

IMPORTANCE OF EARNED VALUE METHOD (EVA) IN THE PERFORMANCE ANALYSIS OF PROJECTS

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Abstract

The economics of the projects is an important process in the project management. Effective control of projects is based on appropriate methods for monitoring, and the entire project, the timetable, cost, quality and risk. Unlike accounting aspects in project management are looking for information that allow insight into the status and trends of financial progress of the project. Such information provide a method of earned value. It is a key component for assessing the actual performance of the project. The method of earned value is a better indicator of the progress of the project in comparison to the classical method of comparing planned and actual costs. This method shows the profit in relation to actual costs at a specific time point.

This method is the basis for calculating the index of the project performance. In this sense, MS Project provides many opportunities for quality control and monitoring of the realization of the projects.

In this study will be described the architecture of this method, outlined the benefits of the application of this method, and the basic criteria that should satisfy project management to be able to apply it.

Key terms: the value analysis, project management, performance indicators, earned value.

JEL classification: C88, L25, M11

1. Important features of the monitoring and control of projects

The implementation of a project is quite complex activity, which is characterized by certain specificities, primarily with uniqueness, participation of many participants in the implementation, using many materials, the climate conditions and so on.

Due to the greater competition at the market the managers are forced to accept projects even when investors seek short deadlines, and set difficult achievable conditions of payment. Therefore it is necessary detailed planning, monitoring and control of project implementation, as only in this way can be preserved the deadlines, coordinate work with large number of participants, and to keep costs within budget. This will ensure a good operating result, ie operating with profit, as a final instance of any enterprise.

Good information basis based on records, monitoring and cost accounting is the basis for satisfying the needs of current planning and control of costs and outcomes.

When we start with the realization of a project, it is necessary to monitor and control its progression to be ensured successful realization in accordance with the planned.

The main task of monitoring the project is data collection and reporting of the process, ie ensuring that all parties involved in the project over time have available and accurate information. It is necessary to build a quality information system that the leader of the project will give the necessary information for work. Other tasks of monitoring projects are:

- creation of a database for future projects;
- learning from past mistakes, and
- informing the higher levels of management.

The monitoring of the projects is implemented in five steps. The first step in the monitoring of projects is to identify the key factors that will be measured and controlled: technical characteristics, deadlines, costs, satisfaction of investors and

so on. The best basis is the plan of activities, resources and costs. The second step is determining how to measure the performance and determining appropriate measurement unit (measurement unit must reliably reflect the actual situation). The third step is to establish standards and procedures for collecting data on key factors (what information will be collected in the form, who will collect information, to whom will be sent, etc.). Of special importance is to organize monitoring data that significantly changed over time and the data that significantly affect the result. The fourth step is processing the collected data. The fifth step concerns the timely distribution of information. The information system project must be connected and adjusted to the information system of the company.

The key of effective project control is measuring the actual progress and comparing to the planned timetable. Based on the information about the current progress of realization of the project, in line with other changes that may occur, it is possible to calculate the corrected project schedule and to assess whether the project will be implemented before or after the requested time of the final implementation. Control of projects takes place in four steps:

1. analysis of the plan, based on determination where will be needed to take corrective action;
2. deciding which corrective actions should be taken;
3. processing plan by entering the selected corrective actions, and
4. recalculation of schedule to overestimated the effects of the planned corrective actions.

The purpose of taking corrective actions is eliminating negative tendencies and phenomena.

The main purpose of monitoring and control of projects is for realization as soon as possible with adequate resources and lower costs.

Important features of the process of monitoring and control of projects are:

- The whole process (plan - monitoring - control) must be carried out fully and cyclical;
- Without monitoring and control of projects, the planning makes no sense, and dramatically increases the probability of failure of projects;
- Basic assumption of monitoring and control is the "dimensions" of projects that are controlled and monitored (time, work, money...) to be measurable;
- Monitoring and control of projects must be formalized as an integral part of the structure of the project, not as "something external";
- Preparation of the plan, monitoring and control, must be a single entity. If the above terms are two separate systems, there will always be problems in their interactions and relationships.

