ANALYSIS ON COST, SCHEDULE AND TRACKING OF RESIDENTIAL PROJECT BY EARN VALUE MANAGEMENT METHOD USING PRIMAVERA P6

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Abstract- Construction industry is the vital industry in the developing countries like India, as it contributes to the socio-economic development of country. Project cost and time is the critical factor in construction industry as its overrun /under run impact the total project duration and cost. So, main preference wants to give for cost & schedule. As a developing country so much competition is there in a market for a construction sector in order to sustain in the market we have to follow the promise was given to the client & customers of the completion of the project on the time and within the budget. We have to think and do our work in a more sustainable way. The EVM gives the details of project working from the planned data, actual cost incurred in project and worth of the work done as spent the money[EV]. Performance indices data is given in EVM by using that data we can ladder way to the project success. Software package primavera p6 is used in this analysis of cost schedule & tracking of a project. From this software package we will get know the performance of project better. Project management body of knowledge (PMBOK) is the body giving set of procedure and policies to maintain in the construction project to make it better manageable, good vision able and stipulated to the budgeted cost. As a construction industry is vulnerable to uncertainties we have to manage a project in good aspects.

Index Terms- Earn value management (EVM), Cost, Schedule, PMBOK, Primavera P6.

I.   INTRODUCTION

Construction industry is a vital commercial enterprise at national level and worldwide level. Construction industry has contributed 19% (2011-2012) to the national GDP in India. Numerous construction projects experience the ill effects of time and cost overrun because of a multiplicity of elements. Project cost and calendar are the administering element in project achievement. To expand profitability as far as human asset and materials can be done by using Project management.

Earn value management (EVM). is an project accomplishment approach that has. been suitable for utilization in project management. Baseline plan can be calculated using EVM to check the progress of the project. EVM operation helps in giving achievement standard to the assessment of evolution report of project and it likewise go about as a command gadget to deal with budget and time. It gives excelling fulfilment impression of a project and gives good outlook of the final finishing cost. Earn Value is a improvement up conventional procedure of cost bookkeeping. The system will give best analogy of estimated cost of work to actual cost. Earn value dissection award recent signs of venture conduct to feature requirement for possible remedial deal.

Generally the estimated cost is assessed by calculate dissimilarity betwixt actual cost & planned cost acquire in a project. The attention was on planned consumption and absolute cost. Earn Value uncovers favourable circumstances and it also examines actual proficient. EMV helps project manager to predict the risky areas, exact project cost and work on it. It resembles a caution for the managers to recognize and command issues by taking timely remedial process before they turn out impossible to conquer. Earn Value Evaluation Scheme is a set of instruction to provide acceptable achievement of project. It has been. seen that to take care of cost overwhelm, project organization undergoes cost lessening either by diminishing the project scope and quality or by giving extra. Likewise if there should arise an occurrence of time

overwhelm, they arrange unlimited of activities or quick tract programs. In this way with the utilization of earn value analysis framework, project goals are accomplished in suitable way.

1.1 OBJECTIVES OF STUDY

The vital objective of construction group is to terminate the project as determined on record furthermore, inside the estimated with appropriate use of the considerable number of assets like labour, money, materials and equipment, and furthermore to execute the project with quality. To accomplish the above, planning is fundamental.

- Planning is done to finish the project on time and financial profit.
- To study primavera p6 software and to use the same for the execution of the on-going project.
- An analysis on cost, schedule, monitor & tracking of a project by using primavera p6.
- Work progress will be estimated based on the baseline created.
- Proper input should be given to management to take a strict action against completion of work on time, data etc.

1.2 SCOPE OF THE STUDY

Earned Value Management (EVM) is a strategy that equitably impress physical achievement of work:

- The projects will always have fixed time, if the project is not completed on time which will increment the complete cost of project, to evade delay and to defeat delay without influencing cost and budget, can be utilized and project management can be done.
- EVM is used to predict the prospective of the project by doing the tracking of the project and cost analysis.
- EVM anticipate the project by statistical methods by using present and old progress of project.
- Stake holders will be benefited by using EVM method.
- At any stage of project we can get actual cost, remaining cost and EVM calculations.
- Cost overwhelming can be reduced by using proper planning and EVM together smartly.
- Outline of scope of study is to do perfect planning, scheduling and updating of various activities, which is done by using primavera p6 software. After scheduling and resource allocation a baseline is set and project is updated, if resources are over allocated it is levelled by levelling option, without affecting the total duration of project. Finally the tracking is done by actual start and actual finish.

