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Project control based on a mutual application of pert and earned value management methods

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Abstract

The purpose of this work is to adapt probabilistic modeling methods to time control and cost control of the investment and construction projects. The paper considered the possibility of application of Program Evaluation and Review Technique (PERT) for the time control of construction project, and the Earned Value Management has been proposed as well as the control method for the project cost control. The study revealed that in the first step is to improve the Program Evaluation and Review Technique for the control and management of construction projects, and to expand Earned Value Management to the possibility of taking into account the probabilistic character of the cost.

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Keywords: monitoring investment and construction project, probabilistic modeling, project time control, Program Evaluation and Review Technique, project cost control, Earned Value Management.

1. Introduction

Compliance with the target date of the construction and building of an object within a defined budget cost are determining factors that characterize the successful completion of the project [1,2].

There are two main reasons for the delay timing - slow implementation of works and the occurrence of unexpected events (failure mechanisms, failure of deliveries of materials and structures, extreme weather conditions,

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natural disasters, emergencies, accidents). In the first case, there are some trends in terms of the backlog that can track and predict. A second reason for the delay of the time is accidental.

If the work is completed more quickly than planned, its cost will rise, also if the work is performed very slowly, a slight increase in cost observed. Therefore it is necessary to take into consideration that the value of the work depends on the duration of its performance (Fig. 1).

2. Main part

In case of failure terms is required to seek a compromise between the acceleration of the implementation of a job and saving the cost of additional resources in the construction process [1,2].

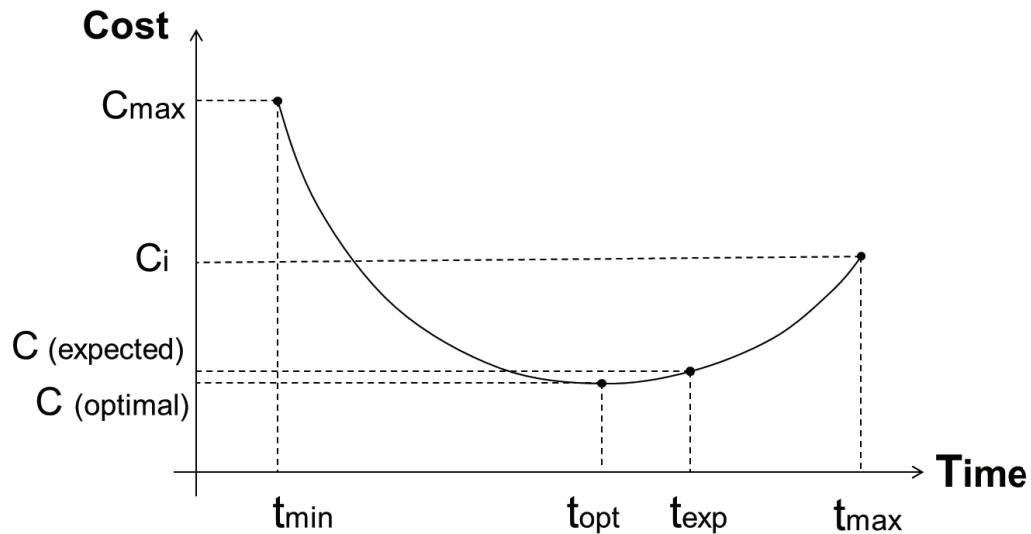


Fig. 1 - the dependence of the work cost and its duration

It is advisable to employ methods of probabilistic modeling to time control, because the slow implementation of the work can be described mathematically.

In modern construction practice, probabilistic modeling techniques used for project planning, but in practice it is useless, so it would be rational to consider the use of these methods for monitoring and control. It will be interesting to all participants of building production.

Objective: adapting probabilistic modeling techniques to time and cost control of the investment and construction projects.

Tasks:

- show the possibility of using PERT method to control the timing of construction;
- offer cost control mechanism for the project.

Consider the example of the use of program evaluation and review technique (PERT) to control the timing of investment and construction project. PERT method - based on the consideration of three estimates the duration of each work: the optimistic, most likely, and pessimistic. These estimates are derived from a survey of experts. [3]

Gathering information about the actual duration of the project work is necessary to fix in a tabular form, or directly in the environment of project management software (Fig. 2).

