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A Defect Value Method for Duration Forecasting in Construction Projects

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Abstract – *Construction management plays an important role in successful completion of any construction project. Time and cost are the two most critical parameters which control the entire construction projects .Any delay in execution of certain activities of construction projects will result into time and cost overruns. So it is important to regularly monitor the execution of construction projects until its completion. There were many factors causing the delays in construction projects, defect is one of them which is critical and required more attention. There were many methods developed to continuously monitor the progress of construction projects thereby predict the future completion time of construction projects. But these methods did not consider the time required for overcoming the delay caused due to defects occurred in construction projects. So this study proposes a new method to forecast the future completion duration by considering the delay caused due to defects occurred in construction projects. A hypothetical case study is illustrated to validate this new method.*

Key Words: Delay, Project duration forecasting, Defects, Construction, Scheduling, Monitoring, Project management

1. INTRODUCTION

Over the period of time, construction sector and its related activities plays important part in the economic growth, development and economic activities across the country. Construction sector greatly contribute to uplift the economic development of the country. It contributes to Gross Domestic Products (GDP) and employment rate. It also offers various job opportunities to skilled, unskilled and semiskilled labors. It helps to generate income in both formal and informal sector. Construction industries seriously taken into account for the economic development of any nation. Construction industries always have a significant impact on economy, as it purchases products and materials from other industries in the sectors.

The primary purpose of execution phase forecasting is to procure early warning signals so that preventive actions may be applied in time. Over the period of time, such predictions need to be revised and compared with scheduled time. So the project duration forecasting needs to be effectively performed during execution phase of project in order to avoid or minimize the time and cost overruns. It is the responsibility of project managers to forecast project duration at respective time intervals or phases of projects. Many researchers have developed various methods to forecast duration of construction projects.

There were number of factors which are responsible for delays in construction projects. Some of the delays were critical and requires more attention to avoid time and cost overruns in construction projects. Defects occurred in construction projects includes crack formation after the plastering works, defective pipe network causing leakage etc. It is important to analyze these defects and estimate the cost and time in overcoming them.

1.1 Aim

The major of this study is to develop a new method for predicting the future completion time of construction projects by consideration of delay caused due to the defects occurred after execution of certain activities with the help of a hypothetical case study.

1.2 Objective

To develop a new method for forecasting the future completion time of construction projects with the help of a hypothetical case study.

2. LITERATURE REVIEW

Adel ALSHIBANI (2012) said that, this study presents a new method for forecasting time and cost of construction projects at completion and/or at any intermediate time horizon.. The method is designed to overcome limitations of current applications of Earned Value Method (EVM) in forecasting project cost and durations. The method enables the user to assess the uncertainty associated with forecasted project cost and duration at completion in order to take corrective actions. The results obtained by the developed method demonstrate the effectiveness of

(1) Using project ratios technique in forecasting project time and cost comparing to that obtained by traditional Earned Value Method (EVM) ,

(2) Measuring the status of critical activities only, is particularly useful in forecasting project durations,

(3) Accounting for uncertainties involved in the forecasting process provides flexibility in modeling forecasted project time and cost.

Greg J. Hoffman (October 2007) expressed that, this research develops a regression model for the factors that impact construction duration. In this study data were collected for

856 facility projects completed between 1988 and 2004. These data were analyzed using Bromilow's time-cost BTC model 1969 as well as multiple linear regressions. The multiple linear regression model was found to provide the most acceptable prediction.

Patricia D. Galloway (July 2006) described that, Critical Path Method **(**CPM) scheduling has become standard project control tool and both owners and contractors use the tool whether it is or is not required by contract. This study summarizes extensive research that has been performed of the construction industry relative to the use of Critical Path Method (CPM) scheduling, its applicability and its acceptance in execution of today's constructed projects. This study includes stakeholder's views and recommendations on the use and effectiveness of Critical Path Method (CPM) scheduling in order to improve the construction industry.

3. METHODOLOGY

Fig -1: Work flow chart

1.1 Defect Value Method

This method is very useful for forecasting the completion duration of construction projects. Various defects occurred after execution of certain activities in execution phase of construction projects. The common defects occurring in construction projects are listed below

- Formation of cracks after plastering work
- Breakdown of pipe network causing leakage etc

So to overcome such defect an extra time as well as extra cost is required which is not included in the schedule and budget of project. So this method will take care of the extra time and cost required to overcome the defects.

✓ **Input Data**

EV = Estimated value/budgeted value = planned cost

SV = Spent value = actual cost spent

DV = Defect value = cost spent to overcome the defects

✓ **Formulae**

Actual Value (AV) = Spent Value (SV) + Defect Value (DV)

$$\text{Duration Performance Index (DPI)} = \frac{\text{Estimated Value (EV)}}{\text{Actual Value (AV)}}$$

✓ **Forecasting Project Duration**

An estimate of duration at completion (EDACt) can be calculated by following formula:

(EDAC)t = PD / DPI

Where,

PD = Planned Duration

DPI = Duration Performance Index

(EDAC)t = Estimated duration at completion when forecasted at time 't'

4. CASE STUDY

A hypothetical case is illustrated here to facilitate the validation process for the Defect Value model. Fig-2 shows the precedence network of the case study, the activity duration, early dates and the budgeted cost of each activity. The actual reporting data (monitoring data) are also indicated in tables. Each table shows the actual percentage completion at the end of that particular monitoring date. The spent value for each activity is calculated and cumulative spent value cost is then calculated by summation of spent value costs of each activity. Similarly estimated values are also calculated for each activity. The project is updated at the time where defects occurred.