2. Key indicators of earned value method

Input data of Earned Value method are[1]:

- Projected costs of the planned work (BCWS-Budgeted Cost for Work Scheduled) - is the amount of costs of the baseline planned to spend up to the status date. This field is calculated immediately after entering the values at baseline and is a cumulative sum of all costs from baseline for all periods up to and including the status date;
- The actual costs of performed work (ACWP - Actual Cost of Work Performed)
- Realized cost during the work completed by the status date. This cost may be different than the planned (due to use overtime work, cost of resources can grow from the baseline, or expensive resource can be replaced by cheaper);
- Planned costs for performed work (BCWP - Budgeted Cost for Work Performed) - is part of the planned value that has already been acquired by the actual amount of work generated by the status date;
- The budget at the end of the project (BAC - Budget at Completion);
- The estimated budget of the project within a specified period of time (EAC - Estimate at Completion);
- Planned duration of the project.

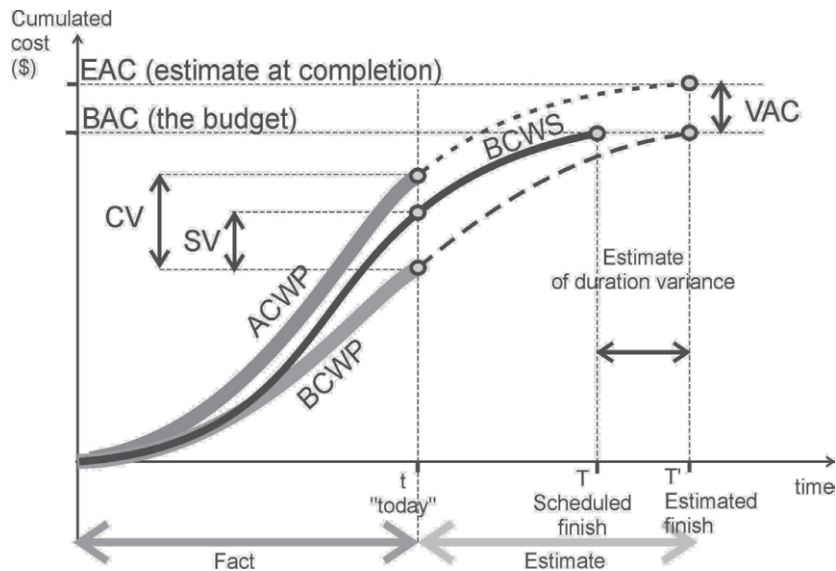


Figure 1. Graphic presentation of Earned Value

While, according to this method, the project status indicators are:

- Percentage of the completion (PC-Percentage Complete):

$$PC = \frac{BCWP}{BAC} \quad [1]$$

- Cost Variance (CV) - a measure of deviation between planned and actual costs, or measure of the financial performance of the project. The positive value of this variance is favorable, an unfavorable and negative state i.e. that the budget is punctured:

$$CV = ACWP - BCWP \quad [2]$$

Often this variance is expressed as a percentage of budget costs:

$$CV\% = \frac{CV}{CWP} \cdot 100\% \quad [3]$$

- Schedule Variance (SV). It shows the time deviation and is calculated as the difference between realized and planned value. Although it is interpreted as time deviation, it is expressed in monetary units. In other words, the difference between the projected costs of work that will be done and the planned costs should be made to the reporting date. If this variance is negative, it indicates a delay:

$$SV = BCWP - BCWS \quad [4]$$

To respond to any disruption caused by the relative value of the activities, the schedule variance can be expressed as a percentage of BCWS:

$$SV\% = \frac{SV}{BCWS} \quad [5]$$

- Cost Performance Index (CPI). It is a measure of the cost effectiveness of the project. This index compares the planned and the actual amount of the done work and shows how efficiently resources are used. If the cost performance index is less than 1, it indicates that the project will spend more money than planned, and if it is greater than 1, suggests favorable status or saving money:

$$CPI = \frac{BCWP}{ACWP} \quad [6]$$

- Index of timeout execution of the project. This index compares the planned actual costs made for work with the planned costs of the planned work. If it is less than 1, indicates a delay, and if it is greater than 1, it is favorable status of execution of the project:

$$SPI = \frac{BCWP}{BCWS} \quad [7]$$

- By monitoring of these last two cumulative indexes of performance of the project after 15% of its duration, a project host can accurately determine the time and cost component of the project, and thus successfully managing the project to the end, or timely responding in the required time.

