Project Schedule Monitoring by Earned Duration Management (EDM)

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Abstract— In earlier days, project managers face many difficulties to maintain the project in a right track. In the 20th century, Gantt chart was developed and since then the management of the projects based on the baseline schedules has come into existence. To monitor the cost and schedule Earned Value Management (EVM) was introduced. The main objective of the EVM when it was introduced is only to monitor the cost aspect. But later on by specific derivatives schedule monitoring is also introduced. For monitoring a project schedule, EVM uses cost in place of time. There are certain misleading's observed while using cost to control the schedule. So to overcome this issue, researchers developed a new method, Earned Duration Management (EDM). In this paper, a railway bridge construction project is considered as a case study and EDM methodology is applied to find out the variation of various EDM indices.

Index Terms— Earned Duration Management, Duration performance Index, Project Monitoring and Controlling Methods, Schedule Performance

1. INTRODUCTION

Managing the project is about checking that all the events are going on budget and in the right duration. It is about being in control, and the risks should be minimized by operating the project on track with the project plan. If there any adjustments or changes in the plan it should be implemented in a way that it should not disturb the project.

The control on the other hand is to look over the implementation of the plan and to compare the data of the planned value with the actual value by the records and by using the data we can keep the project on track.

To maintain all these one of the most commonly used method is Earned Value Analysis and due to some deviations another method is developed known as Earned Duration Management.

Schedule performance monitoring is observed to be more accurate in EDM than EVM. So this method can be easily used by the schedule engineers, clients and contractors to measure the schedule performance. By this method completion date of the project can be depicted easily and controlled easily. In this paper, a railway bridge construction

project is considered as a case study and EDM methodology is applied to find out the variation of various EDM indices.

II. LITERATURE REVIEW

Completing the project in a given time and budget is the way to earn profits. But it is very difficult to attain the accuracy for

macro projects, because there are various events and each event should be monitored simultaneously. To control

this, a method was introduced and it is known as Earned Value Management (EVM). This was used to control the project performance and it was developed by the Defence Department of United States in the year 1967, it came into existence because the contractors were to be complied with the (cost and schedule) criteria of Control System (Anhor : 2003) The EVM has Some Key parameters by which an Analytical process will be done and the performance i.e. schedule and cost can be controlled. (Vanchouche:2014)

The usage of the EVM became very successful and many companies started handling huge projects stated to implement it, nut the major drawback of it that there is a lack of schedule performance indicator was observed. Due to this there

existed an unreliable behaviour which is observed at the time factor, few depicted that this may be the reason for the unreliable results. To overcome this, a new method was developed and it is Earned Duration Management. (Homayoun Khamooshi).

After that the drawbacks are easily covered due to more reliable results and applicable indices. After that many Literatures are prepared regarding the use of the Earned Value Management and Earned Duration Management, many also showed the difference in the schedule parameter by using both the methods and also by taking different case studies. Here, we are going to focus only on the schedule parameters of the EDM and the method to determine the Schedule Performance.

III. METHODOLOGY

Earned duration management measures the duration of each and every activity in tracking period. The project execution has to be reviewed on mentioned dates. The duration between the dates is known as Tracking Point. Based on the project duration, sensitivity and importance, tracking periods have to be assigned. From the schedule, the sum of the planned duration of all the activities in a tracking period will be considered as Total Planned Duration. During the

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execution of the work the Actual Duration of every activity is noted in respective tracking periods and their summation is known as Total Actual Duration. Based on the work executed, Earned duration of each activity is calculated at their tracking periods and by adding those give Total Earned Duration. Based on the total earned duration and the total planned duration the Earned duration of time ED(t) is found out. Now, from the obtained parameters we calculate the Duration Performance Index, Earned Duration Index, Project Process Index, Duration Variance and Total Duration Variance shown below.

Total Planned Duration

The sum of all the planned activities at a particular time is known as Total Planned Duration (TPD).

