International journal of industrial engineering and operational research (IJIEOR)
Volume 2, No. 1, 2020
www.ijieor.bgsarman.ir, www.ijieor.ir **ISSN: 2676-3311**

Practical Methods to forecast the Actual Completion Date of the Project

Ali Fazeli Moslehabadi [1,*]

[1]*Department of Industrial Management, University of Tarbiat Modares*
[1]*Director of Project Planning and Control of Civil, Oil & Gas Projects at Kayson & Farab Companies.*

Article info:

Received 2020/06/01
Revised 2020/06/16
Accept 2020/02/07

Keywords:
Project management, Scheduling, Resource Efficiency, Earned Value Method

Abstract
One of the most important issues for stakeholders, managers, and the entire body of the project is to know the actual completion date of the project. Lack of knowledge of this subject and lack of familiarity with the techniques of estimating the actual completion date of the project, additional to the mistaken decisions made by the project managers and stakeholders, will result in financial and credibility losses for the project implementers. The methods used to predict the end time of the project are divided into methods based on the logic of the schedule (Critical Path Method) and methods based on the Earned Value Method. The first-class methods, due to the assumptions of linear programming and network logic, and the limitations of the project planning and software control, and the second category (Earned Value Method), due to the dependence of this method on the costs estimation requirement of the activities, are not generally well-suited to predict the completion date of the project. The methods used to estimate the completion time of a project, after starting the project, lose their efficiency and effectiveness by breaking the assumptions that are based on them. Current paper presents some of the most practical techniques for predicting the actual completion date used in construction projects, reviewing the conditions of use, and the strengths and weaknesses of each of the techniques.

1. Introduction

Effective project management aims to bring the project to completion on time and schedule. Estimating project duration is a key function of scheduling. Individual activities make up the schedule, and the estimates of their duration determine the project timetable. The accuracy of the overall schedule depends on the accuracy of these estimates. While project managers can't know the actual time it will take to complete an activity, there are six methods they can use to obtain reliable estimates [1].
Some researches [2] have mentioned that accurate time estimation is a skill essential for good project management. It is important to get time estimates right for two main reasons:

1. Time estimates drive the setting of deadlines for delivery and planning of projects and hence will impact other people's assessment of your reliability and competence as a project manager.
2. Time estimates often determine the pricing of contracts and hence the profitability of the contract/project in commercial terms.

Often people underestimate the amount of time needed to implement projects. This is true particularly when the project manager is not familiar with the task to be carried out. Unexpected events or unscheduled high priority work may not be taken into account. Project managers also often simply fail to allow for the full complexity or potential errors and stuff-ups, involved with a project.

