

New Challenges in Accounting and Finance

2019(2)11–18



A New Approach for Complementing the Earned Value Method for Project Progress Monitoring and Controlling

Ali M. Fayad¹, Bassam Hussein^{2*}, Mohamad Hajj-Hassan², Amin Haj-Ali¹

¹Lebanese International University, Bekaa, Lebanon

²International University of Beirut, Beirut, Lebanon

Received 20 May 2019 Accepted 06 July 2019

ABSTRACT

The earned value management method is commonly used for monitoring and assessing project budget and schedule performance. Although widely used, this method does not consider the time value of money. This paper suggests the inclusion of inflation as a factor affecting project performance and gives a methodology to do so using the net present value. This is done by adjusting the present value and actual cost of the work packages. The result is more realistic progress measurements and performance indicators.

Keywords: Project Management, PMI, Earned Value Management, Time Value of Money, Performance

1. Introduction

The Project Management Institute (PMI) recommends using earned value management as a best practice for monitoring project performance. This artifact is a quantitative method that uses an integrated schedule and budget based on the project work breakdown structure (Lukas, 2012). The three main inputs of the EVM are the planned value (PV), the earned value (EV) and the actual cost (AC). This method is great for monitoring schedule and cost performance by calculating schedule and cost variances and performance indexes. However, it has one shortcoming: it does not take into consideration the time value of money.



*Correspond author E-mail address: bassam.hussein@liu.edu.lb Doi:10.32038/NCAF.2019.02.02

The time value of money is the idea that money available at the present time is worth more than the same amount available in the future (The Pennsylvania State University, n.d.). In other words, the time value of money is the inflation of the currency. From an engineering economics perspective, if two amounts of money are to be compared, they have to be compared during the same time period in order to have the same worth, otherwise the comparison will not be accurate. Essentially, a variation of the net present value method has to be used in order to calculate the current values of all cash flows used in the earned value management method. These calculations allow the project manager to compare cash amounts during the same time period using their equivalent values. This will allow the project manager to make accurate judgments regarding the project's time and cost performance, and therefore determine an appropriate future course of action.

Different practices have been developed to measure project performance. Some practices only consider financial performance while others take different aspects into consideration. J. Westland, recommends monitoring everything that will be measured and reported at the end of the project; the five items that should be monitored are:

- **Schedule:** weekly updates are recommended to monitor if the project is meeting the original timeline.
- **Quality:** check the quality of the project management practices and the quality of the deliverables.
- **Cost:** compare actual spending to the budget and explain variances.
- **Stakeholder Satisfaction:** this could be measured using different methods. Engage stakeholders more if they are not satisfied.
- **Performance to Business Case:** make sure the project still serves its original goal (Westland, 2015).

In her book "Practical Performance Measurement", S. Barr recommends using 7 KPI's:

- **Direct Impact:** It's the size of the difference between the level of performance of a business before the project's start time, and the level after the project's end time. It provides a direct measure on the project's success.
- **Bottom Line Impact:** from a financial point of view
- **Return on Investment (ROI).**
- **On-Time:** actual timeline versus schedule.
- **On-Budget:** actual costs versus budget.
- **Stakeholder Support and Engagement:** measured by the amount of stakeholder participation in project tasks and events (Barr, 2015).

Finally, the Project Management Institute (PMI) recommends best practices for all aspects of a project including project performance monitoring. Earned value management (EVM) is the recommended best practice as it can be applied to projects from virtually any industry. The issue that will face evaluators of long duration projects (project of 3 years or more) when using the traditional EVM is that the performance measurements will be inaccurate. This will happen due to the inflation of currency; the PV set at the beginning of the project and the costs accrued throughout

the project will not have the same worth. This in turn will affect the decision making process by producing inaccurate forecasts to completion and the differences will increase as the life of the project is increases.

