

Study of a Construction Project in Greece Using Earned Value Analysis and Agile Project Management

Odysseas Manoliadis

(Associate Professor, Democritus University of Thrace, Xanthi, Greece)

Lazaros Minasidis

(Graduate Student, Hellenic Open University, CitPatras, Greece)

Demetrios Oustadakis

(Graduate Student, Hellenic Open University, CitPatras, Greece)

Abstract

In the present work an improvement of the Earned Value Analysis (EVA) method is introduced for the planning and management of technical projects with use of Agile Project Management (APM). Some features of the Agile Project Management and specifically regularly concretely measurements for the reliable recording of changes in the EVA as well as segregation of behavior of various sub-projects of constructional work are used and examined for their adaptation in construction project management. The method used in this study is recording per sub-project recording of elements EVA per regular time intervals adaptation of time intervals of recording and composition of EVA per every time period. The construction project in which the method is applied is a wastewater treatment plant in Veria Greece. The project consists of the construction of four sedimentation tanks and has 3.5 months duration. The projects work breakdown structure is consisted of the construction of initial sedimentation tank, sedimentation tank and the final sedimentation tanks. EVA figures were produced following the suggested method and were compared with the traditional EVA figures. The method suggested appeared to be better than the traditional method in terms of time of completion and related cost and can be easily implemented to construction project management and is useful for quick and satisfactory results.

Keywords

Agile management, Construction Project Management, Earned Value Analysis

1. Introduction

1.1 EVA in Construction Management

In the decades of 1980 and 1990 EVM were transported in the construction industry. [1] [2] More concretely, the period 1995-1998, EVM was appeared as a comprehensible and functional methodology of construction management and was used by construction managers and executives of technical enterprises and not only by experts in the particular method. [3] [4]. An important aspect of managing a project is to control the cost and time of completion of the project. [5]

A basic method used to manage a project, which was developed in the 21st century, is the Agile Project Management [6]. Agile is a repetitive method that is made to recover information on the continuity of work after each iteration that it happens in the work. [7]. The Iterations the project is programmed last maximum from one to four weeks. [8] This does not mean naturally that their duration cannot be changed

at the duration of work, as the particular method is adapted at the duration of the project depending on the needs of the activity.

1.2 Adaptive project management (APM),

Adaptive project management (APM), also known as adaptive resource management (ARM), is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision making simultaneously meets one or more resource management objectives and, either passively or actively, accrues information needed to improve future management. Adaptive management is a tool which should be used not only to change a system, but also to learn about the system [6]. Because adaptive management is based on a learning process, it improves long-run management outcomes. The challenge in using the adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future and achieving the best short-term outcome based on current knowledge [6]. According to [7] the comparison between the traditional and adaptive process is as follows:

1.3 Application of APM and EVA to construction IPMA project management

Below are described concisely the application of APM and EVA and the basic processes of Management of the project, at the process start up process, are determined and clarified the objectives and the object of work. Are drawn up the timetable of individual work, the program of fluctuation of needs in resources and the program of fluctuation of revenues and expenses. The planning of organizational structure and the frame of operation (project organization), become the constitution configuration of work as social system, the configuration of “culture of” work and are drawn the processes of management of dangers as for the objective, the timetable, the expenses, and the income.

In the phase of Co-ordination, is shaped a plan for who is responsible it receives each information on the work, as also for the way that will be transmitted each information. Also, becomes the guarantee continuous and effective communication between manager, the members of Team of Work and the members of Team of his main work. Finally, are ensured the continuous control and the adaptation of relations with the representatives of interested parts, the continuous support for the completion of each parcel of work and the continuous control of availability of necessary resources.

In the Control of the Project or the control of progress, the comparison with expected, the corrective energies for by any chance divergences and the growth of Reports of Work on each resource, or on the all project consisting of his departments. The processes of control take place in regular time intervals. It begins with the start of the project and finishes with the deposit of final report on the completion and the record of work.