Parameters of forecasting using Earned Value method are the following:

- Estimated costs by the end of the project (EAC - Estimate at Completion). They are calculated according to the following patterns:

$$EAC = \frac{BAC}{CPI} \quad [8]$$

$$EAC = \frac{AC + (BAC - EV)}{CPI} \quad [9]$$

where:

AC - Actual Cost;

EV - Earned Value;

$$EAC = \frac{AC + (BAC - EV)}{CPI \cdot SPI} \quad [10]$$

EAC represent simple linear extrapolation of current tendencies. However, they indicate potential problems with costs.

The last formula can have different scenarios. One of them is the following:

$$EAC = ACWP + \frac{BAC - BCWP}{PF} \quad [11]$$

where:

PF - factor, which reflects the relationship between the future and the past of the project.

From the last form can be stated that can occur the following variations:

- The cost of the remaining work (tasks) to be as planned, ie future costs are not related to the current costs, which $PF = 1$ and in this case $EAC = BAC + CV$;
- costs of the remaining work (tasks) to be in proportion with the current CPI and in this case is ignored the link time-costs (if the project speeds up, usually requires more money);
- for the costs of the remaining work (tasks) to be in connection with the current tendencies and the performance costs and schedule, PF will be a critical relationship, called as the relationship of the costs and schedules and it is getting the index of schedules and costs: $SCI = CPI \cdot SPI$

Another measure used for predicting, i.e. for simple extrapolation is the efficiency index up to the completion of TCPI (To Complete Performance Index), which is the ratio between the remaining work and the remaining budget. The form for calculation of this measure is the following:

$$TCPI = \frac{BAC - VCWP}{BAC - ACWP} \quad [12]$$

3. Illustrative example for application of earned value method

By the following simple example will be showed how monitoring of the acquired value improves the accuracy of the real project status.

Suppose we are working with a project budget of 160 euros, planned to be implemented in 4 days. As a project status day (the day that follows the development of the project) is the third day. For the implementation of the project are planned 32 working hours. Let be hired one resource with 100 % commitment. These data shall be recorded in the baseline project or plan (Baseline), whose data are provided in Microsoft Project at the following picture:

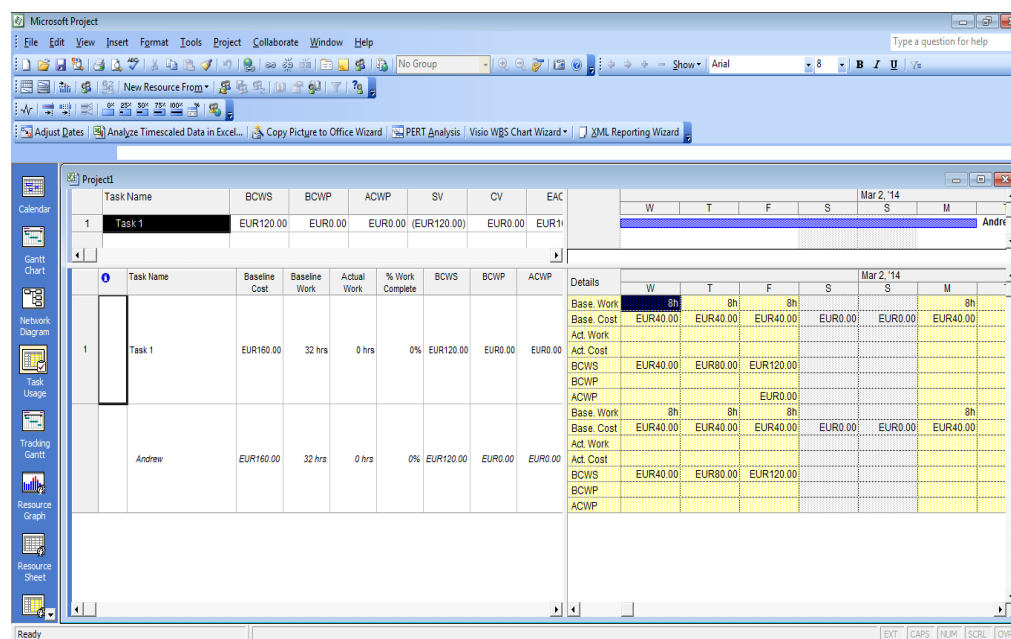


Figure2. Project Baseline

From the data can be noted that the planned value (BCWS) is calculated for each day, and cumulatively, up to the status date. On the other side, the acquired value or Earned Value (BCWP) and the actual (current) value (ACWP) are not calculated until they input data for the actual work.

