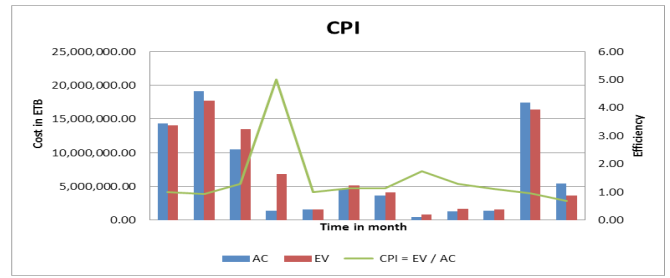
Figure 20: Cost Performance Indexes (CPI) Analysis in implementation of for case study one, year 2021.

The SPI in this (**Figure 21**) below, explain the value of SPI in the implementation of EVM, which is the close to one which implies the project efficiently go as planned if EVM was applied.
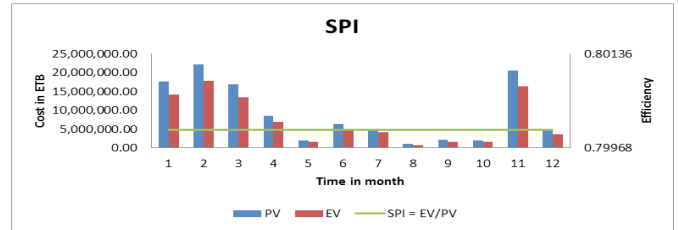

Figure 21: Schedule Performance Indexes (SPI) Analysis in implementation of EVM case study one, year 2021.

CR in the implementation of EVM in the case study one is explained in (**Figure 22**) below, when EVM is applied CR is greater than one that implies the project good health. Therefore, When EVM is applied, the project will perform good which is greater than one.
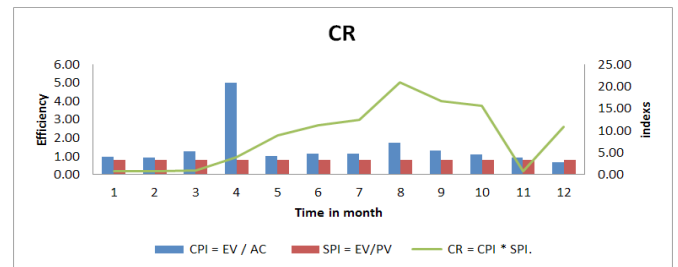

Figure 22: Critical Ratio (CR) Analysis in implementation of EVM, for case study one.

3.8.2. Case study -2

Affini Hall/Gudumale cultural park project aimed to be constructed to show the multicultural of sidama people and representation of the regions. it is multi buildings having different purpose for both governmental and non-governmental. The project started on July 14 ,2017 and completion date of July 2020 with the budget of 256,000,000 birr. Yirgalem construction takes the contract and BET Architects PLC Consultant in the client side. The currently the 26.5 % of the project is completed. the project has been stopped for about 9month currently. This Affini project is taken as one the case study due the fact that project one of the largest projects in the region which is built in the city Hawassa.

I. Analysis of Actual Project State

The cost variance analysis for the case study 2 implies negative as show the (**Figure 23**) below, which explain the project is over budget or less than one.
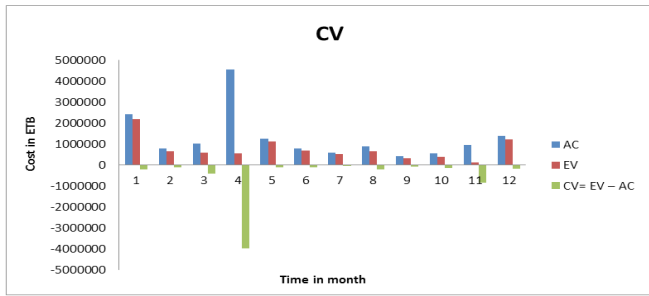
Figure 23: Cost Analysis for case study Two, year 2021.