II. LITERATURE REVIEW.

Kunal B. Badgujar, B.A.Konnur, Amarsinh B. Landage "A Review of EVM Analysis with Primavera" [1]. These authors form an outline of construction project management by using a project management software primavera p6. The main advantage of the primavera software is tracking of the project, analysis, auditing of a project can be done easily. The primavera management software package helps in making a customized report from the report wizard that extract a specific data from the data base, many projects with more number of planners can work together. This paper include the purpose of earned value management, input data needed, earned value forecasting parameter, advantages & limitations of EVM, application of EVM toward project because it gives an sign to managers to correct the project early to get the project to track. These authors finally concluded that the analytical procedure and proper schedule management with EVM will be beneficial.

Anuj dubey "Earn Value Analysis for a Construction Project" [2]. Anuj dubey has carried out a case study of bridge constructed on Pune Solapur highway at Saswad phata pune of costed INR25cr. He stated that the cost-over run and schedule over run are the prevalent in the most of the project; this problem can be reduced by using construction project management software like Microsoft project and primavera p6, in that the efficient use of earned value method. Finally author concluded three different durations is obtained with varying the cost. Hence a solution can be obtained in between these three values by experience of the project manager, There is a more cost when the project is full crash and the less cost when the project is smoothened. So, the project manager should have a sufficient experience to make optimal solution by using earn value analysis.

Harsha H.N, Devanand.R & Shaik mohammad masood, "An Analysis on Resource Planning, Cost Estimation and

Tracking of Project by Earned Value Management"[3]. These authors carried out their study on a Duplex apartment in Whitefield, Bangalore. It's a real time project; authors states that the estimation of cost and time for a project with the progress of the project can be reviewed through the baseline as set up earlier. For project planning, EVM calculation and analysis authors used primavera p6 software. Authors have done cost estimating and resource planning by considering parameters involved in EVM. After the planning and scheduling, they form a project cost base line by integrating project cost, time, scope, and technical operation. By comparison with the base line authors evaluate the project performance. Necessary action should take if a project takes a deviation from planned values. The project is traced by four type of tracking, Finally concluded that SPI,CPI is negative than the project is lagging behind prepared schedule and overwhelmed budgeted, if the SPI,CPI is equals to zero the project is on planned track.

III. EARN VALUE MANAGEMENT (EVM)

3.1 EARNED VALUE MANAGEMENT SYSTEM (EVMS) FRAMEWORK

The EVMS framework can be categorized into three stages

1**. Input** - what all are things essential to implement Earn Value.

2. **Earn Value Methods** –equations, measurements and execution estimations utilized.

3. **Output** – revealing necessities (structure, time-stages, subtle elements).

3.2 ABOUT 32 GUIDELINES OF EARNED VALUE MANAGEMENT

The ANSI-748 Standard of 32 Guidelines for EVMS is separated into five areas which are talked about beneath.

1. Project Organization

2. Project Planning, Project Scheduling and Project Budgeting

3. Accounting Deliberations

4. Project Reports Analysis & Management

5. Data Maintenance & Review

3.3 EARN VALUE ANALYSIS

Earn Value Analysis (EVA) is an approach to manage assess the measure of work genuinely performed on a project(i.e., to gage its empowering) and to figure an endeavors cost and date of wrapping up. The strategy depends on upon a key measure known as the earn value (by

and large called the "Budgeted cost of worked performed" or BCWP). This measure empowers one to process execution records for cost and timetable, which tell how well the project is getting along with respect to its extraordinary course of action. These records moreover engage one to figure how the project will do later on. Earned value truly utilizes three information esteems, which are dealt with every week, month, or whatever other period you wish to utilize.

3.3.1 Earned Value Key Parameter.

- **Planned Value (PV):-** This is the cost that we planned to spend on the various activities of the construction project.

This value gives a cost of how much we planned to spend as of this date

PV is the physical work booked or "what you plan to do"

The planned value can be computed by utilizing taking consecutive formula,

Planned value = % Planned work finished * BAC

Where,

BAC = Budgeted cost at completion.