If it is checked at the status day and determined that the resource worked only 2 days and the task is 50% complete will be obtained the following data:

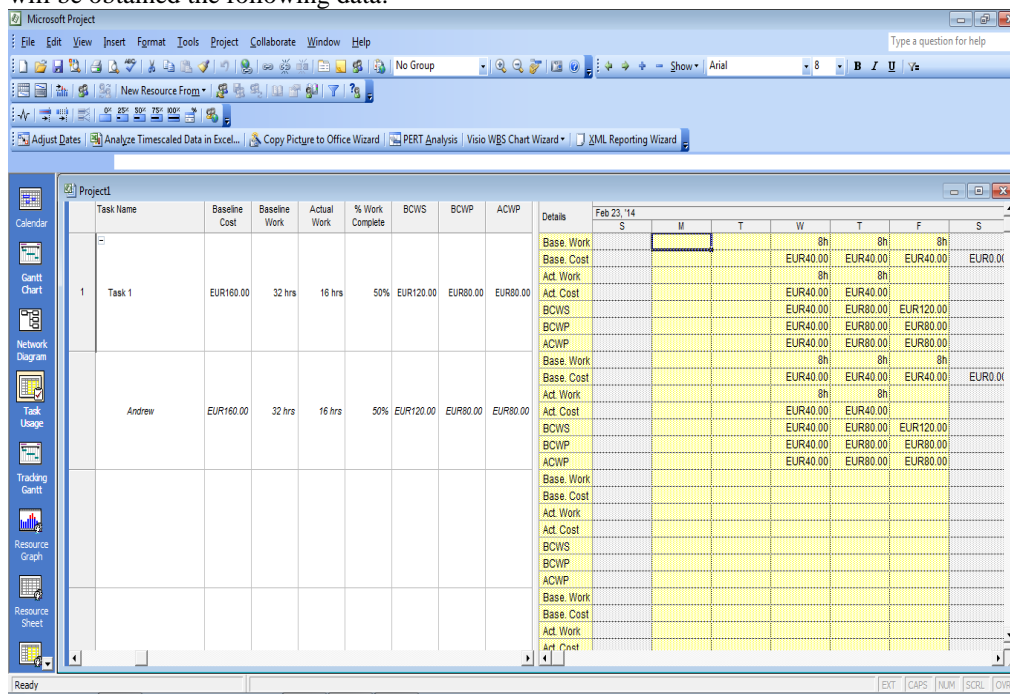


Figure 3. Result at the status date if have change in % Complete (50%)

The data show that BCWP and ACWP are the same values. Since the division of the resource is 50% complete, he earned 50% of the planned amount of 160 EUR (i.e. 80 EUR). The values of BCWP and ACWP for the third day are the same as for the second day because there is no real work for the third day. In order to illustrate how the values of BCWP and ACWP can be distinguished the example will be modified, or will be assumed that the resource is no longer available

and will enter a new resource that will work the next two days, but its price will be 50% greater than the cost of the previous resource, or will be 7.5 EUR/hour. If we bring this change and it will inject 50 % completed work, we will get the following information:

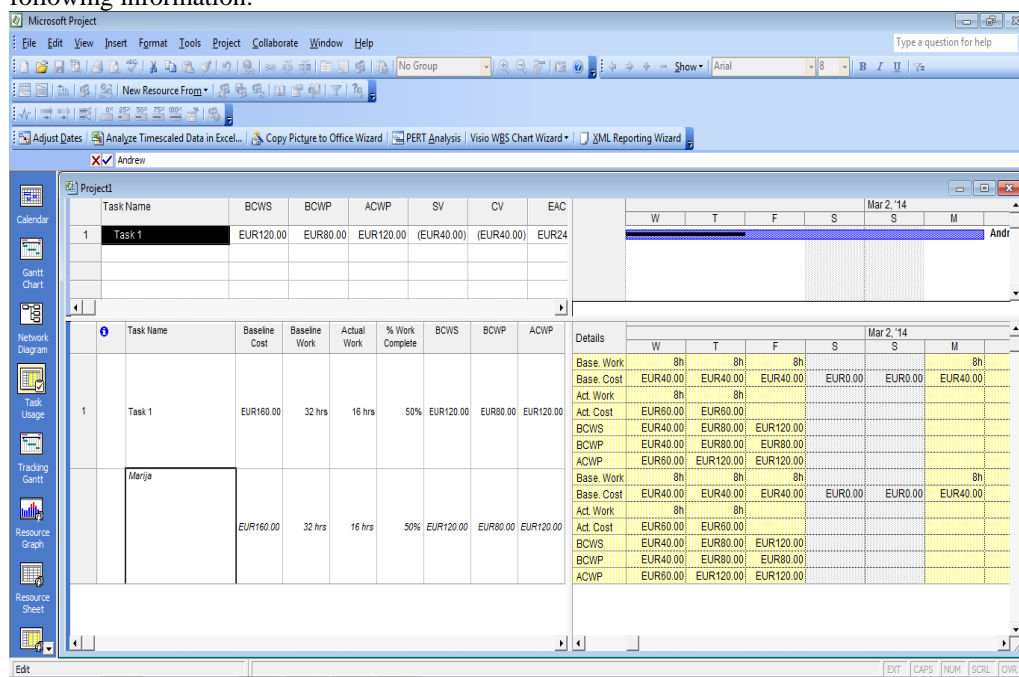


Figure 4. Result of status date if there actual work (difference between BSWP and ACWP)

The data show that the values of BCWS and BCWP are the same as in the previous example. But now the actual costs are higher, 60 EUR per day in front of budgetary, the planned 40 EUR, while the actual ACWP costs to the status date now are 120 EUR. The acquired value to the status date is 80 EUR (value of planned real work). Therefore we can say that cost 120 EUR to gain value of 80 EUR. The difference of 40 EUR clearly states that there are negative consequences to the final cost of the project if it continues.

Will be calculated descriptive appropriate indicators of Earned Value, especially the primary, particularly performed.

Table 1: Primary indicators of Earned Value Method

Planned work (BCWS)	120
Current (real) costs (ACWP)	120
Earned Value (BCWP)	80

Table 2. Derived indicators for project status

Cumulative spending (Planned – Actual)	0
Variance of the costs (Cost Variance –CV=Cum EV- Cum Actual Cost)	-40
Planned cost variance (Schedule Variance –SV=Cum EV – Cum Planned)	-40I
Index of cost performances (Cost Performance Index –CPI=Cum EV/Cum Actual)	80/120 ≈ 0.67
Index of temporal execution of the project (Schedule Performance Index –SPI= Cum EV/Cum Planned)	80/120 ≈0.67
Estimated project budget (Estimate at Complete –EAC=ACWP+(BAC-BCWP)/CPI	120+(160-80)/0.67= ≈240

Final cost variance (Variance at Completion -VAC=BAC-EAC

**160-240= -
80**

These data can be seen from the Earned Value table in Microsoft Project:

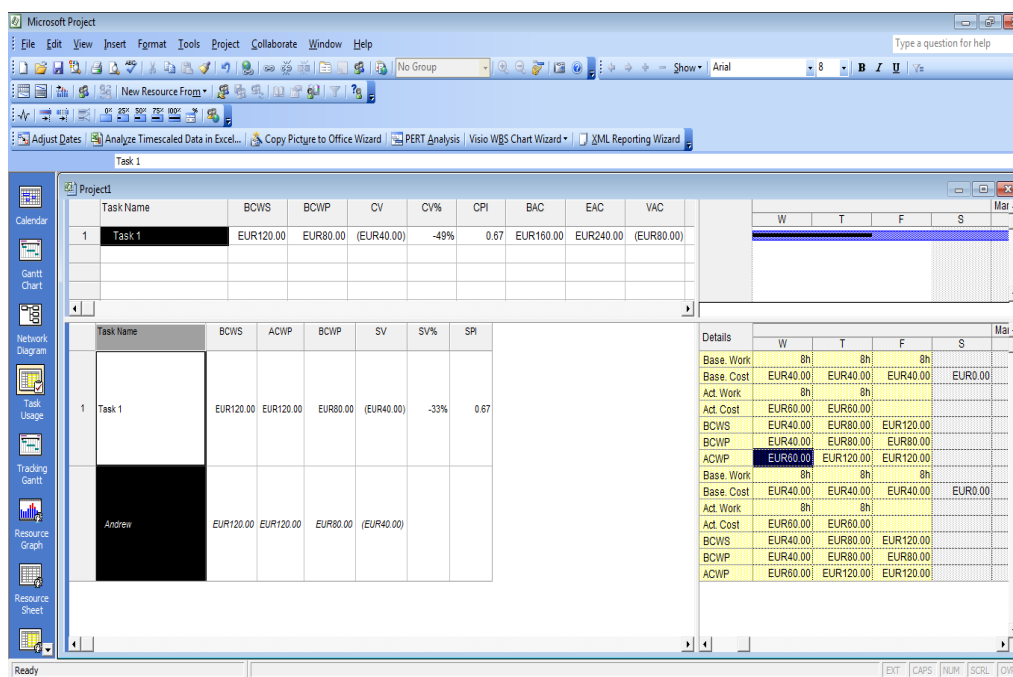


Figure 5. Earned Value Table

So, instead of simply comparison of the planned and actual costs, it is necessary calculation and expert interpretation of the previously mentioned indicators.

The cost variation of -40 EUR shows that the actual costs are higher for 40 euros from the gained value. Given the fact that this indicator has a negative value, it is inconvenient. The percentage of cost variance is obtained from the ratio $CV/BCWP$, in this particular instance amounts to -50% and that means it's spent 50% more than planned in the budget. If we continue the project realization, it will not be able to complete the task i.e. the project with the planned budget. Can be seen that this indicator is not calculated at the division.

The planned cost variance is also - 40 EUR, which is inconvenient because it means that the project earned less than was planned by the status date. The percentage of planned cost variance is calculated by the ratio $SV/BCWS$, in this particular instance amounts -33%, which indicates that the decline in the acquired value is 33% of the planned amount. The negative value of this indicator means that there is something that interrupts the task to be completed on time and the project manager should identify what need to be taken to get a positive value.

Performance cost index shows the earning on every euro of actual costs. Performance cost index in the example of 0.67 means that every euro of the real costs earns 0.67 of the planned value. Performance cost index shows the earnings by every euro of actual costs. This indicator can be used to predict whether the project will break the budget and how much.

Timing performing index of the project should be greater than 1 for positive impact of the project. In the example it amounts 0.67 which means that the project is only 0.67 productive in terms of the planned productivity. If we continue with the same dynamics it will take another 24 hours (16/0, 67) to complete the project which means that it will delay the completion of the project.

The estimated project budget shows how much will be the total costs when we complete the project if the value of the CPI is constant as at the status date. EAC in the example amounts 240 EUR which is 80 more than the planned costs.

The final cost variance VAC is a negative value which is negative regarding the project.

The indicators are valuable for measuring project performance and making decisions about corrective actions. Studies show that the evaluation of completion (EAC) based on data from the CPI and SPI tend to be significantly higher and more accurate.

Conclusion

One of the main benefits of Earned Value method is that it can be used for all projects independent of size and type, which gives comparable data or collective data for the entire portfolio of projects. Despite its simple model, it is widely used method in practice.

Using this method for measuring project performance today, it is recommended by Project Management Institute (PMI), British Standards Institution, and many other professional institutions for project management. According to the experience of its practical application it is best standard methodology for practice monitoring and control, as a simple way to simultaneously considered indicators related to the scope, time, cost, quality and risk of the projects. As an additional advantage, this methodology can be used to predict future performance of projects and the time and cost at the moment of their completion.

The basic contribution of Earned Value concept is to motivate project managers and members of project teams to manage rationally with the project costs and be implemented within budget. This concept provides reliable information essential for realized productivity and taking corrective actions. Basic information tool for effective application of this method is MS Project. Earned Value table in MS Project provides a complete overview of the performance of the project. This method is implemented in accordance with its objectives: it is not a predictive tool, it makes it easy the monitoring of progress, determines the status (in terms of time, budget, etc.), identifies potential negative phenomena and makes rough evaluation of their combined effect on the result of the project.

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