Measuring the actual work accomplished in relation to planned accomplished in the case study-2 shown in the (**Figure 24**) below, the SV is negative that indicate the project behind the schedule.
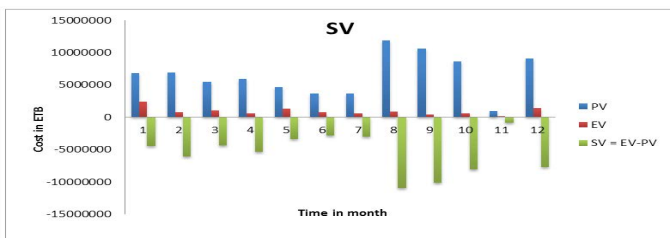

Figure 24: Schedule Analysis for case study Two, year 2021.

The case study 2 cost performance indexes (CPI) analysis indicates CPI is less than one this implies the project is not efficiently performed as planned. This is shown the (**Figure 25**) below.
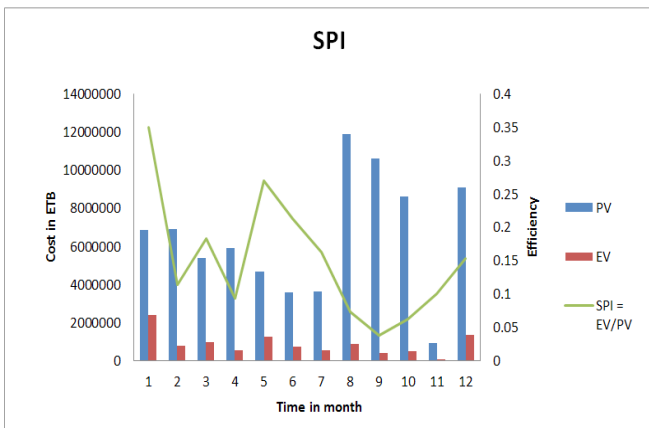
Figure 25: Cost performance indexes Analysis for case study Two, year 2021.

SPI analysis for the case-2 study explain (**Figure 26**) below, and the result is that the project is not efficiently going as planned and the value of the SPI is less than one as show.
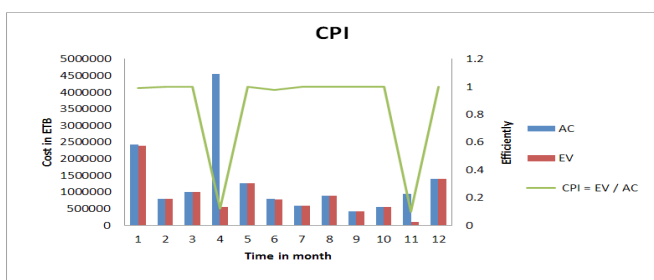
Figure 26: schedule Performance Indexes Analysis for case study Two, year 2021.

The critical ratio (CR) analysis for case study 2 is less than one that indicates the performance of the project is low (poor) this is explained in the (**Figure 27**) below.
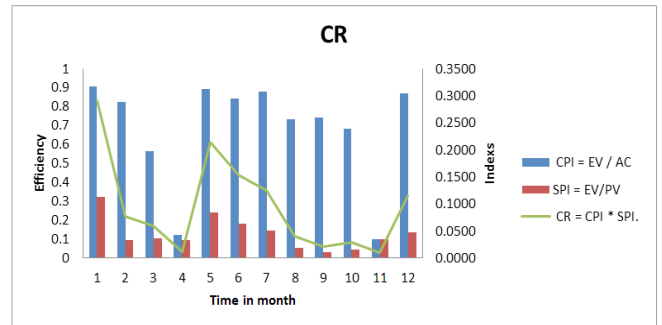

Figure 27: CR: Critical Ratio Analysis, for case study Two, year 2021.

II. Analysis on the case study two in case of EVM is implemented

In case two project if there is applicability of EVM the project it goes far better than the progress and the performance facing right now. The (**Figure 28**) explained the usage of EVM for case to project that can impact the cost. The value of CV is greater than one. This implicates the applicability of EVM allow proper use of resources.
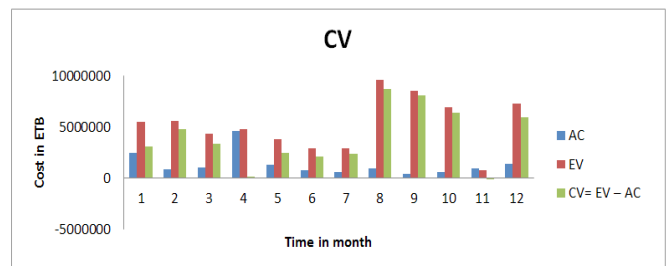

Figure 28: Cost variance (CV) Analysis in implementation of EVM for case study Two, year 2021.