Method

Earned Value Management

The earned value management (EVM) method relies on three main quantities:

- **Planned Value (PV):** the authorized budget assigned for the work to accomplish a scheduled activity or work package. The sum of PV’s for all work packages in the project is called the budget at completion (BAC), or baseline budget (Project Management Institute, 2013).
- **Actual Cost (AC):** the cost incurred to accomplish the activity or work package during a specific time period. It’s the cost of the accomplished work (Project Management Institute, 2013).
- **Earned Value (EV):** it is the budget associated with the authorized work that has been completed for an activity or work package. It is a measure of the work performed expressed in terms of the budget authorized for that work (Lukas, 2012). It is calculated using the formula:

$$EV = \% \text{ complete} \times \text{budget} = \% \text{ complete} \times PV \text{ (Project Management Institute, 2013).}$$

Table 1 summarizes the rest of the metrics used in earned value management and earned value management.

Table1: Earned Value Management Metrics

Metric	Definition	Equation
Cost Variance (CV)	Measure the budget performance expressed as the difference between the earned value and the actual cost at a specific point in time during the project	$CV = EV - AC$
Schedule Variance (SV)	Measures the schedule performance expressed as the difference between the earned value and the planned value at a specific point in time during the project	$SV = EV - PV$
Cost Performance Index (CPI)	Indicates the cost efficiency for the earned work. PMI considers the CPI as the most critical EVM metric	$CPI = EV / AC$
Schedule Performance Index (SPI)	Indicates the schedule efficiency.	$SPI = EV / PV$

Figure 1 shows a graph of the PV, AC and EV for a certain project.

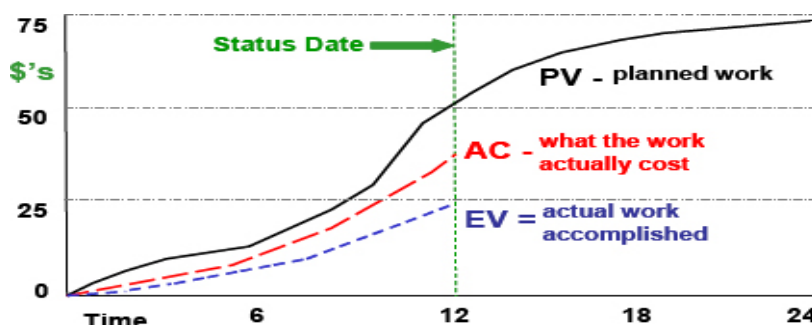


Figure 1: Earned Value, Planned Value, and Actual Cost (Lukas, 2012)

At time period 12, the earned value of the work is less than the planned value and the actual cost. This means that this project has a negative SV and CV. However, is the PV on one side, and the EV and AC on the other side equivalent? The answer is no because the PV was estimated during time 0, while EV and AC were obtained during time period 12. In order to correct this, the time value of money should be considered.

Net Present Value

The net present value (NPV) is an evaluation method for capital investments that calculates the present values of future cash flows (inflows and outflows) and subtracts the initial investment from their sum. The higher the NPV of a project, the more desirable it is to the company assuming its rate of return is higher than the minimum rate of return set by the company (B. Needles, 2011). The NPV can be applied for a single cash amount or a series of periodic amounts. The equation of NPV is shown below for a series of cash flows:

$$NPV = I_0 + \sum_{t=1}^n \frac{F_t}{(1+k)^t} \quad (1)$$

Where: I_0 : initial investment (negative because it's an outflow)

F_t : the net cash inflow in period t (positive because it's an inflow)

k : rate of return (E. W. Larson, 2018)

The NPV method can be used to calculate the future value of a single cash amount using equation 2 shown below (Blank & Tarquin, 2012):

$$F = P \cdot (1+i)^n \quad (2)$$

Where : P : the present value

F : the future value

i : interest rate

n : number of time periods

This equation derived from the net present value method and is used to calculate the future value of any sum of money assuming a constant discount rate. In reality, each year will have a different inflation rate. To correct this, the following formula should be used:

$$PV_i = PV_0 \cdot \prod_{i=1}^t (1+k_i) \quad (3)$$

where: PV_i : the equivalent worth of PV in year i

k_i : inflation rate in year i

PV_0 : the estimated PV at the beginning of the project

t : number of years (current year)

Using this equation, a different inflation rate for each year can be used (k_i). $i=1$ is the first year and $i=t$ is the current year during which the EVM is being performed.