- **Earned Value (EV):-** This is the cost that shows the worth of the work done as spent the money in the construction project.

It answers the question "what measure of work has truly been done?". EV is the estimation of the "value" of the work done to date or "what you physically refined".

Earned Value can be ascertained by utilizing taking consecutive formula,

Earned value = % finish effort * Budget at completion

- **Actual Cost (AC):-** This is the cost actually incurred in performing a various activities of the construction project. This cost is the total cost that coming from the different account section of the venture.

It answers the question "what sum have we really spent?". This is for the most part chosen from the associations bookkeeping framework.

Actual cost is the cost caused for executing deal with a project or "what you have spent".

The actual cost can be ascertained by utilizing taking consecutive formula,
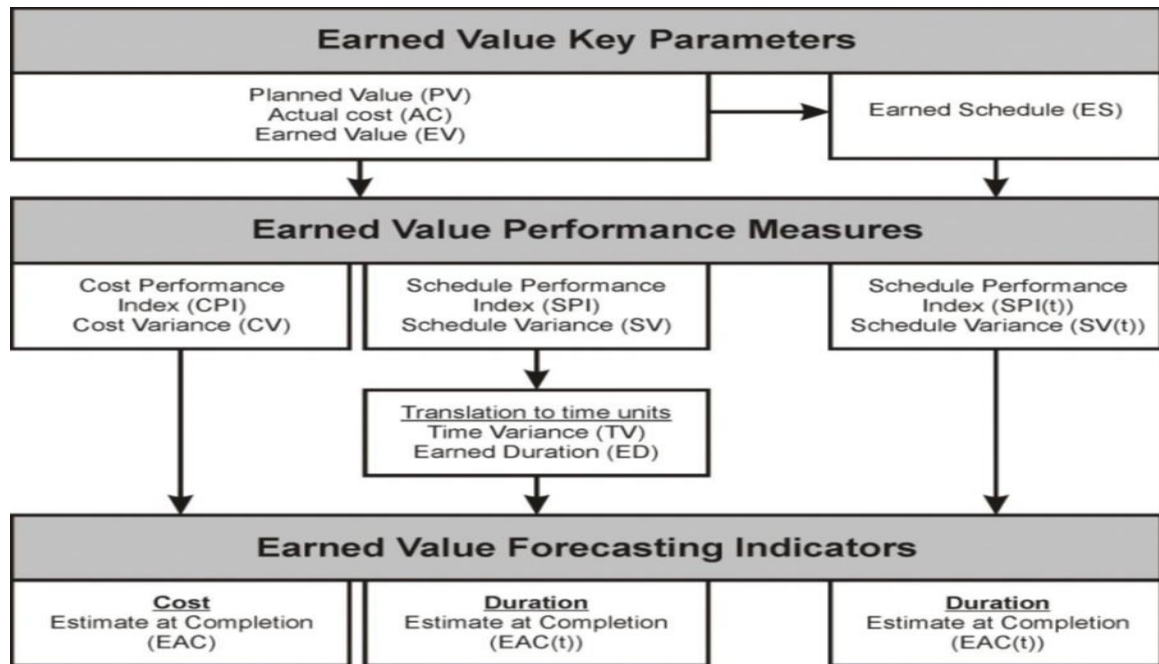
Actual cost = Hourly Rate * Total hour spent

Fig 3.1 Earned Value Elements

3.3.2 Earned value performance measures

Earned value execution estimations take a gander at the project cost and timetable execution by breaking down the cost and calendar fluctuation alongside cost and timetable productivity

- **Cost Variance (CV):-** This is the variance of cost from worth of the work done on project to actual cost accomplished in project. (or) The distinction between earn value and actual cost.

Scientifically it is spoken to by,

Cost variance = Earn Value – Actual Cost

If the cost variance is positive the project is underrun from planned value. And if the cost variance is negative project is overrun from planned value & troublesome condition.

- **Schedule Variance (SV):-** This the variance of cost from worth of the work done on project to planned value of the project. (or) The distinction between earn value and planned value.

Scientifically it is spoken to by,

Schedule variance = Earn Value – Plan Value.

If the schedule variance is positive the project is ahead of schedule and if the schedule variance is negative the project is running behind the schedule.