The schedule variance analysis for the case study 2 in the implication of EVM is explained in the (**Figure 29**) below. The graph indicates the project will be accomplished according the baseline if EVM was applied. There the graph explained the schedule is by far better than the schedule applied without the application of EVM.
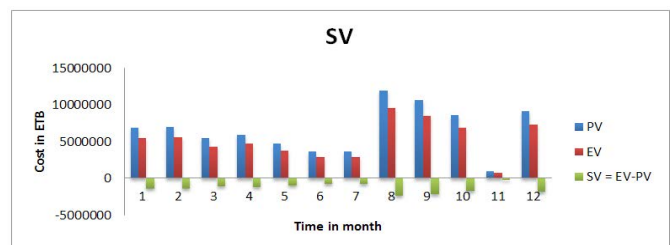

Figure 29: Schedule Analysis in implementation of EVM for case study Two, year 2021.

The CPI analysis in the implementation of EVM is greater than one that is the efficiency of using resources is good that in most of the month and it is explained the (**Figure 30**) below.
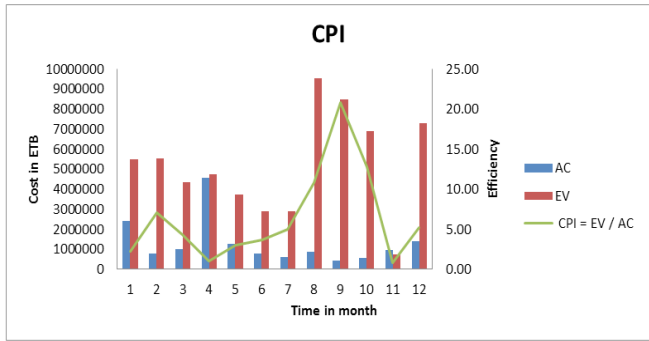
Figure 30: Cost performance indexes Analysis in implementation of EVM for case study two, year 2021.

The SPI analysis for the case study two is near one that implies the project efficiently going according the schedule if EVM was applied. This explained the (**Figure 31**) below.
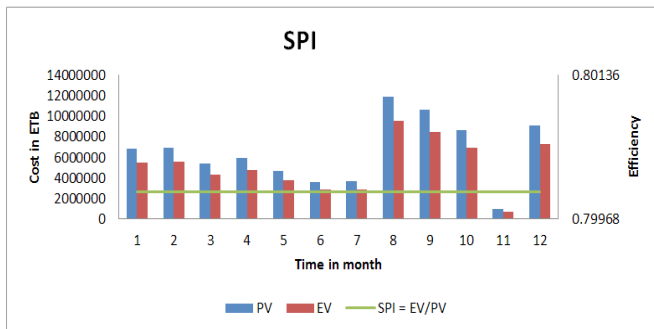

Figure 31: Schedule Performance indexes Analysis in implementation of EVM for case study Two, year 2021.

The analysis of CR for the case study two in the implementation of EVM is good performance that is indicated in the (**Figure 32**).CR is greater than one that implies the project health is good. The project health is determined based on the performance and progress.
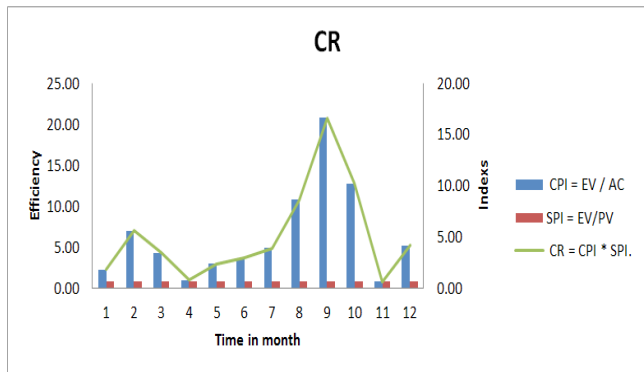

Figure 32: Critical Ratio (CR) Analysis in the implementation of EVM for case study two, year 2021.

