

Application of Quality Earned Value Method in the Integrated Management of Highway

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Abstract

On the basis of traditional earned value method and in consideration of quality factor, this paper use expert scoring method to measure the quality level of projects, which aim at the defects that traditional earned value method is unable to monitor project quality. By introducing quality earned value parameter, confirming the engineering quality evaluation index and explained by engineering examples, this paper has implemented the integrated management of project quality, cost and schedule by Earned Value Measure.

Keywords

Quality Earned Value Method, Highway Engineering, Entegrated Management, Evaluation Index, Variance Analysis.

1. Introduction

Earned Value Method is a method that will convert the completed quantity into money to measure progress of the project, its basic principle is that by calculating 2 absolute indexes sv, cv and 2 relative index SPI, CPI based on three basic variables ACWP, BCWP, BCWS, the cost and schedule of projects is monitored timely. However, the earned value is premise of qualified quality target for analysis and does not consider the impact of construction quality on the project, which can cause the omission of project quality control and difficult to achieve the integration control of three objectives on the project quality, cost and schedule. Therefore be further improved.

2. Quality Earned Value based on the quality factor

Project cost control, schedule control, the quality control impact and restrict each other and if the adjustment of one of the elements, it will impact on other factors. The high quality of the project at the expense of the high cost, In order to improve the quality, often require careful construction work and high costs, this will increase the project cost or extend the project period; On the contrary, inferior quality can increase the project expenses for rework and testing. Therefore, Project managers should pay attention to the overall consideration, taking effective measures to coordinate the cost goal, schedule goal and quality goal, ensuring project smoothly.

On the basis of the traditional earned value method, considering the influence of construction quality on project and by introducing quality index, the Quality Earned Value Method determines the evaluation system of engineering quality. It is used to analyze the quality deviation of the project and then the appropriate corrective measures is taken to control the quality of project, which implements the integrated control of project cost, schedule and quality.

2.1 Quality level

The quality level of project plan is controlled at a reasonable level range according to the contract or construction requirements in advance. Because there are many factors affecting the quality of engineering in practical engineering, the quality of the final project level may have deviation compared with the plan, but the quality levels of completed projects can be expressed as the actual

quality level. The actual and specified quality level of projects constitutes two important parameters of Quality Earned Value Method.

2.2 Quantization of quality earned value

The basic idea of quality earned value is through quantitative quality goals to weigh the relationship with the cost and schedule. To analyze the quality earned value to quantify, an intermediate variable, Project Quality Index Q_e , need to be introduced, which reflects the degree of deviation from the actual quality and quality of the program and can be represented as in mathematical formula:

$$Q_e = \frac{\text{the actual quality level}}{\text{the plan quality level}} \times 100\% \quad (2-1)$$

$Q_e > 1$: quality improvement; $Q_e < 1$: quality reduction.

In this way the project quality factor can be introduced into the earned value method in order to confirm intuitively the gap of between the actual quality level and the quality target plan. The quality earned value of the project can be expressed by $QBCWP$ what is the Intermediate parameters of the Quality Earned Value Method, the formula is:

$$QBCWP = BCWP \times Q_e$$

The quality earned value curve as shown in figure 1.

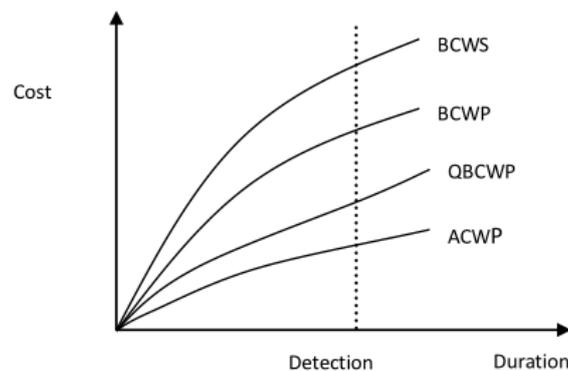


Fig 2-1. Quality earned value curve

As can be seen from the figure 1, $QBCWP$ is a curve closely around $BCWP$. $QBCWP$ curve can clear and intuitive reflect the deviation degree of the actual quality level distance the quality goals in one project. If $QBCWP$ curve above $BCWP$ curve, the actual quality level is higher than quality level in the project. If $QBCWP$ curve under $BCWP$ curve, the actual quality level is lower than quality level in the project. Because the quality factors have great influence on project schedule, cost, therefore, the appropriate adjustment measures need to be taken under the premise of guarantee quality standards, to ensure the smooth realization of the target.