- **Cost Performance Index (CPI):-** This is the ratio of worth of work done to actual cost accomplished in doing a endeavor.

CPI is spoken to scientifically as,

Cost performance index = Earn Value / Actual Cost

If the CPI ratio is below one it shows the activities are consuming more cost to finish the work. If the CPI is above one the activities consuming less cost to finish the work as from plan.

- **Schedule Performance Index (SPI):-** This is the ratio of worth of the work done to planned value

SPI is spoken to numerically as,

Schedule performance index = Earn Value / Plan Value

If the SPI ratio is below one it shows the activities are consuming more time to finish the work. If the SPI is above one the activities consuming less time to finish the work as from plan.

3.3.3 Earned value forecasting indicator

- **Budget at Completion (BAC):-** This is the cost planned to finish the activities while planning.
- **Estimate at Completion (EAC):-** This is the cost estimated by individual to complete the project activities at the end of the project.
- **Estimate to completion (ETC):-** This is the estimation of amount of money u will spend on the project to complete

the remaining work except the actual cost spent.

- **Variance at Completion (VAC):-**
Forecast of final cost variance

Variances will be available later on = AC+(BAC-EV)/CPI

Variances are typical=AC+ (BAC-EV)

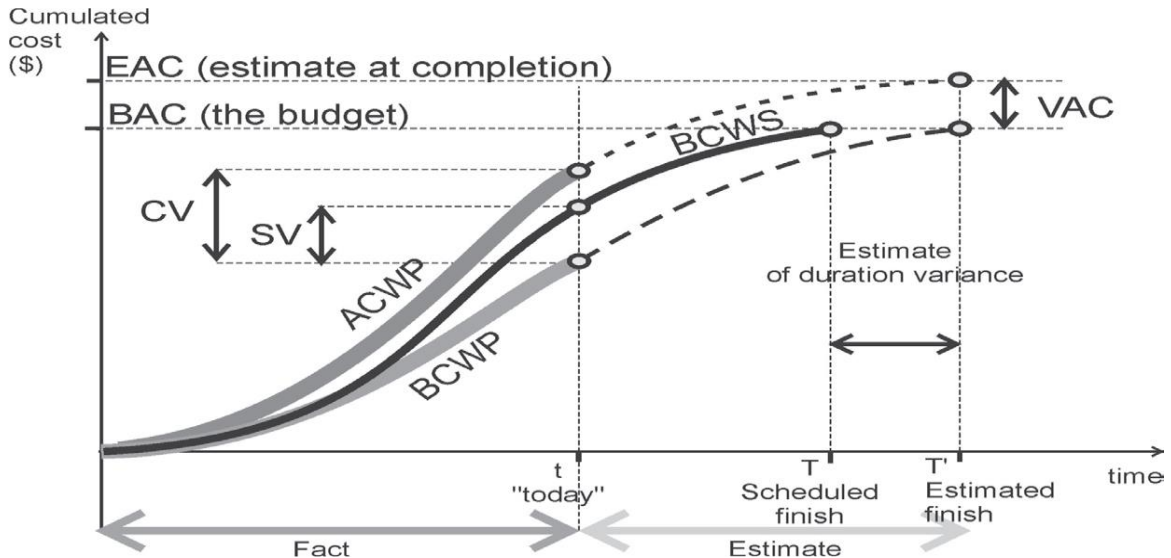Past evaluating suppositions are not substantial =AC+ETC (Estimate to complete)

Fig 3.2 Indicates The Ideal Graph Of EVM Elements.

IV. CONSTRUCTION SITE DETAILS

The vajram elina is located at Shree Vijayaraja Estate, Chokkanahalli Thanisandra Main Road, Yelahanka Hobli,Bengaluru. It is a G+10 apartment with 2 blocks named as A&B. it has a total of 87flats. The apartment is comprised of premium 2 & 3 BHK homes. The construction began in June 2015. The structural part is done in February 2017. It is to be available for possession by September 2017. This apartment is a client financed project. But, the various activities of the project are done by the following consultancies.

V. METHODOLOGY

The construction projects are tremendous & composite in nature and hence for improvement of endeavor, utilization of programming tool appeared. The project is planned and monitored utilizing Primavera P6 software. The work breakdown structure is prepared for the project and falling activities for WBS are recognized. The span of the activities are predicted on premise of ancient information, consultation with project chief, applying labor production formula and utilization of bureau of

Indian standards. The connections are analyzed and connected to the activities.