In the phase of Crisis Management we consider potential divergences from as a rule, as extreme situations and developments, in however in one interval from the bad possible script in the better possible script. The management of Danger involves three stages. The recognition and evaluation of danger, the planning and concretization of meters and, finally, the control of danger. It is marked that the crises and the occasions emerge without warning. In the frames of Process of Departure and Process of Control it is possible are shaped Scripts on potential Crises in the development of work, accompanied from Alternative Reactions (Responses). The confrontation of crisis begins with the definition - the recognition - the Crisis and finishes with the briefing of responsible that the crisis finished.

Finally, in the phase of Closure of Project initially, the sentimental closure, as the “dissolution of” Team of Work, the exemption by responsibilities, the recognition of offer, the finish of relations and channels of communication with the interested parts, as a by any chance social event for the closure. Then, it is the essential closure as for the content with evaluation of record of work with a Certificate of Acceptance of work from the gentleman of work, the evaluation of total, but also the record of each involved member.

The main problems that are presented in the course of implementation of work and which are called to face with effectiveness the administration of work is the exceedance of cost, the exceedance of time and the labor problems.

In construction project management APM can be used for flexible production planning and control and construction, and is very useful for quick and satisfactory results [9].

From the other hand Agile management can be adapted easily and differs from the traditional methods of Project Management based on the Waterfall approach that is to say forecasted and programmed having a concrete form [10].

The method is used for Project of different project duration forecasting methods using Earned Value Metrics [11]. The paper is structured as follows. First the study metrics of earned value management coupled are presented. The description application area is following. Then the study results using these metrics are presented. Finally the conclusions of using the suggested methods and the comparison with the traditional method are presented.

2. Metrics of Earned Value and Adaptive Project Management

Monitoring of the manufacture of a construction project is an important tool of proper project management from the Project manager. To evaluate the progress of the project, three key parameters must be identified:

The estimated percentage completion of the project, the percentage of the budget has been spent and the time that has elapsed.

At this point we can present the principles of Earned value method (Earned Value Analysis-EVA) as applied to the specific problem. The EVA is an industry standard by which we can check the progress of a project and predict the date of completion. The application is based on the calculation and use of numerical indicators by which we can evaluate and compare various projects.

The three key variables are:

1. The budgeted cost of work scheduled (BCWS), which is defined as the planned value to be performed to a specific time period under the project timeframe.
2. The actual cost of completed tasks (ACWP), which is defined as the actual cost has been performed until the specified time control time.
3. The budgeted cost of completed tasks (BCWP) or else EV (Earned Value) which defines how it should be the cost of a job this time based on the implementation rate.

To control project at a time designated deviations factors which are:

1. Schedule Variance $SV = BCWP - BCWS$

If the difference is positive, the activity progresses faster than expected .An is negative, the activity is delayed while it is zero, the activity progresses on schedule.

2. Percentage Schedule Variance $SV\% = SV / BCWS$

3. Cost Variance $CV = BCWP - ACWP$

If it is negative, the cost is higher than expected. If it is positive, the cost is less than the forecast and if it is zero, the same as the projected

4. The percentage Cost Variance $CV\% = CV / BCWP$

Also designated the following performance indicators:

1. Cost Performance Index (CPI), which presents the construction progress cost, $CPI = BCWP / ACWP$

If greater than zero, the progress cost is higher than designed. If less than zero, the progress rate is lower than the designed and whether it is equal to zero, progress costs in line with planned.

2. Schedule Performance Index (SPI), which shows us the relationship between the time schedule and the current situation. If greater than zero, the project progresses faster than expected. If less than zero, the project is developing slower than expected, while if it is equal to zero, the project is in line with the construction program.

3. Case study: construction of wastewater treatment tanks

3.1 Project Description

The project which is analyzed in this work is the building construction of a biological treatment. By building construction meant the earthworks, the reinforced concrete construction, plumbing and waterproofing work.

The new wastewater treatment plant consists of four tanks of circular ground plan that are connected by high-strength pipes.

The treatment plant height is up to 11, 10 meters and its diameter is 32, 60 meters while the sedimentation tanks have height up to 4, 65 m with ground plan diameter of 24,5 meters and 28,5 meters.