TPD=PD1+PD2+PD3+……..+PDn

Total Earned Duration

The sum of all the values of Earned Duration at a particular time is known as Total Earned Duration (TED).

TED=ED1+ED2+ED3+……..+EDn

Total Actual Duration

The sum of all the values of Actual Duration at a point of time is known as Total Actual Duration (TAD).

TAD=AD1+AD2+AD3+……..+ADn

Project Progress Index

The Schedule of the progress of the project is known as Project Progress Index (PPI). If the value is '0' the there is no progress and if the value is '1' then the project is completed. So at each point by PPI we can know the status of the project.

$$PPI = \frac{ED(t)}{BPD}$$

Duration Performance Index

The Duration Performance Index is calculated to know how well the project is going on and achieving the target in a specific date (DPI).

$$DPI = \frac{ED(t)}{AD}$$

Earned Duration Index

By the Earned Duration Index we can calculate the overall work performed in the terms of Earned Duration comparing with the planned work (EDI).

$$EDI = \frac{TED}{TPD}$$

The values may be less or greater than one or equal to one.
Duration Variance

The deviation of the project duration is found from the Duration Variance (DV).

$$DV = ED(t) - AD$$

Total Duration Variance

The difference between the Total Earned Duration and the Total Planned Duration gives the Total Duration Variance. It can be found at any point of the project.

$$TDV = TED - TPD$$

CASE STUDY

A Railway Bridge project completed in September 2013 is considered as a case study in this paper.

Project Planned details are
Planned Duration: 225 days
Total No. of Activities: 28
Number of Workdays per week: 5
Project Planned Start Date: 25-10-2012
Project Planned End Date   : 04-09-2013
Total Planned Duration: 221 Days
Tracking Period   : 1 month

IV.RESULTS

Table – i: Earned Duration Analysis

Months	Total Planned Duration	Total Actual Duration	Total Earned Duration
1	7	7	7
2	34	34	34
3	44	44	36.5
4	64	64	41.5
5	76	81	48.7
6	101	97	62
7	131	121	86
8	154	144	114
9	176	174	144
10	199	189	159
11	219	200	170
12	221	224	194
13	221	244	214
14	221	251	221
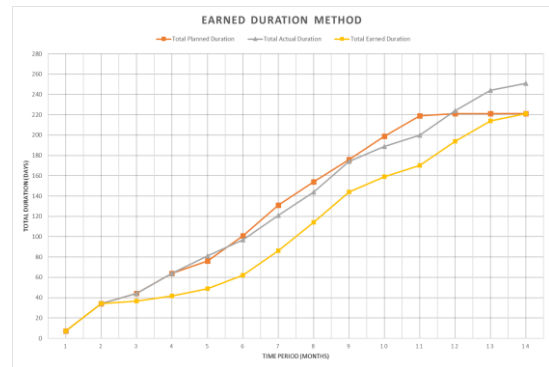
Figure 1: Earned Duration Analysis

Project Actual Details:
Actual Start: 05-11-2012
Actual Finish: 02-12-2013
Actual Duration: 268 Days
Actual Total Duration: 251 days
Duration Variance: 43 days

From the above line graph, we can depict that from first month to second month all the three parameters coincided.

From the second month to final period, there are fluctuations in the durations which indicates work executed is not according to the plan.

Table – 2: Duration Performance Index

| Months	Duration Performance Index
1	1
2	1
3	0.75
4	0.69
5	0.65
6	0.65
7	0.77
8	0.80
9	0.84
10	0.82
11	0.79
12	0.82
13	0.79
14	0.86
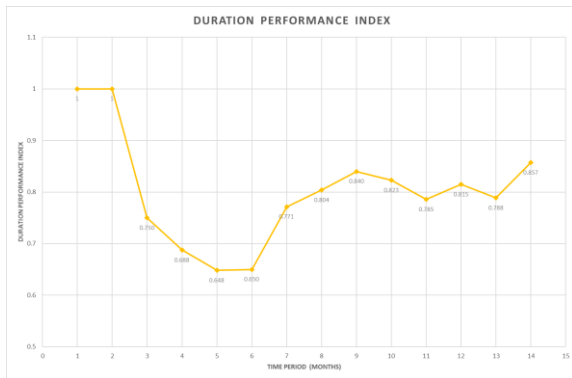
Figure – 2: Variation of Duration Performance Index