*Corresponding author email address: Fazeliali63@gmail.com

Time estimates are important as inputs into other techniques used to organize and structure all projects. Using good time estimation techniques may reduce large projects to a series of smaller projects.
Rafik Nafkha [3] investigated the inputs to the process of activity duration estimating. In his research the inputs to the process of activity duration estimating were:
The enterprise environmental factors (databases of organizations involved in similar projects with information on activity duration estimates and other historical reference information).
Organizational process assets of the performing organization may have calendars and schedules of previous similar projects.
Project scope statement describes the project constraints and some assumptions that may be taken into consideration in the process of activity duration estimating
The project scope statement, activities list, and their attributes, as well as demands on resource requirements, are also significant information in the initial period of work on the preparation of project implementation schedule.
Some traditional and total project estimation time can be approached as follow ways:
Bottom-up Estimation or Expert judgment – is the project work breakdown until the lowest level possible, at which the presented work time and resources can be determined very precisely. This method, however, is very labor intensive and uses expert knowledge, which make the method one of the most accurate.
Bottom-up evaluation method is most useful while planning the whole project, where decision about the project requirements and implementation method was already made, as well as resources availability are known.
Evaluation by analogous estimating – using data from earlier completed projects, in combination with Expert judgment can give perfect results. This method is used both for the whole project duration assessment as well as its fragment. Unfortunately, the difficulties in the application of such method are often a lack of historical data.
Parametric estimating – the method uses historical data as an input to different models and mathematical formulas. Based on the knowledge of resources availability, the amount of work to be performed and the values of factors influencing labor productivity (based on historical data), project as well as its individual activities duration can be than estimated
Reserve analysis – project manager and / or project team can be choose to incorporate additional time referred to as contingency reserves, time reserves or buffers, into the coverall project schedule in recognition of schedule risks.
Three – Point estimate for activity duration is an estimate that includes optimistic, most likely and pessimistic estimate. This Method is known as
PERT analysis or PERT method. The method used these three different time estimations for each activity duration and calculated the probability of project completion by any given time.
Estimated activity duration resulting from the application of the above methods can cause a lot of problems and before all many errors due to the lack of complete historical data. Therefore, the application of three-point estimation derived from
PERT method provides very effective results, and is most frequently used by project managers [3].
Also Óskar Gísli Sveinsson in his paper, pointed that Lipke introduced the concept of the Earned Schedule (ES) to overcome the anomalies of the earned value schedule variances. In the earned schedule method the earned variance at a specified review point is traced forwards or backwards to the planned value (S-curve, PV). This intersection point is moved along the time scale axis to calculate the Earned Schedule (ES). They used detailed mathematical formulas and relations to introduce and describe concepts of Earned Schedule (ES) [4].
But in this paper we use simple relations and portions to introduce and use these conceptions applicable to forecast actual completion date of the project that will be mentioned in the following.

2. Research methodology

The research methodology is descriptive qualitative type.

3. Findings

The most prevalent method of predicting the project's finish date in construction projects which is also a foundation used in project control and planning software is the first method pinpointed at this paper. Underlying assumption of this method is how project process continuation complies with initial schedule. That means future is complying with future process. In virtue of this fundamental assumption, this method is not too much realistic which usually anticipates the project's finish date sooner than the actual date.
The second method: It is similar to the first method that requires using project control and planning software
The third method: It requires calculating the finish date of all remained activities until the reporting date of the project using resource efficiency.
The forth method: It is Earned Schedule Method. The underlying assumption of this method is fixed implementation conditions of the remaining of the project at the time of running the project.

4. Discussion and conclusion

a. The first method

This method which is one of the most common methods of anticipating the project's finish date and is prevalent in all of project control and planning software is in a shape that after inserting the actual progress percentage, schedule plan is updated. Then, software is automatically reversing the rest of undone activities until the date of reporting tailored to the scheduled duration of done activities.
In this method, the duration of activities, in proportion to their scheduling delays according to the schedule, is transmitted to beyond of contract completion date of the project.
The fundamental assumption of this method is that future activities are linearly complying with the same initial schedule. That means that it calculates how we act so far. If we act based on this schedule since then, when is the project's finish date [5].
For example:

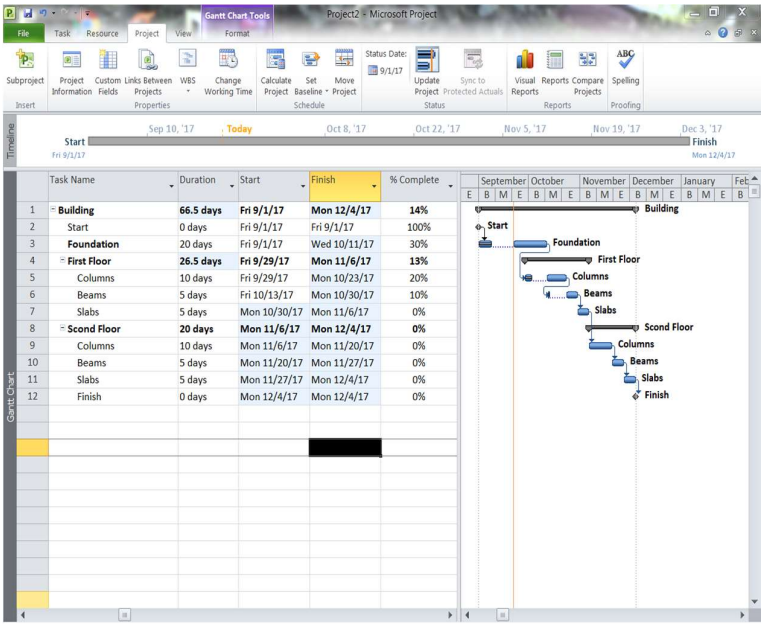

Figure 1- First Method Schematic Concept

b. The second method

In this method, after each updating of schedule, a Base Line can be provided from updated schedule. Then, that Base Line is considered as the basis of the new schedule (as-built schedule). Again to update the schedule, the present updated schedule (as-built schedule), is used (Not initial schedule). In this sense, the actual trend of doing project activities until the date of reporting is transferred to the new schedule and remained activities comply with the process of updated schedule [6][7].

For example:

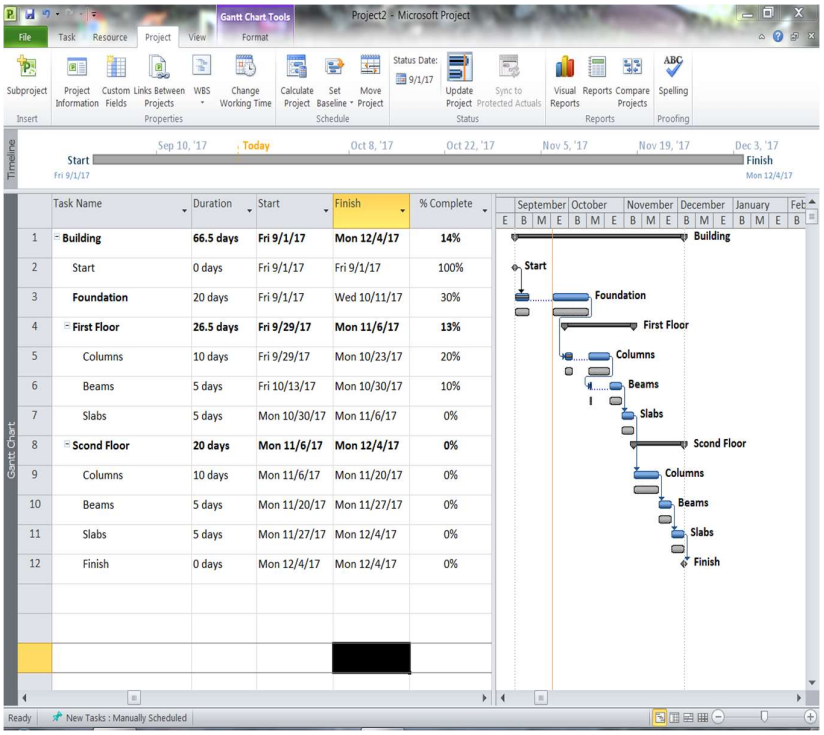

Figure 2- Second Method Schematic Concept

c. The third method

In this method, predicting the project's finish date is taken into the consideration using efficiency of each of resources.

As an example, rebar bending team of our project install 30 tons of armatures per day. Due to the residual volume and the performance of this team in rebar binding, it will be specified how much time is needed to finish this activity.

Finish date of all activities can be obtained via this method. Then, without disturbing the sequence relations of activities, the finish date of the project can be foreseen.

This method assumes that the future is complying with the past without disturbing the past trend that means if the efficiency of exploiting our resources in the project and also sequence relations of the activities are continuing as the same, how will it be like the finish date of each activity and thereby the whole project?

Also, to calculate the remaining activity planned duration from the logging date using this method (third method), after calculating the actual progress of the activities up to the reporting date, for other activities, we can divide the estimated remaining activity volumes into resource planned efficiency. It is necessary to explain that this is the same as the calculation of the first method, with the difference that in this case, we performed the program time manually using the estimated resource efficiency by ourselves, but the first method is by software according to the assumptions of planning its linear programming assumptions.