The calculation of the actual cost differs from that of the planned value. While the planned value is a one-time cost estimate, usually estimated at the beginning of the project, the actual cost for a work package is usually incurred over multiple time periods for any given work package. In this case, how is the actual cost computed taking into consideration the time value of money? The answer is to adjust the actual cost value from the previous year by calculating its current equivalent amount, and adding the actual cost incurred during the current year. This is shown in equation 4 below, which is based on the formula for a single cash flow (equation 1).

$$AC_i = AC_{i-1} \times (1 + k_i) + C_i \quad (4)$$

where: C_i : cost incurred in year i

k_i : inflation rate in year i

AC_i : cumulative AC in year i (the current year). It is the total actual cost incurred until the current year.

AC_{i-1} : cumulative AC in year $(i-1)$ (the previous year). It is the total actual cost incurred until the previous year.

Now that the equivalent values of the PV, EV and AC are found, the earned value analysis calculations are carried out normally to find the schedule variance (SV), the cost variance (CV), schedule performance index (SPI), cost performance index (CPI).

Results

The proposed method was implemented on a project that started in 2010 and ended in 2015. The inflation rates of each year are shown in table 2.

Table 2: Inflation Rates in Lebanon (Knoema, 2019)

Year	2010	2011	2012	2013	2014	2015
Inflation Rate	4.0%	5.0%	6.6%	4.8%	1.9%	-3.7%

The EVM dimensions and metrics were calculated using the classical EVM method and then the proposed method. The results of the case study are shown in tables 3 through 8 below for both methods along with the percentage difference.

Table 3: Classical and Proposed EVM Result Comparison for 2010

	Classical EVM	Modified EVM	% Difference
Cum PV	208,950	217,308	4%
EV	201,198	209,246	4%
AC	209,850	209,850	0%
CV	-8,652	-604	93%
CPI	0.96	1.00	4%
SV	-7,752	-8,062	4%
SPI	0.96	0.96	0%

Table 4: Classical and Proposed EVM Result Comparison for 2011

	Classical EVM	Modified EVM	% Difference
Cum PV	493,200	538,574	9%
EV	438,539	478,885	9%
AC	528,590	539,083	2%
CV	-90,051	-49,705	45%
CPI	0.83	0.89	7%
SV	-54,661	-59,690	9%
SPI	0.89	0.89	0%

Table 5: Classical and Proposed EVM Result Comparison for 2012

	Classical EVM	Modified EVM	% Difference
Cum PV	792,650	922,702	16%
EV	719,799	837,898	16%
AC	930,050	976,122	5%
CV	-210,251	-92,152	56%
CPI	0.77	0.86	11%
SV	-72,851	-84,804	16%
SPI	0.91	0.91	0%

Table 6: Classical and Proposed EVM Result Comparison for 2013

	Classical EVM	Modified EVM	% Difference
Cum PV	1,167,400	1,424,167	22%
EV	1,061,042	1,294,415	22%
AC	1,373,450	1,466,376	7%
CV	-312,409	-79,035	75%
CPI	0.77	0.88	14%
SV	-106,359	-129,752	22%
SPI	0.91	0.91	0%

Table 7: Classical and Proposed EVM Result Comparison for 2014

	Classical EVM	Modified EVM	% Difference
Cum PV	1,426,000	1,772,698	24%
EV	1,304,736	1,621,952	24%
AC	1,735,000	1,855,787	7%
CV	-430,264	-113,048	74%
CPI	0.75	0.87	16%
SV	-121,264	-150,746	24%
SPI	0.91	0.91	0%

Table 8: Classical and Proposed EVM Result Comparison for 2015

	Classical EVM	Modified EVM	% Difference
Cum PV	1,578,950	1,890,210	20%
EV	1,578,950	1,890,210	20%
AC	2,095,550	2,147,673	2%
CV	-516,600	-205,340	60%
CPI	0.75	0.88	17%
SV	0	0	0%
SPI	1.00	1.00	0%

Discussion

As expected, the longer the life of the project, the larger the difference between the classical and the proposed EVM methods. The main result observations are:

1. The PV, EV and AC in the proposed EVM method are larger than those in the classical method since the inflation is positive.

