



XXIII R-S-P seminar, Theoretical Foundation of Civil Engineering (23RSP) (TFoCE 2014)

## Application of Earned Value Method to Progress Control of Construction projects

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### Abstract

Earned Value Method (EVM) is the efficient and well known tool for project management. Application of the method together with complementary - dedicated for EVM - known approaches, make the method well adjusted for use on dynamic and multidisciplinary construction site. The concept of Schedule Forecast Indicator to be used as the addition to EVM has been developed to support site managerial decisions concerning variation orders.

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Peer-review under responsibility of organizing committee of the XXIII R-S-P seminar, Theoretical Foundation of Civil Engineering (23RSP)

*Keywords:* Earned Value Method; construction project management; variation order.

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### 1. Introduction

It is still difficult to get the exact answer about the real progress of many construction projects. A construction project is perhaps one of the most complex and dynamic processes if to consider business and engineering activities. Engineers usually express the progress of works referring to the time schedule or to the cost plan. Since the changes or variation orders are normal practice in real construction projects, more integrated method is needed to describe the true status of a project. According to [1], the Earned Value Method (EVM) is recommended as the global standard for project performance measurement. The method really integrates scope, cost and schedule measures, and could give good picture of current project status at the date of control. The concept of implementation the EVM into the cost control and even to overall performance measurement of construction projects have been presented by many authors [3, 4, 5, 7].

Application of the EVM in the construction site management practice do require systematic register of time and cost data (usually once a week) in order to get the two following values: ACWP which is Actual Cost of Work Performed and BCWP – Budgeted Cost of Work Performed. The third required value, namely BCWS – Budgeted

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Cost of Work Scheduled can be defined before start of works, based of the time schedule of all works and the respective cost plan (Fig.1).

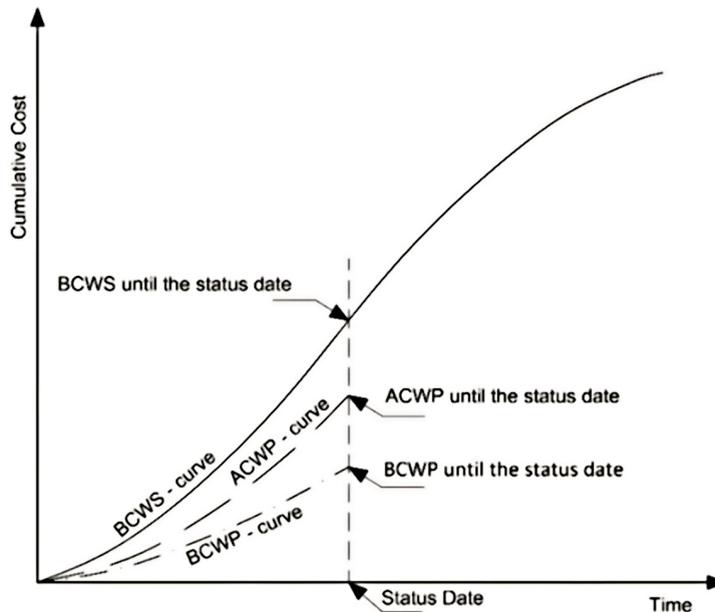


Fig. 1. Three basic curves used in the EVM.

Effective managing the construction site with supporting decisions by the EVM needs use of some additional managerial instruments which enable for quick and efficient cost/time data identification needed for each date of control. Firstly, the two corresponding documents: the cost plan and the breakdown of lump-sum price are needed. Without those documents, which should present breakdown of all works and costs in identical orders, one would have spent many hours to calculate especially BCWP value. Moreover, since variation orders happen nearly every week, especially in large construction projects, it would be beneficial to be well prepared to reduce eventual Cost Variance ( $CV=BCWP-ACWP$ ) and Schedule Variance ( $SV=BCWP-BCWS$ ), which are the two important measures of the EVM. Reducing SV and CV means simply to catch up the target final cost and the deadline date of the project. In order to do it, the site manager should know all the critical works to relocate people and other resources - in effective way - to critical activities. Thus, except of the cost plan and the breakdown of lump-sum price, the CPM network, considering the same activities as listed in the two other mentioned project documents, is required for efficient use of the EVM on site. As an effect of systematic use of the EVM, the site manager can get every week the up-dated prognosis on cost variance at completion and schedule delay at completion (Fig. 2)

## 2. Modification of EVM by additional approaches

The core concept of the EVM is of deterministic nature. Several authors proposed some additional approaches to model the construction works in probabilistic way [2, 9, and 11]. More often, the Monte-Carlo simulation has been used to generate the three shapes of the basic EVM curves, referring to: minimum, maximum and most likely of BCWS, ACWP and BCWP values. It should be noted, that even the construction site managers use powerful computers in their daily practice, but correct application of the Monte-Carlo simulation and use of function of distribution of probability which is adequate for particular construction works would be successful provided the software is dedicated for a given type of a construction project. The other group of EVM modification approaches is focused on shaping the original EVM to controlling the project time in better way, than it is possible by use of the original edition of the method. It is worth to notice, that originally the EVM was developed for both, cost and time management, but on the other hand, most of construction project managers use it for cost management, only.

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