

DUY TAN UNIVERSITY

INTERNATIONAL SCHOOL



SOFTWARE MEASUREMENT & ANALYSIS

Topic 5: Build the Earned Value Analysis Tool

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1. Theoretical foundation.

- Earned value management (EVM), earned value project management, or earned value performance management (EVPM) is a project management technique for measuring project performance and progress in an objective manner. It has the ability to combine measurements of the project management triangle: scope, time, and costs.
- Essential features of any EVM implementation include:
 - A project plan that identifies work to be accomplished
 - A valuation of planned work, called planned value (PV) or budgeted cost of work scheduled (BCWS)
 - Pre-defined "earning rules" (also called metrics) to quantify the accomplishment of work, called earned value (EV) or budgeted cost of work performed (BCWP)
 - Actual Cost which is also known as Actual Cost of Work Performed (ACWP) [5]
 - A plot of project cumulative costs vs time especially to show both early date and late date curves
- EVM implementations for large or complex projects include many more features, such as indicators and forecasts of cost performance (over budget or under budget) and schedule performance (behind schedule or ahead of schedule). However, the most basic requirement of an EVM system is that it quantifies progress using PV and EV.
- There are some data involved in Earned Value Management:
 - Planned Value – PV or BCWS
 - Earned Value – EV or BCWP
 - Actual Cost – AC or ACWP
 - Schedule Variance – SV
 - Cost Variance – CV
 - Schedule Performance Index – SPI
 - Cost Performance Index – CPI
- The 3 values PV, EV, AC are those you need to determine.
- PV is the amount (Monetary Value) of the activity or task that you are supposed to complete on that particular data date.
- EV is the amount (Monetary Value) of the activity or task that you actually done.

- AC is the actual spending on the Work done on your project.
- All the remaining data in Earned Value Management are calculated base on 3 values we identify upstairs.
- SV indicates the schedule status of the project.
- CV indicates the cost status of the project.
- SPI is the schedule variance in percentage terms. If:
 - Greater than 1: Your project is ahead of schedule.
 - Less than 1: Your project is behind schedule.
 - Equal to 1: Your project is on schedule.
- CPI is the cost variance in percentage terms. If:
 - Greater than 1: Your project is under budget.
 - Less than 1: Your project is over budget.
 - Equal to 1: Your project is on budget.
- There are other data like BAC (Budget in Completion), EAC (Estimate at Completion), ETC (Estimate to Complete)

2. Presentation of a tool.

2.1 Introduction tool (Visual studio)

- Visual Studio is an Integrated Development Environment (IDE) developed by Microsoft to develop GUI (Graphical User Interface), console, Web applications, web apps, mobile apps, cloud, and web services, etc. With the help of this IDE, you can create managed code as well as native code. It uses the various platforms of Microsoft software development software like Windows store, Microsoft Silverlight, and Windows API, etc. It is not a language-specific IDE as you can use this to write code in C#, C++, VB (Visual Basic), Python, JavaScript, and many more languages. It provides support for 36 different programming languages. It is available for Windows as well as for macOS.
- Evolution of Visual Studio: The first version of VS (Visual Studio) was released in 1997, named as Visual Studio 97 having version number 5.0. The latest version of Visual Studio is 15.0 which was released on March 7, 2017. It is also termed as Visual Studio 2017. The supported .Net Framework Versions in latest Visual Studio is 3.5 to 4.7. Java was supported in old versions of Visual Studio but in the latest version doesn't provide any support for Java language.
- There are 3 editions of Microsoft Visual Studio as follows:

- 1. Community: It is a free version which is announced in 2014. All other editions are paid. This contains the features similar to Professional edition. Using this edition, any individual developer can develop their own free or paid apps like .Net applications, Web applications and many more. In an enterprise organization, this edition has some limitations. For example, if your organization have more than 250 PCs and having annual revenue greater than \$1 Million (US Dollars) then you are not permitted to use this edition. In a non-enterprise organization, up to five users can use this edition. Its main purpose is to provide the Ecosystem (Access to thousands of extensions) and Languages (You can code in C#, VB, F#, C++, HTML, JavaScript, Python, etc.) support.
- 2. Professional: It is the commercial edition of Visual Studio. It comes in Visual Studio 2010 and later versions. It provides the support for XML and XSLT editing and includes the tool like Server Explorer and integration with Microsoft SQL Server. Microsoft provides a free trial of this edition and after the trial period, the user has to pay to continue using it. Its main purpose is to provide Flexibility (Professional developer tools for building any application type), Productivity (Powerful features such as CodeLens improve your team's productivity), Collaboration (Agile project planning tools, charts, etc.) and Subscriber benefits like Microsoft software, plus Azure, Pluralsight, etc.
- 3. Enterprise: It is an integrated, end to end solution for teams of any size with the demanding quality and scale needs. Microsoft provides a 90-days free trial of this edition and after the trial period, the user has to pay to continue using it. The main benefit of this edition is that it is highly scalable and deliver high-quality software.
- Visual Studio brings advanced editing, debugging, and customization to your everyday programming tasks. As you program, Visual Studio can help you diagnose issues quickly to get you unblocked and back to building and publishing your apps.
- Windows Forms is a Graphical User Interface (GUI) class library which is bundled in .Net Framework. Its main purpose is to provide an easier interface to develop the applications for desktop, tablet, PCs. It is also termed as the WinForms. The applications which are developed by using Windows Forms or WinForms are known as the Windows Forms Applications that runs on the desktop computer. WinForms can be used only to develop the Windows Forms Applications not web applications.

WinForms applications can contain the different type of controls like labels, list boxes, tooltip etc.

- The .NET Framework (pronounced "Dot net") is a software framework that runs primarily on Microsoft Windows. It includes a large library and support several programming languages which allow language interoperability (each language can use code written in other language). The .NET library is available to all the programming language that .NET support. Programs written for the .NET framework execute in a software environment, known as the Common Language Runtime (CLR), an application virtual machine that provides important services such as security, memory management, and exception handling. The class library and the CLR together constitute the .NET Framework.

2.2 User Interface

[How to calculate on Earned Value Analysis Tool \(EVAT\)?](#)

Earned Value Analysis Tool

Calculator

	Scheduled progress (%)	Actual progress (%)	Budget (\$)	Cost (\$)
Task 1				

X

Add new task
Submit

Guide

There are 4 fields you need to fill and all the button:

- **Scheduled Progress:** The percentage of current task in all task(s) that you estimate (Must less than or equal to 100)
- **Actual progress:** The real percentage of the current task (Must less than or equal to Scheduled Progress)
- **Budget:** The cost that you estimate for the current task
- **Cost:** The actual cost that you spend for the task
- **Add new task:** To add new field for another task
- **Submit:** To calculate the earned value

Notice

Total task percentage of **Scheduled Progress** must equal 100%

EVAT report

Project overview

- Total budget:
- Actual cost (AC):
- Earned value (EV):
- Planned value (PV):

Cost

- Cost performance index (CPI):
- Cost variance:

Conclusion:

Schedule

- Schedule performance index (SPI):
- Schedule variance:

Conclusion:

Predictions

- Estimate to complete (ETC):
- Estimate at completion (EAC):
- Projected budget overrun:

Earned Value Tool

Created by: K2&_DTU_WEB_TEAM
Version 1.0

Start calculate

Table of contents:

- What is earned value management / earned value analysis?
- How to use the EVM calculator?

Welcome to our **EVT(Earned Value Tool)**. Whether your project is building a skyscraper, hosting a wedding, or holding an office pizza party, applying **earned value management (EVM)** methodology will ensure you're on time and on budget. With the help of our EVM calculator, you'll get these insights and much more. This accompanying article will cover **what earned value management is** and how to apply it in **project management**. We'll also discuss how to calculate earned value, planned value, and many other **project progress indicators**.

What is earned value management / earned value analysis?

Earned value management(sometimes called **earned value analysis**) is a project management methodology. It allows a project manager to **inspect a project's current status**, **measure its performance**, and **predict its final cost** and **completion date**. It has proven to be one of the most **powerful project management tools** out there:

- It's **flexible and scalable** — You can apply earned value management to any project of any size.
- It's **robust and dynamic** — It can extract hidden, but valuable insights where projects are large and tasks are hard to interpret.
- It's **reliable** — Studies have shown that, with EVM, you can predict your final expenditures within a 10% margin when you're just 20% of the way done with your project.