From the above graph, we can observe that there is a sudden drop in performance of the project from second month to fifth month. And from there to end, there are fluctuations. The DPI value ranges from 0 to 1. '0' indicates the null performance and '1' indicates the completion of work in given schedule.

Table – 3: Earned Duration Index

Months	Earned Duration Index
1	1
2	1
3	0.830
4	0.648
5	0.640
6	0.614
7	0.656
8	0.740
9	0.818
10	0.799
11	0.776
12	0.878
13	0.968
14	1.000
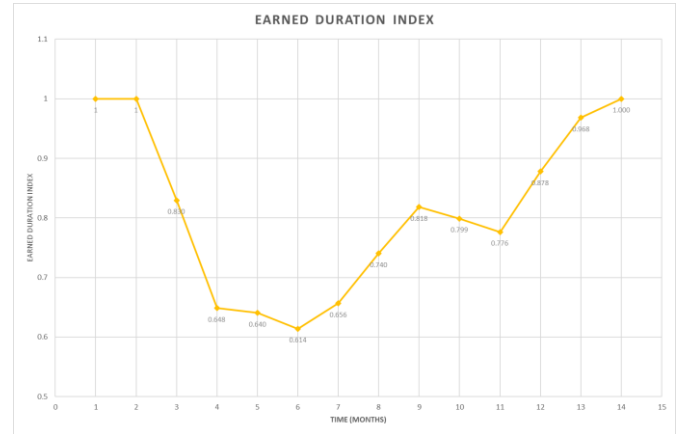
Figure– 3: Variation of Earned Duration Index

Here, from the above graph there is a sudden drop from second month to fourth month and a slight decrease from fourth to sixth month and from it increased slowly till the end. The EDI value must be equal to 1 at the completion of the project.

Table – 4: Project Progress Index

| Months	Project Progress Index
1	0.083
2	0.167
3	0.188
4	0.229
5	0.270
6	0.325
7	0.450
8	0.536
9	0.630
10	0.686
11	0.720
12	0.815
13	0.854
14	1.000

Figure– 4: Variation of Project Progress Index

From the above graph, there is a continuous increase from starting to end period but there are fluctuations during the progress. If it is straight line then it is said that the project is performed well. Caution should be taken to avoid these fluctuations during the tracking periods.

Table – 5: Duration Variance

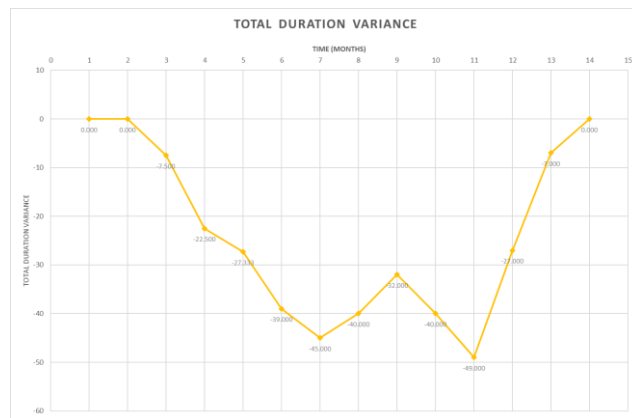| Months	Duration Variance (Months)
1	0
2	0
3	-0.75
4	-1.25
5	-1.76
6	-2.1
7	-1.6
8	-1.57
9	-1.44
10	-1.77
11	-2.36
12	-2.22
13	-2.75
14	-2
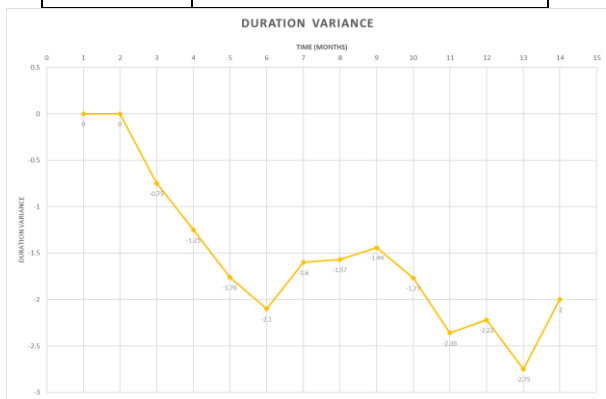
Figure– 5: Variation of Duration Variance