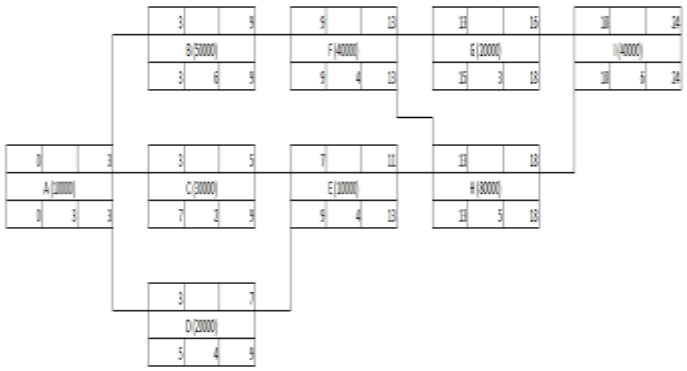

Fig-2: The precedence network of Case Study

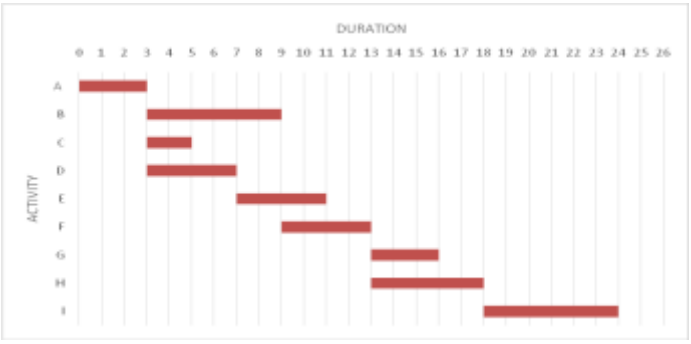

Chart-1: Bar chart of Case Study

Chart-2: Estimated value curve of Case Study

Table-1: Cost details of the Case Study

ACTIVITY	STARTING DAY	TIME REQUIRED	TOTAL COST	COST PER DAY
A	0	3	10000	3333
B	3	6	50000	8333
C	3	2	30000	15000
D	3	4	20000	5000
E	7	4	10000	2500
F	9	4	40000	10000
G	13	3	20000	6666
H	13	5	80000	16000
I	18	6	40000	6666

✓ **4th day monitoring**

Table-2: 4th day monitoring data

Actual project data at the end of 4th day	
Activity	**% Work complete**
A	100
B	10
C	50
D	25
E	0
F	0
G	0
H	0
I	0

✓ **Defect Value Method**

Table-3: Estimated and spent values (4th day)

PERIOD	ESTIMATED VALUE	CUM EV	4TH DAY SV	CUM SV
1	3333	3333	3333	3333
2	3333	6666	3333	6667
3	3333	10000	3333	10000
4	28333	38333	25000	35000
5	28333	66666		
6	13333	80000		

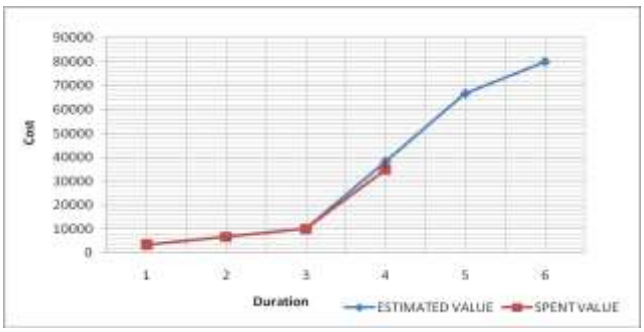

Chart-3: S-curve for Case Study on 4th day

Total cost of project = 300000₹,

Cumulative estimated value = 38333₹,

Cumulative spent value = 35000₹,

Defect Value = 5000₹

Cumulative actual value (AV) = Spent value (SV) +Defect Value (DV) = 35000+5000 = 40000₹

Duration Performance Index (DPI) = Estimated Value (EV)

Actual Value (AV)

= 38333/ 40000

= 0.958

Estimated project duration at complete = PD/DPI = 24/0.958 = 25.05 days,

So the forecasted project duration at completion

=25.05 days

5. RESULT

Forecasted duration using Defect value Method = 25.05 days

Planned project duration = 24 days

The graphical representation of variation of forecasted duration by Defect Value method with respect to planned duration is illustrated in Chart-4 as follows:

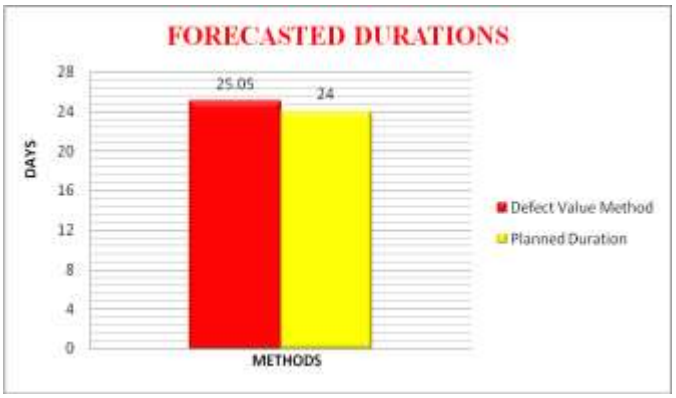

Chart-4: Graphical representation of the forecasted duration with respect to planned duration

6. CONCLUSIONS

The newly developed Defect value method provide more accuracy in forecasting project completion duration as it includes the time and cost spent in overcoming the defects occurred in construction projects. But Defect value method provides better results only for the construction projects involving defects. Defect value method provides a new way to forecast the future completion duration of construction projects by considering the impact of delay caused due to defects on overall construction duration which helps project managers to take preventive measures to minimize time and cost overruns.

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