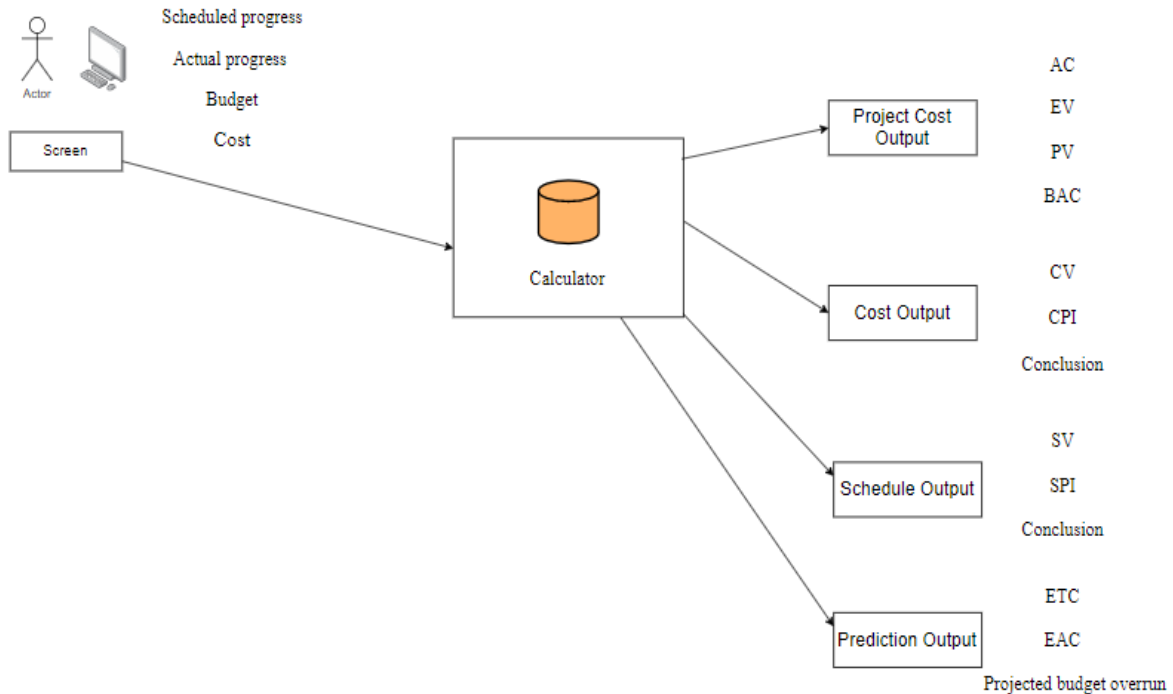
How to use the EVM calculator?

The bigger your project, the harder it's going to be performing all the **EVT calculations** by hand. That's why we made the EVM calculator, which will automatically perform EVM for you with the task data you give it. The tasks appear dynamically as you enter them. At the bottom, the EVM calculator will give you a detailed EVM report. If you're not sure what the calculator's results mean, read on!

What are the earned value management formulas?

The earned value management process can be split into three steps: **collecting task information**, **evaluating performance**, and **making predictions** based on current knowledge. There are quite a few formulas involved; we'll

2.3 Algorithm diagram



The Four Input Fields:

- Scheduled progress – is the percent of a task in total all tasks to complete a project. You must estimate your project plan's task to input this field. This value and budget will be used for calculating the PV (Planned Value).
- Actual progress – is the percent of the task that your team has done. It must be less than or equal to the Scheduled progress. You need to estimate the percentage your team did for this task to input the field. It and the budget will be used for calculating the EV (Earned Value).
- Budget – is the budget you estimate in the schedule will be used for this task. It will be used to calculate the PV, EV, BAC (Budget in Completion) with Scheduled progress and Actual progress.
- Cost – is the actual budget you spend for the task. It uses to calculate the AC (Actual Cost).
- After we have inputted all fields of all task (s), It will start to calculate the PV, EV, AC, and BAC. Next, it uses those data to continuously calculate the SV and SPI to compare the actual work to the schedule, CV and CPI to compare the actual cost to the scheduled budget of the task. Continue, to use those data to calculate the ETC (Estimate to Complete) and EAC (Estimate at Completion) to predict the cost to finish the project. Finally, show all data that we calculated with the conclusion to the user.

$$PV = \sum_{i=1}^n \text{Scheduled_progress}_i * \text{Budget}_i$$

$$AC = \sum_{i=1}^n \text{Cost}_i$$

$$EV = \sum_{i=1}^n \text{Actual_progress}_i * \text{Budget}_i$$

$$BAC = \sum_{i=1}^n \text{Budget}_i$$

$$SV = EV - PV$$

$$CV = EV - AC$$

$$SPI = EV / PV$$

$$CPI = EV / AC$$

$$ETC = (BAC - EV) / CPI$$

$$EAC = ETC + AC = AC + (BAC - EV) * AC / EV$$

3. Test data

	Task 1
Scheduled progress	100%
Actual progress	100%
Budget	1000\$
Cost	1000\$
Output	
Total budget	\$1000
PV	\$1000
AC	\$1000
EV	\$1000
CPI	1
Cost Variance	0%
CPI Conclusion	Exactly on budget
SPI	1
Schedule Variance	0%
SPI Conclusion	Exactly on budget
ETC	\$0
EAC	\$1000
Projected Budget overrun	\$0 over budget