The accompanying strategy required in scheduling and monitoring projects.

1. Open Primavera & Create Project.
2. Define Work Breakdown Structure.
3. Creating Calendars for Activities & Resources.
4. Define The Activities Coming in Project.
5. Appointing Activity Durations.
6. Assigning Logic Links.
7. Performing Scheduling.
8. Allocating Resources/Budgeting For Activities.
9. Creating Baseline for the Project.
10. Updating schedule.
11. Tracking / Earned Value Analysis.
12. Publishing Reports for the Project.

5.1 OPEN PRIMAVERA & CREATE PROJECT.

Steps to create a new project in primavera are as shown below
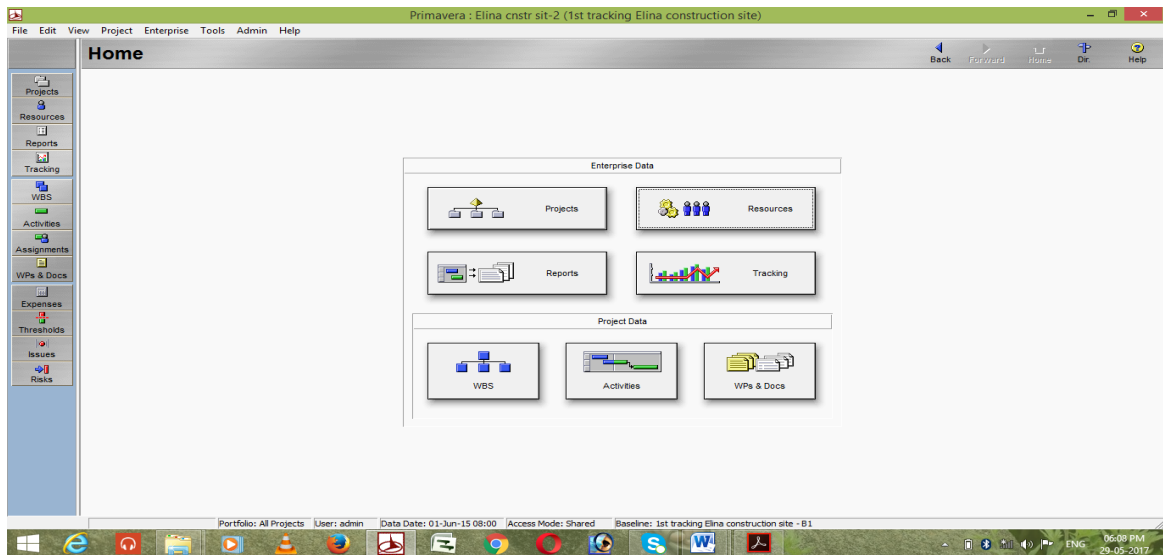
i. Login to primavera
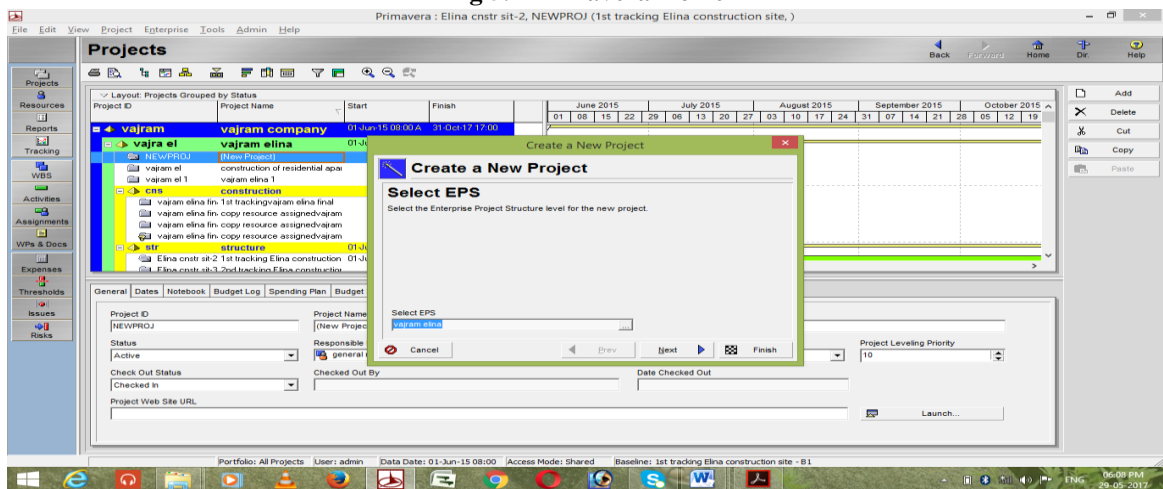ii. Click Add Button & Select EPS