2.3 Evaluation Indexes of Quality Earned Value Method

Quality earned value method put the quality target elements combined with the earned value management system. On the basis of parameter $BCWS$, $BCWP$, $ACWP$ of Earned Value Method, It is concluded that project quality earned value $QBCWP = BCWP \times Q_e$ by the project quality index of Q_e . Evaluation Index of Quality Earned Value Method as shown in table 1.

2.4 The application of quality earned value method

The specific steps that Quality Earned Value Method is applied to monitor synthetically projects are as follows:

Establishing project breakdown structure by works and organization.

Since each work package impact on the project is different, first by experts or managements who have abundant construction experience give each work package with a weight in engineering, sum to 1.

Experts or project managers who have rich experience in construction assessed separately for the quality level of each work package by the Program Quality and the Completion of the actual quality. The Quality situation of the project reflected by "gifted" "good", "medium" and "qualified", which can be counted as 90,80,70,60 points.

The weight of each work package rates multiplied by the value corresponding to the weight on the project has been defined quality level, the same token, it can also come to the actual quality level projects. It can be formulated as follows:

Predetermined level of quality = \sum Predetermined level of quality scores for work package \times The corresponding weights

Utilizing the method of principle of earned value to calculate each performance indicators of the project and Analyzed by it, if found deviations, corrective measures should be taken to adjust in time.

Table 2 Evaluation index of Quality Earned Value Method

No	Earned Value Quality Evaluation Index	Formula	Performance Efficiency	Deviation Status
1	Quality cost variance	CVq= QBCWP-ACWP	CVq>0	By showing consideration quality factors, the actual cost savings
			CVq<0	By showing consideration quality factors, the actual cost overruns
2	Quality schedule variance	SVq= QBCWP-BCWS	SVq>0	By showing consideration quality factors, the actual progress in advance
			SVq<0	By showing consideration quality factors, the actual schedule lags behind

3. Points that Quality earned value method used in highway engineering

Quality earned value method is an improved method of earned value management, which should be applied in highway engineering note the following.

3.1 Founding Earned Value Management Organizations

In the basis of existing organizational forms, aiming at the characteristics of highway projects, simple and efficient Earned Value Management Organizations is founded. Earned Value Management mechanism can be divided into three levels from top to bottom, Earned Value Management Leadership Center, Earned Value Management Project Implementation Office, Earned Value Management Executive Team, ensuring Project Earned Value Management Work smoothly .

3.2 Establishing a complete project detection reference

The successful implementation of Earned Value Management based on the establishment of clear and complete project reference. If the Detection Benchmark is not to able accurately established or detection reference regular change, then earned value method could not be successfully used in the project to evaluate the performance.

3.3 Accurately collecting basic data

Earned Value Analysis is based on accurate data and the authenticity of the source of the data is very important. Statistics such as the amount of chemical pipeline project has been completed, according to standardized criteria, carefully calculate summary, do not enlarge or reduce the amount of engineering; Capturing the actual cost of Highway Engineering also based on the market price, the actual labor expenses and other statistics truthfully, Only the basic data collection of the project is accurate, in order to ensure the smooth application of earned value method.

3.4 To focus on the flexible use of the critical path earned value, earned value quality

It should be focused on that the flexible use of the critical path earned value, earned value quality In the course of the implementation of the highway engineering. Critical path earned value, quality

earned value earned value method retains the original advantages of the earned value method to further improve and supplement. It makes up for the shortcomings of earned value method can further analyze the effect of the implementation of the project's cost, schedule and quality and providing a reliable basis for project managers to accurately grasp the progress of the project.

3.5 Application of Earned Value Management System Software

If the earned value method used in highway project monitoring, a lot of basic data need to be collected and processed in project implementation. Application of Earned Value Management software can work breakdown structure, set up accounts and control performance baselines, schedule formulation and management, project budgeting, earned value calculation of the project, analyze and generate deviation data reporting.

3.6 Enhance staff Training, improve the overall management of highway engineering

The successful application of earned value management has a great relationship with the company's internal management system, the organization of the sound and perfect, the management level of management personnel. Therefore, employees should receive regular professional skills related to learning and training, especially Earned Value Management Training; According to the results of the earned value analysis, the combination of material and spiritual incentives is implemented, fully mobilize the enthusiasm of the staff, improve work efficiency.

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