	Task 1	Task 2
Scheduled progress	100%	100%
Actual progress	100%	80%
Budget	1000\$	10000\$
Cost	1000\$	8000\$
Output		
Total budget	\$11000	
PV	\$11000	
AC	\$9000	
EV	\$9000	
CPI	1	
Cost Variance	0%	
CPI Conclusion	Exactly on budget	
SPI	0.818	
Schedule Variance	-18.18%	
SPI Conclusion	Behind schedule	
ETC	\$2000	
EAC	\$11000	
Projected Budget overrun	\$0 over budget	

	Task 1	Task 2	Task 3
Scheduled progress	100%	100%	100%
Actual progress	100%	80%	100%
Budget	1000\$	10000\$	100\$
Cost	1000\$	8000\$	1000\$
Output			
Total budget	\$11100		
PV	\$11100		
AC	\$10000		
EV	\$9100		
CPI	0.91		
Cost Variance	-0.89%		
CPI Conclusion	Over budget		
SPI	0.82		
Schedule Variance	-18.02%		
SPI Conclusion	Behind schedule		
ETC	\$2198		
EAC	\$12198		
Projected Budget overrun	\$1098 over budget		

	Task 1	Task 2	Task 3	Task 4
Scheduled progress	100%	100%	100%	100%
Actual progress	100%	80%	100%	100%
Budget	1000\$	10000\$	100\$	100\$
Cost	1000\$	8000\$	1000\$	1000\$
Output				
Total budget	\$11200			
PV	\$11200			
AC	\$11000			
EV	\$9200			
CPI	0.836			
Cost Variance	-19.57%			
CPI Conclusion	Over budget			
SPI	0.821			
Schedule Variance	-17.86%			
SPI Conclusion	Behind schedule			
ETC	\$2392			
EAC	\$13392			
Projected Budget overrun	\$2192 over budget			

	Task 1	Task 2	Task 3	Task 4	Task 5
Scheduled progress	100%	100%	100%	100%	100%
Actual progress	100%	80%	100%	100%	80%
Budget	1000\$	10000\$	100\$	100\$	10000\$
Cost	1000\$	8000\$	1000\$	1000\$	8000\$
Output					
Total budget	\$111200				
PV	\$111200				
AC	\$19000				
EV	\$89200				
CPI	-4.695				
Cost Variance	78.7%				
CPI Conclusion	Under budget				
SPI	0.802				
Schedule Variance	-19.78%				
SPI Conclusion	Behind schedule				
ETC	\$4686				
EAC	\$23686				
Projected Budget overrun	\$-87514 over budget				

4. Conclusion

EVM provides more information than normal project tracking. It is a step further by answering the question; Have we got to where we want to be in the project? and When are we going to finish this project? It helps define more accurately as to where we are in the project as well as calculate its successful completion. The value added approach helps achieve greater visibility and control of the project activities which helps in responding to issues early on, thus making it possible to meet the project timelines. It provides a clear communication of the activities involved and improves project visibility and accountability. The basic principle of earned value management (EVM) is that the value of the piece of work is equal to the amount of funds budgeted to complete it.

5. References

- https://en.wikipedia.org/wiki/Earned_value_management
- <https://project.pm/earned-value-management/>
- <https://studyresource.duytan.edu.vn/access/content/group/162933/Lecture%20Slides/B%C3%A0i%20gi%E1%BA%A3ng%20v%E1%BB%81-Earned%20Value%20-%20ti%E1%BA%BFng%20Vi%E1%BB%87t.pdf>
- <https://apmg-international.com/article/what-earned-value-management-and-why-it-important>

6. Table of group work breakdown

Project Leader	Tuan, Huynh Duc Thanh	Description: Code, plan
		Assessment: ★ ★ ★ ★ ★
Team Member(s)	Hieu, Huynh Ngoc	Description: Code, document
		Assessment: ★ ★ ★ ★ ★
	Hieu, Vo Trung	Description: Design, document
		Assessment: ★ ★ ★ ★ ★
	Thuan, Le Van	Description: Code, document
		Assessment: ★ ★ ★ ★ ★
	Lich, Nguyen Hong	Description: Code, test
		Assessment: ★ ★ ★ ★ ★