Fig 5.1 Primavera Home

Fig 5.2 Selecting EPS

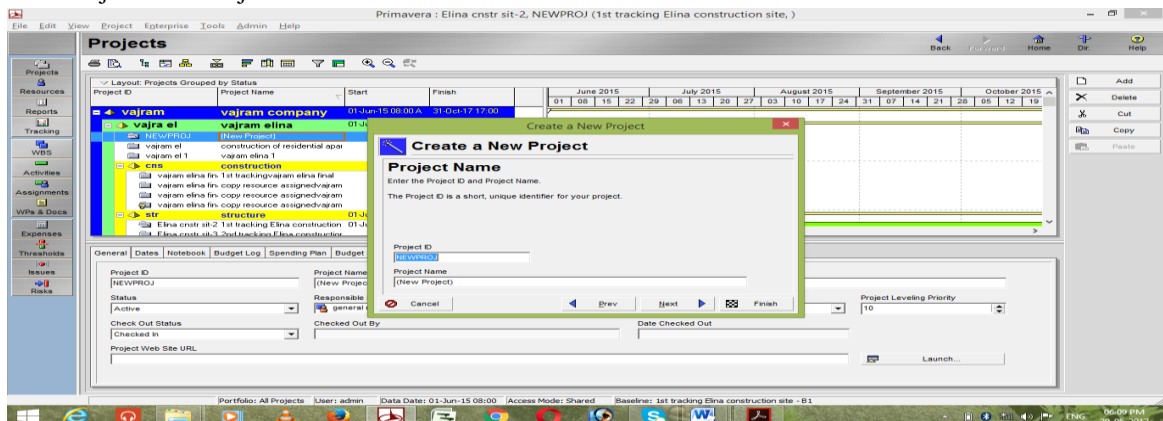iii.   Project Id & Project Name

Fig 5.3 Project Id & Project Name

iv.   Then select planned start and finish for the project and assign Responsible manager for project from the organizational breakdown structure of an enterprise.

v.   Afterwards assign rate type then run a project as an architect or non-architect.

Project creation will finished and appear a congratulations wizard

vi.   Open project
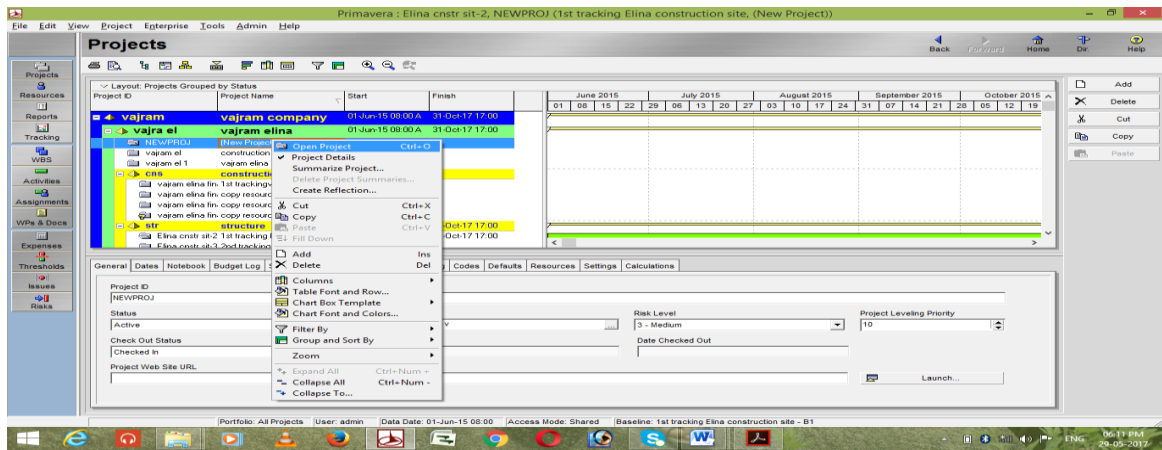
Fig 5.4 Select New Project and Open the Project