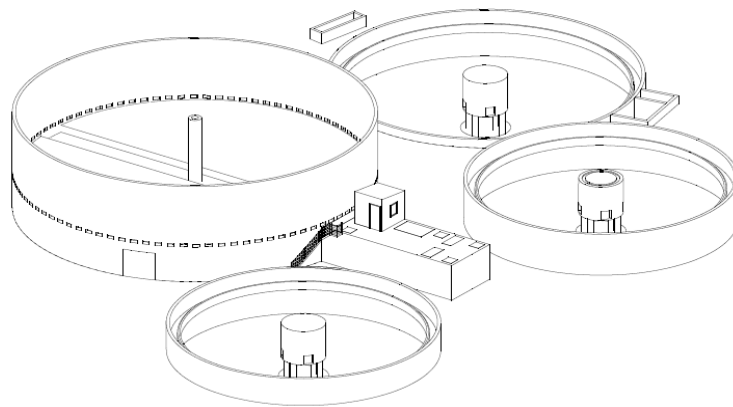


Fig. 1 3d photorealistic view

3.2 Agile Project Management application

Project Analysis subprojects

The projects structure consists of four pieces

- a) Primary sedimentation tank
- b) Treatment plant
- c) Sedimentation tank
- d) Final sedimentation tank

Initially designed the planning and scheduling charts for each building separately. In this way it is easier to analyze the construction and reach faster to the programming conclusions of the project.

3.3 Project Monitoring

All tanks, in the design, are broken down into four groups work.

- a) Excavations and groundwork
- b) Backfilling
- c) Reinforced concrete C25 / 30: Includes the installation of reinforced steel (iron), molding, concreting with concrete class C25 / 30 and tank compartments
- d) Waterproofing

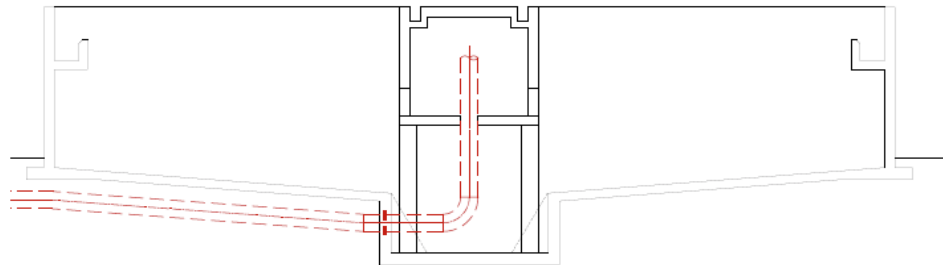


Fig. 2 Sedimentation tank

4. Results

Although the application of agile management in Earned the Value Analysis is a very useful tool for forecasting [11], there is not used for the control of construction projects. Therefore the objective of this study is the composition of these methods for the project control that has the advantage of a flexible method which gives us fast results and does not require the time of preparation that require the traditional methods of management.

Using the proposed methodology EVA figures were produced for the time intervals suggested and compared to traditional EVA figures (fig.3).