The limitation of this method is that, if there is an activity of the project that has not occurred before the date of the report, because of the lack of efficiency of the operation, we cannot estimate the estimated time of completion of that activity [6],[7].

d. The forth method

Applying Earned Schedule Technique

In this method (Earned Schedule Method), by applying a simple proportion, the past trend can be generalized to the future with the difference that the actual trend of the future will be affected by the actual trend of the past, in the event of the stability of the past condition.

The methodology is in a way that for example assumes a project which its total duration is 10 months, now is the 12th month and we had 80 percentage progress. The time we spent is 12 months, now we have to calculate where the planned progress has been 80 percentages for example in the 7th month. In this case, obtained time is 7 month and the actual time is 12 months that means we have done a work during 12 months which was supposed to be done in 7 months. Consequently, we practically lag behind the plan about 5 months. On the other hand, it can be calculated that when we did 7-month activity in 12 months, if we set a proportion, 10-month work (i.e. the whole project) will be done in 17 months. In another word, the project will be probably completing with 7 months delay [8], [9].

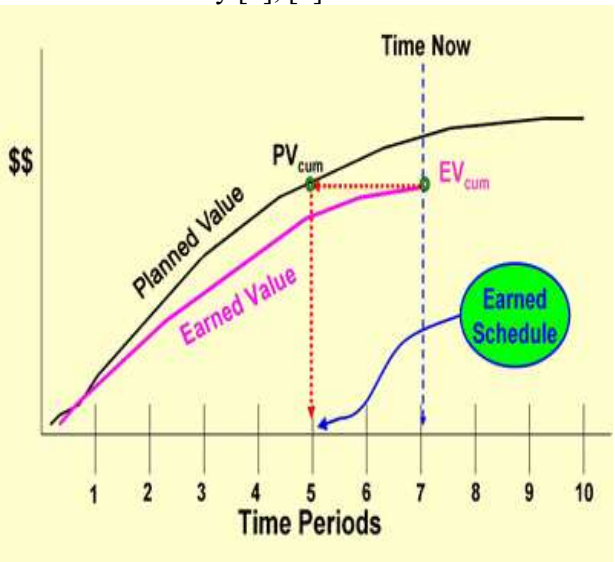

Figure 3- Earned Schedule Schematic Concept

Albeit, it is noteworthy that all of these methods can be deployed when we are allowed to update the master schedule of the project or as it was aforementioned in the paper, it is done to notify the various project bases of the current implementation of the project and the repercussions of the following this trend and deciding for project managers. Otherwise, to do these issues, we require obtaining a permit from the employer, preparing a delay bill based on the contract, and then preparing a new timetable and proposing to the employer [10].

It is noteworthy that in all of aforementioned methods in the paper, the project must be working up to the first date of reporting period. Then concerning the first actual implementation period of the project, an action is taken to forecast the actual finish date of the project. Also in all of aforementioned methods, the arrangement of scheduling relationships between activities is assumed to be fixed and only the duration of activities is changing based on the mentioned methods. The third and fourth methods addressed in this paper in terms of content and conception have all the same logic which are different with each other only in calculations, technique and applying pertinent software. It implicates that for example when you are using Earned Schedule Technique; in fact you are generalizing the resource efficiency to the project's remained activities according to the activities (Status Date/Data Date) done so far. Also, all of the methods

mentioned in this paper are methods based on linear programming assumptions [11] that assume that the efficiency of using resources in the continuation of the project is constant, that by changing the gradient of project progress, these methods lose their efficiency.
In the end, it should be noted that the process of monitoring and estimating the completion time of the project is a continuous and ongoing process during the duration of the project. Because the terms of the scheduling based on them may change several times during the project, and the lack of estimation and prediction of the new project completion date and the updating of this process will result in a lack of preparation for appropriate actions and responses for obtaining and decisions are made to take appropriate measures to correct the processes and cause financial and non-financial losses to stakeholders and project owners. We suggest other methods like for evaluation of projects Analytic Hierarchy Process [13, 14], or Data envelopment analysis [15] for future research and combining with this research. Using a metaheuristic algorithm can help to a better plan completion time too [16,17].

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