Since the % completed reflects the actual portion of the job that was completed, it is the same for both methods.

2. The cost variance in the proposed method is lower than that of the classical method. This means that the classical method exaggerated the cost variance causing the project to appear as not profitable.
3. The CPI in the proposed method is higher than that of the classical method, indicating that the project budget is used more efficiently than was shown in the classical method.
4. The schedule variance in the proposed method is higher than that in the classical method. This means that the classical method tended to undermine the variance in the schedule causing the PM to think that the project is performing better than it actually is schedule wise.
5. The schedule performance index is the same for both methods. The reason is shown in the following equation:

$$SPI = \frac{EV}{PV} = \frac{\% \text{ complete} \times PV}{PV} = \% \text{ complete}$$

These results matched the expectations formulated at the beginning of this paper. It should be noted that the results obtained above will be reversed if the inflation were to be negative. If there is a deflation in the currency, the PV, AC and EV in the proposed method will be higher than the classical method, the CV and CPI will also be higher and the SV will be lower.

The proposed method of correcting for the time value of money necessitates that the equivalent of the planned value and actual cost be calculated in the current time of the EVM. Comparing all equivalent amounts during the same time period will decrease errors associated with the change in currency value. Since inflation is generally positive, the cost and schedule variances are usually exaggerated if the time value of money is not accounted for. As a result, the financial performance of the project will appear to management and stakeholders worse than it actually is. Basing future actions on such a flawed analysis will lead to bad decisions.

Within a project context, it is crucial to have all features, tools and artifacts fully integrated within the adapted project management information system (PMIS) (Hussein & Dayekh, 2014). Based on this recommendation, the proposed complementation of the EVM should be integrated within the PMIS in use such MS Project, PRIMAVERA, Open Workbench or any other generic or proprietary systems that are being used by the organization undertaking the project.

Earned value management is an excellent practice for monitoring project performance. One shortcoming is the disregard of the time value of money for long duration projects where inflation has a significant effect on the schedule and cost variances, especially in the later years of a project. A method was proposed to rectify this where the equivalent of any sum of money is calculated in the current time of the measurements so that the comparison is done in the same time period. This allows project managers to reflect the performance accurately and help in making future decisions accordingly.

References

- B. Needles, M. P. (2011). *Principles of Accounting* (11th edition ed.). USA: Cengage Brain.
- Barr, S. (2015, 7 21). Retrieved from Stacey Barr, the performance measure specialist: <https://www.staceybarr.com/>
- Blank, L., & Tarquin, A. (2012). *Engineering Economy* (7th edition ed.). (M. Lange, Ed.) New York, USA: McGraw-Hill.
- E. W. Larson, C. F. (2018). *Project Management: The Managerial Process* (7th edition ed.). Oregon, NY: McGraw-Hill Education.
- Hussein, B., & Dayekh, A. (2014). Business Process Reengineering (BPR) Key Success Factors. *International Journal of Applied Management Sciences and Engineering (IJAMSE)*, 1(1), 58-66.
- Knoema. (2019, 04 15). *Lebanon - Average consumer prices inflation rate*. Retrieved 06 2, 2019, from Knoema: <https://knoema.com/atlas/Lebanon/Inflation-rate>
- Lukas, J. A. (2012). How to make earned value work on your project. *PMI Global Congress 2012*. Vancouver: PMI.
- Project Management Institute. (2013). *PMBOK Guide* (5th ed.). Project Management Institute.
- The Pennsylvania State University. (n.d.). *Time Value of Money*. Retrieved 11 20, 2018, from MoneyCounts: A Penn State Financial Literacy Series: <https://psu.instructure.com/courses/1806581/modules>
- Westland, J. (2015, Sep 28). *Five ways to measure project success*. Retrieved from ProjectManager: <https://www.projectmanager.com/blog/5-ways-to-measure-project-success>