From the above graph, we can observe that there is continuous decrement from second to sixth month and from sixth to fourteenth month there are fluctuations. The negative value indicates the lag in duration.

Table – 6: Total Duration Variance

Months	Total Duration Variance (Months)
1	0
2	0
3	-0.75
4	-1.25
5	-1.76
6	-2.1
7	-1.6
8	-1.57
9	-1.44
10	-1.77
11	-2.36
12	-2.22
13	-2.75
14	-2

Figure– 6: Variation of Total Duration Variance

In the graph, there are increments and decrements simultaneously. Decrements are from 2 to 7 and 9 to 11 months respectively and increments are from 7 to 9 and 11 to 14 months respectively. The negative value indicates the variation in months from the planned scheduled.

VI. CONCLUSIONS

1) In the Earned Duration analysis, if the executed work is according to the planned work then all the three lines would coincide. Due to some delays, Total Actual Duration is more than the Total Planned Duration. In these cases, the actual duration line will not match with planned duration line.

2) In this project, the minimum value of Earned Duration is observed as 0.614 in the 6th month, which indicates only 61.4 % of the work earned at that particular time. Therefore, in these situations Schedule managers have to be very cautious.

3) The Duration Performance Index represents the overall schedule progress performance at any point in time. It shows how well the project is going on and here the least value observed is 0.65, which indicates that there is poor performance at particular period.

4) If the progress of the project should be well and good then the graph of the Project Progress Index should be in a straight line i.e. y=x graph, but there are fluctuations in the path which represents the poor performance during the progress of the project and measures should be taken to avoid it.

5) In the project, the Total Duration Variance deals with all the activities and deviations from the plan. It depicts the accuracy of work performed. The negative value indicates more deviation and '0' indicates negligible deviation i.e. perfectly accomplished.

6) The Duration Variance deals with the delays in the project at particular event even here too the negative value indicates the delay in certain event.

REFERENCES:

1. Operations Research and Scheduling research group; http://www.projectmanagement.ugent.be/.
2. Khamooshi, H., and Golafshani, H., EDM: Earned Duration Management, a new approach to schedule performance management and measurement. International Journal of Project Management, 32:1019–1041. 2014.
3. Lipke, W., "Schedule is Different". The Measurable News, pp. 10-15, March 2003.
4. Paige, Hilliard W.W., How PERT-cost helps the general manager. Harv. Bus. Rev . 41 (6), 87–95. 1963.
5. PMI, Practice Standard for Earned Value Management (2nd ed.). Newtown Square: Project Management Institute, Inc., 2011.
6. Fleming, Koppelman; If EVM is so good… why isn't it used on all projects? The Measurable News, pp. 1–5. 2004
7. Batselier, J., Vanhoucke, M., Construction and evaluation framework for a real-life project database. Int. J. Proj. Manag. 33, 697–710. 2005.
8. Batselier, J., and Vanhoucke, M. Evaluation of deterministic state-of-the-art forecasting approaches for project duration based on earned value management. International Journal of Project Management, 33:1588–1596. 2015.
9. Lipke, W. H... Earned schedule: an extension to earned value management for managing schedule performance, 2009.