Activity	Time estimates				
	Optimistic	Most likely	Pessimistic	Expected	Fact
A	3.5	5.0	6.5	5.0	5.5
B	2.0	3.0	4.0	3.0	3.5
C	2.5	4.0	5.5	4.0	5.0
D	2.0	3.0	4.5	3.1	3.5
E	3.5	5.0	6.0	4.9	4.0
F	4.5	6.0	7.5	6.0	6.5
G	2.5	4.0	6.0	4.1	3.5
I	2.0	3.0	4.5	3.1	4.0

Fig. 2. Planned and actual duration of individual works

Generally, time control is based on a comparison of planned and actual duration of the work. The advantage of the PERT method is not only detection the deviation of the completion of each work during the time controlling of the project. Also we assess "where we are", in which an assessment has got the actual duration of the work and calculate the new range of the deadline for the project, taking into account the already completed works. Moreover, PERT method allows to calculate the probability of completing the project on time (Fig. 3) [3].

Activity	Term of actual completion of work	Estimation of completion based on the actual duration of the work already completed			Range of the project end date	Z	P(Z)	P, %
		Optimistic	Most likely	Pessimistic				
A	5.5	3.5	5.0	6.5	24.5 – 43.5	0.762	0.77	77.0
B	9.0	7.5	8.5	13.0	26.0 – 43.0	0.381	0.6459	64.6
C	14.0	11.5	13.0	19.5	28.5 – 42.5	-0.381	0.3541	35.4
D	17.5	16.0	17.0	22.0	30.0 – 41.5	-0.762	0.23	23.0
E	21.5	21.0	22.5	27.5	30.5 – 39.5	0.000	0.5	50.0
F	28.0	26.0	27.5	35.5	32.5 – 38.5	-0.381	0.3541	35.4
G	31.5	30.5	32.0	37.5	33.5 – 36.0	0.000	0.5	50.0
I	35.5	33.5	34.5	40.0				

Fig. 3. Control of performance time using PERT method

Controlling the realization of work, you can keep track of what kind of work leads to the disruption of construction terms. For example, after doing half of the project work, we are seeing a decrease in the probability of timely completion of the project (see Fig. 4).

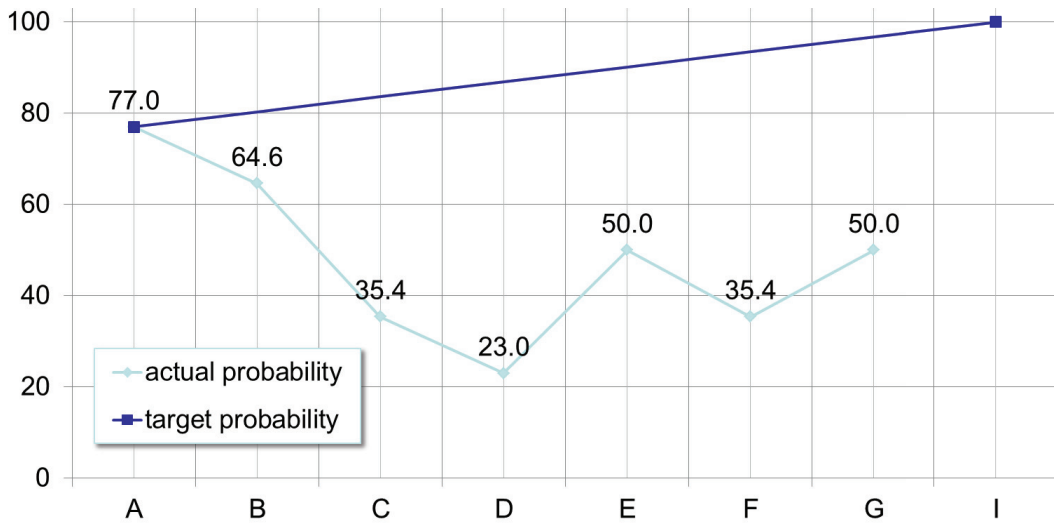


Fig. 4. The probability of completing the project as scheduled

To keep within appointed time requires the development and implementation of corrective actions to accelerate the implementation of the following works, which in turn leads to increased costs.

Figure 4 shows a typical dependence of the work cost and its duration used for the majority of projects. Point I corresponds to the planned execution of the work [4].

The duration of its implementation can be reduced (compressed), increasing the intensity of the use of resources (i.e. the amount of resources required for execution the work per unit time), and, therefore, increasing the cost of the work. Therefore it is necessary to control not only the deadline, but the cost [4].