3.8.3. Case study -3

The B+G+10 office Complex building is being constructed with the assistance of the owner of the Sidama Regional Admissions Office and Consultant South Design Construction Supervision Enterprise. It is constructed with purpose of administration offices in the sidama region. The project sign on 17, 2018 GC with the budget of 442,266,061.63ETH.BIRR for 1262 days. The beginning of the project, the project did not start with work-based contract due to design issue, which is later fixed with 6 month and the project start. The project is taken as a case to implicate the impact of not using EVM, especially when it is mega projects.

I. Analysis of Actual Project State

The cost variance analysis for project case study 3 is also negative like the other two project that indicate the project is over the budget, this is described in the (**Figure 33**) below.
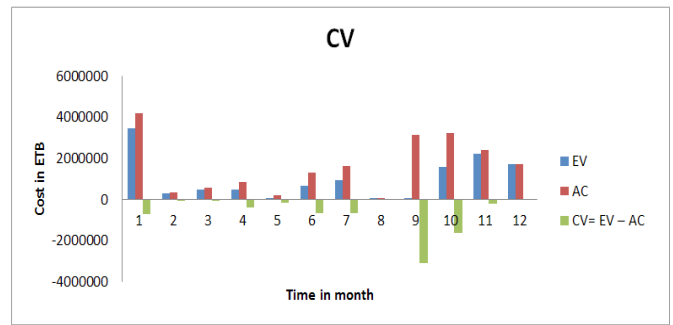

Figure 33: Cost variances (CV) Analysis `for case study three, year 2021.

The actual work accomplished with the given baseline of schedule case study 3 is negative like that of the other two projects as the (**Figure 34**) below indicted the project is behind the schedule.
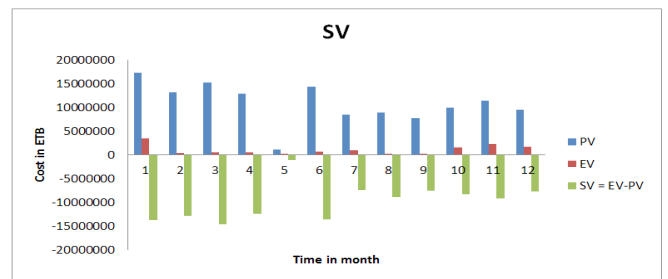

Figure 34: schedule variances (SV) Analysis (for case study three, year 2021.

The efficiency of the cost performance indexes for the case study 3 is less than one that implies the project performance is poor which is explained the (**Figure 35**) below.
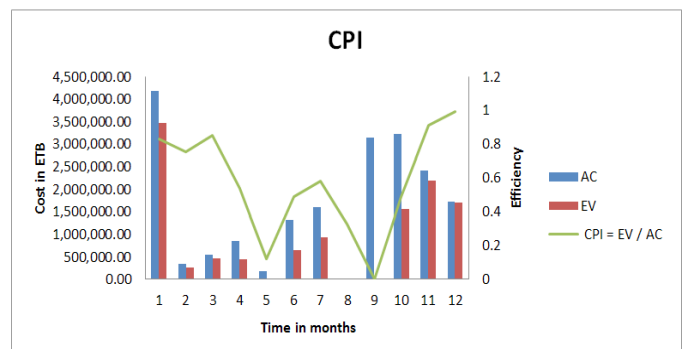

Figure 35: cost Performance Indexes Analysis (Actual value, Earned value and CPI for case study three, year 2021).

SPI analysis for the case study 3 is explained in the (**Figure 36**) below, it shows that the SPI is less than one, which implies the project efficiency of schedule is poor.
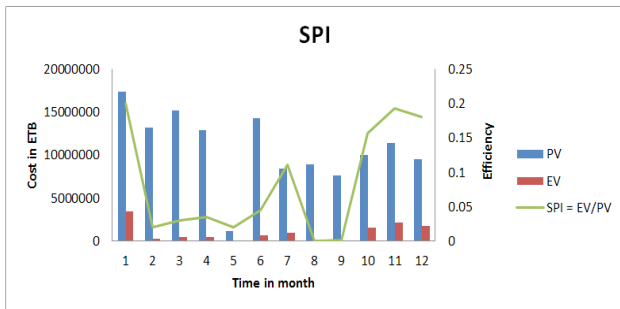
Figure 36: Schedule Performance Indexes Analysis for case study three, year 2021.