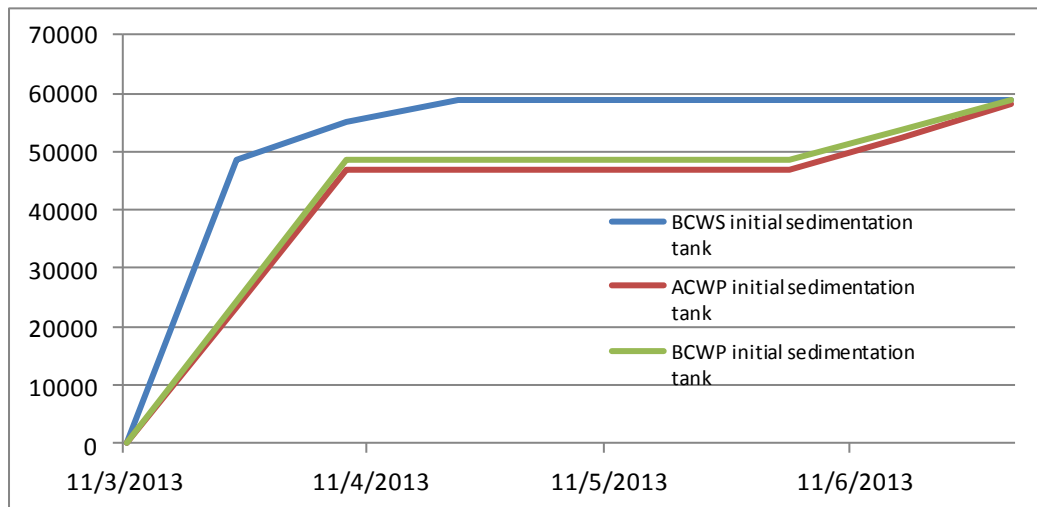


Fig. 3 Initial sedimentation tank E.V.A. metrics

As seen in Fig. 3 an important point to be considered by the use of this method is the use of thickening time checkpoints during use of Agile Project Management and Earned Value Analysis. Due to the delay found in the 3/6 scheduled control, using the indicator S.V., and the rush need of the project completion, it was necessary to thicken the time checkpoints and install additional check point in 17/6. Between the study results are

(a) Small iteration time periods where the divergences of cost that became perceptible that is about two weeks for the work analyzed.

(b) Control of the project activities does not only give the entire picture of work.

This is only achieved with the combination of the project as total. The Agile Management method imposes the aggregation of work in subsets and the time separation of duration of manufacture in repeated iterations.