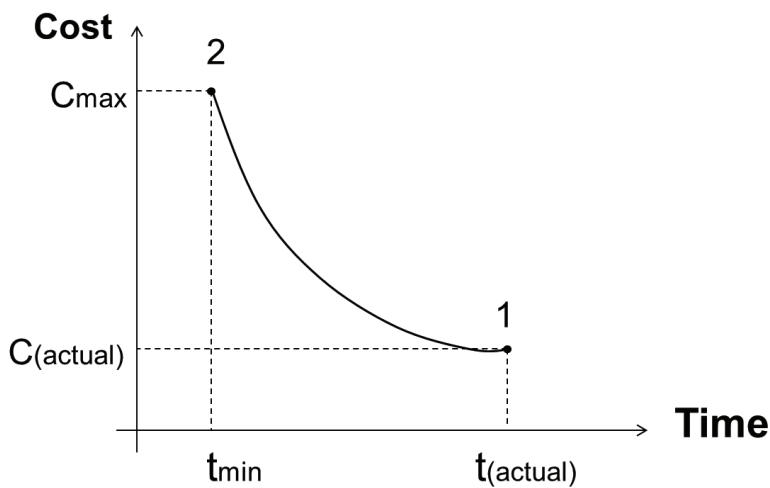


Fig. 5. Simplified graph of the dependence of the work cost and its duration [4]

Consider as a method of controlling the cost of Earned Value Management method. It is important to note that the Earned Value Management is not a probabilistic method, but there is a possibility of its use mutually with the PERT method as a single mechanism for the control of the project.

The appearance of deviations from the planned budget in the course of the project caused the necessity of implementation of cost control. Usually cost control is based on a comparison of planned and actual costs. In turn, Earned Value Management method compares the value of work that has been physically completed, with the amount of budget actually spent for it [5,6].

Earned Value Management method allows to periodically recalculate the final cost of the project that also called "Estimate at Completion". Budget forecast is one of the main advantages of this method, due to which the project manager can determine the necessary amount of funds to complete the work (Fig. 6) [5,6].

Time	Budget allocation plan	Actual cost	Earned value
5	1500	1700	1400
10	4300	5000	4100
15	3100	3300	2900
20	12600	12900	12100
25	8700	8900	8500
30	2300	2400	2100
35	5700	5700	5600

Fig. 6. Cost control by Earned Value Management method

Using Earned Value Management method can accurately assess the implementation of the project on the actual date compared with the initial plan [5,6]. According to the schedule of costs (Fig. 7), we see that the actual costs do not correspond to value of the execution works, as well as higher than planned costs. This suggests the need for changes in the project. However, the results obtained on the actual date are past stage, so improvements should be related to the implementation of future activities.

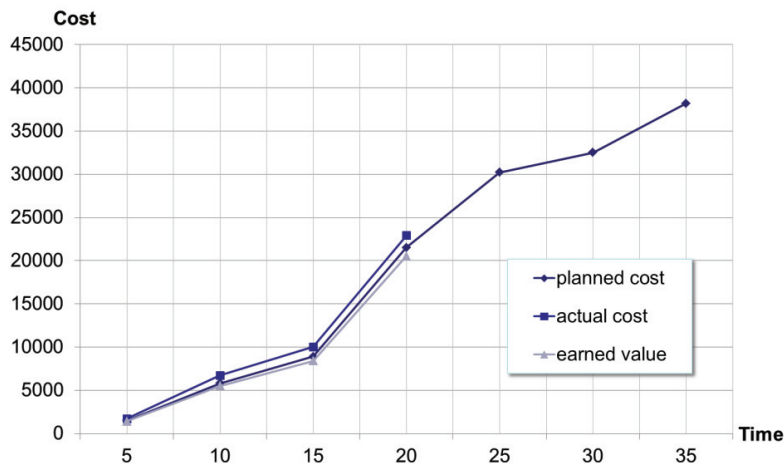


Fig. 7. Graph of the cost control by Earned Value Management method

3. Conclusions

This study has shown the possibility of using PERT method to time control of the investment construction project, as well as in the proposed method of Earned Value Management as a method of project cost control. However, the topic contains unsolved problems, which we submit for further study. Firstly is to improve the PERT method to control and manage construction projects, as well as to expand the Earned Value Management method to account the possibility of the probabilistic nature of the cost.

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