The critical ratio CR analysis for the case study 3 is less than one that implies the project health poor. Also (**Figure 37**) indicated project status as poor which is not going as planned cost and schedule.
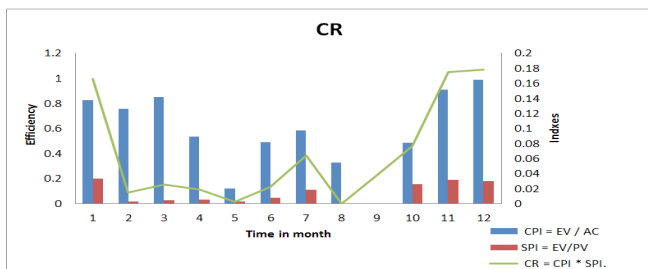

Figure 37: Critical Ratio cost Performance Indexes Analysis for case study three, year 2021.

II. Analysis on the case study Three in case of, if EVM is implemented

The cost variance analysis in the implementation of EVM for the case study 3 indicates CV is positive that implies the project cost going based on baseline as indicated in the (**Figure 3.38**) below.
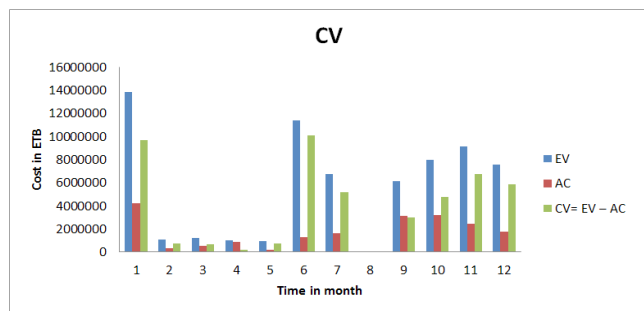

Figure 38: Cost variance (CV) Analysis in the implementation of EVM for case study three, year 2021.

The SV analysis for case study 3 in the implementation of EVM implies, the value is near one. This proof in the application of EVM projects goes as planned, and it is explained in the (**Figure 39**) below.
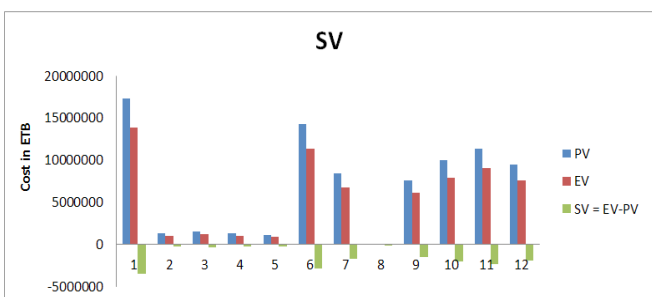

Figure 39: Schedule variance (SV) Analysis in the implementation of EVM (for case study three, year 2021).

The CPI analysis in the implementation of EVM for the case study three is, project CPI value is great than one for all month that is expressed in the (**Figure 40**) below. This indicates the project efficiently in usage of resource (cost).
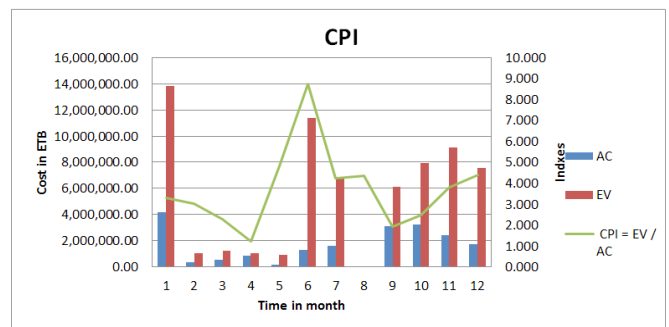

Figure 40: Cost performance indexes CPI Analysis in implementation of EVM for case study three, year 2021.