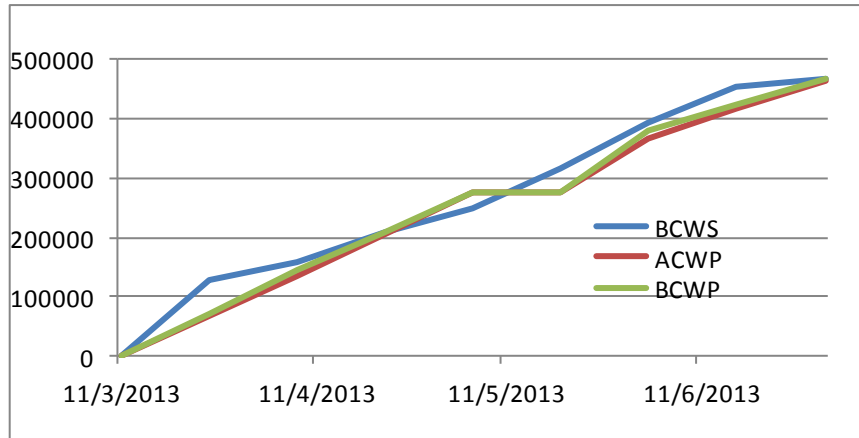


Fig. 4 Total E.V.A. Metrics

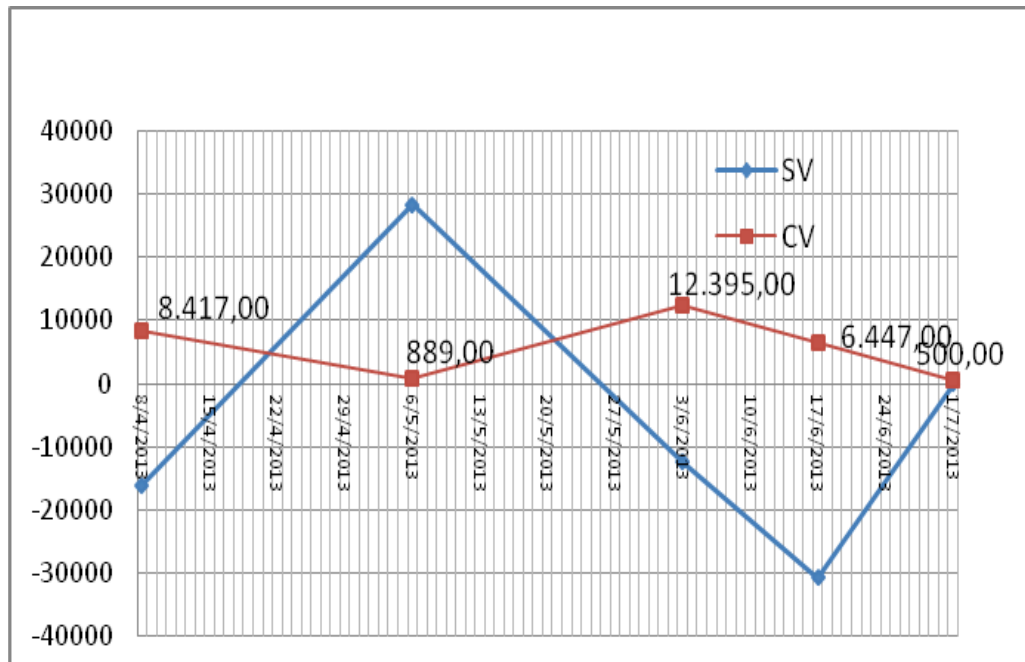


Fig. 5 Total S.V. and C.V. variation metrics

As it can be shown, the E.V.A. metrics BCWP and ACWP are almost equal with the BCWS indicator, which means that the whole project is in total control from the project manager (Fig. 4). Also, using the variation indicators S.V. and C.V., we could control the project with greater ease and accuracy (taking into account that those specific indicators lead into thickening of the time checkpoints) (Fig. 5). The suggested method appears to be better than the traditional method in terms of time of completion time as high as 12% (Fig. 4) and reduction of the related cost up to 17% (Fig. 5).

5. Conclusions

Although Earned Value Analysis is a useful tool for monitoring a project, without a systematic, timely and precise manner to deal with any delays and over charges, the method cannot meet the requirements for the construction of a technical project with predefined and strict deadline for completion of construction as and low budget. For this reason its use in combination with a flexible form of management such as Agile Project Management (AVM) can greatly contribute to the successful management of a construction as will be described below conclusions drawn should be mentioned here. Agile Project Management appeared very useful and important for the management of the construction project examined. Its use is easy and fast, after big part of planning of work becomes at his manufacture. The suggested method appears to be better than the traditional method in terms of time of completion and related cost. The collaboration of Flexible method and EVA is a useful for the Construction Project analyzed.

References

- [1] Erik, Gregory T. (2001) Effective Work Breakdown Structures. Management Concepts, (1st Edition), pp 7-8.
- [2] Royce, Winston (1970), "Managing the Development of Large Software Systems", Proceedings of IEEE WESCON 26 , pp. 1-9.
- [3] Owen R, Koskela, Lh, Henirch. G and Codinhoto. J. Is agile project management applicable in construction, 14th Annual Conference of the International Group for Lean Construction, 2006
- [4] PMP, Project Management Practice Leader, Management Concepts Exclusively for Project Management World Today Submitted by Trade Press Services
- [5] Wysocki, Robert K (2013). Effective Project Management: Traditional, Adaptive, Extreme
- [6] Cox, Jeff; Goldratt, Eliyahu M. (1986). The goal: a process of ongoing improvement. [Croton-on-Hudson, NY]: North River Press, 1986, ISBN 0-88427-061-0.
- [7] Kathleen B. Hass, The Blending of Traditional and Agile Project Management Published in PM World Today - May 2007 (Vol. IX, Issue V)
- [8] Subramani T. (2014) Analysis of Cost Controlling In Construction Industries Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 6(Version 1), June, pp.145-153 title:
- [9] Quentin W. Fleming and Joel M. Koppelman, (1998), Earned Value Project Management, A Powerful Tool for Software Projects, Primavera Systems Inc, The journal of Defense Software Engineering, pp.19-23
- [10] Joseph A. Lukas, P. (2008), Earned Value Analysis-Why it doesn't work, AACE International Transactions P1, Evm01.1
- [11] Stephan Vandevoorde, Mario Vanhoucke (2006). "A Comparison of different project duration forecasting methods using Earned Value Metrics" Science Direct International Journal of Project Management 24 pp. 289-302.