The SPI analysis in the implementation of EVM for the case study three is near one for all month that implies the project is efficiently going with the schedule; this is explained in the (**Figure 41**) below.
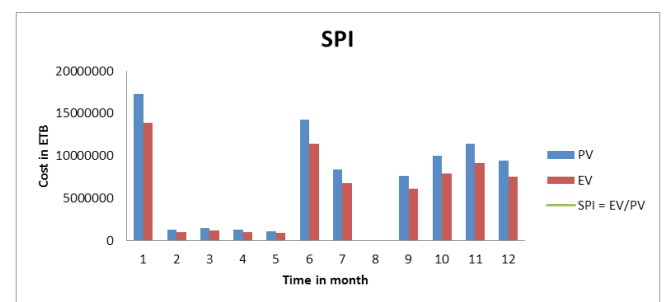

Figure 41: Schedule Performance Indexes Analysis in the implementation of EVM for case study three, year 2021.

The project performance (CR) for the case study three in the implementation of EVM is greater than one which advocate the application of EVM has a great impact on health of the project.it is explained in the (**Figure 42**) below.
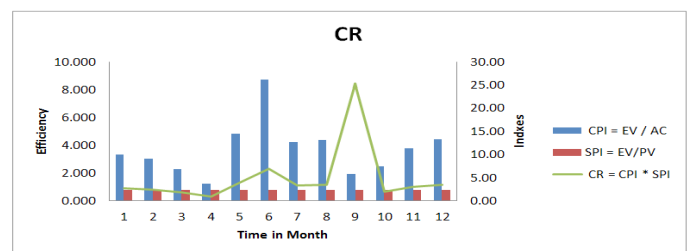
Figure 42: Critical Ratio (CR) Analysis in the implementation of EVM for case study three, year 2021.

3.8.4. Summery on the case study

Table 11. Summery on the case study

Parameter		Case Study -1	Case Study -2	Case study -3
CV	+VE (under budget)	-VE	-VE	-VE
	0 (as planned)			
	-VE (over budget)			
SV	+VE (Head of schedule)	-VE	-VE	-VE
	0 (on the schedule)			
	-VE (Behind schedule)			

CPI	>1 (cost under run)	<1	<1	<1
	0 (exactly as planned)			
	<1 (more cost overrun)			
SPI	>1 (more work has been completed)	<1	<1	<1
	0 (exactly as planned)			
	<1 (work is not been completed as planned)			
CR	>1 (good performance)	<1	<1	<1
	<1 (poor project performance)			

Generally, the analysis of the three-case studies explains the project status and the project performance in terms of cost and time is summered in the (**Table 11**) above. It is based on the analysis in the application of EVM. The case studies imply that there is low implementation of EVM which led to poor performance of the projects. And also, this paper explained the difference between using EVM or not to show the gap. In the case studies if EVM was implemented the result will be far better than the one with not using EVM which is explained in the above analysis too. therefore, this indicates enhancement of EVM is necessary, especially in mega project the loss of resource and time high. Which for sure show enhancement in implementation of EVM is mandatory.

4 Conclusions & Recommendations

4.1. Conclusion

The result of this research shows that, in assessing the way construction projects tracked and monitored projects progress in Sidama region, most of the construction projects comparing planned cost against actual cost for performance and progress measurement. Which does not leave room for the implementation of EVM as a system.

There are many hindering factors that trouble the applicability of EVM. The top three factors are inadequate knowledge of EVM, not required by the clients and current situation construction of the country impeded its applicability that required the enhancement of EVM. The performance and progress evaluation tools; cost, time safety and quality related factors were also identified in this study, which is important to solve the low application of EVM as a problem form different direction and give the best solution for in enhancement of EVM.

In assessing the integration of EVM with other software, in the region MS project is used widely with integration of EVM as well as Primavera software also used often in some projects. The stockholders applied EVM with other software, if it is required by the client or willing done by some contractor. Yet most of them nether use nor Integrate EVM with other management tool, that indicate the applicability of EVM is low and need enhancement. This study also shows 3 mega projects (Yirgalem IAIP, B+G+10 office Complex building, Affini Hall/ Gudumale cultural park project) as a case study to explain the application of EVM in the real world. In these projects there is low application of EVM that led the projects to cost overturn and delay. Therefore, the projects need the EVM enhancement as a system.

To enhance EVM in the construction industry, Integration of EVM with the other management tool is the best techniques that has to be adopted. Besides integration with other tools, efforts have to be done in providing training on EVM and Awareness creation for all the responsible stockholders to resolve the problem the industry facing right now with time delay and cost overturn.

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