5.2 DEFINE WORK BREAKDOWN STRUCTURE (WBS)

Work Breakdown Structure is a gadget for describe the hierarchical breakdown of responsibilities and work in a project. To make better control over the break downed activities.
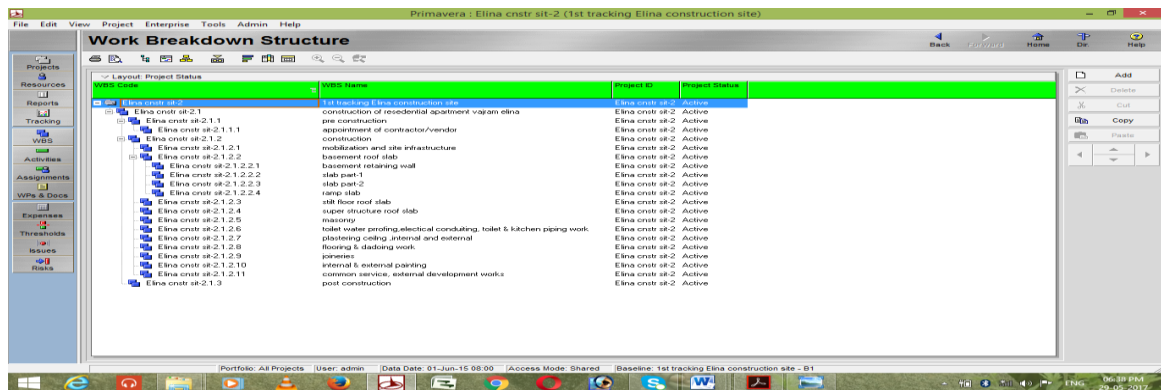
Fig 5.5 WBS of a project

5.3 CREATING CALENDAR FOR ACTIVITIES AND RESOURCES

The project calendar drafts the time layoff in which activities or resources can or cannot be scheduled.

For creating calendar go to enterprise in the tool bar and select calendar, there is a three type of calendar available in primavera that is global calendar, project calendar & resource calendar. For this project I selected global calendar.

Select calendar if we want to change the working day like introduce holiday, changing in working hours, then select modify option and modify the calendar working hours & days.
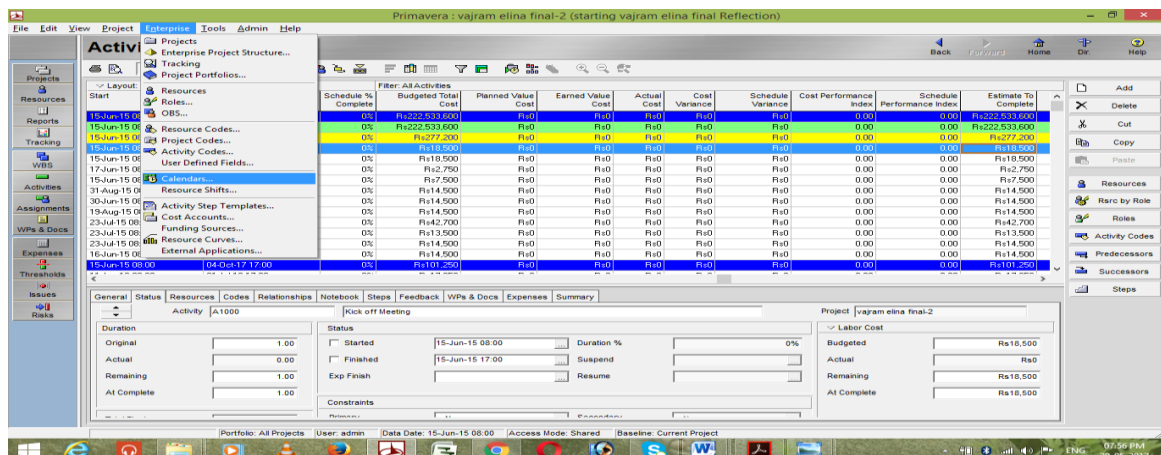

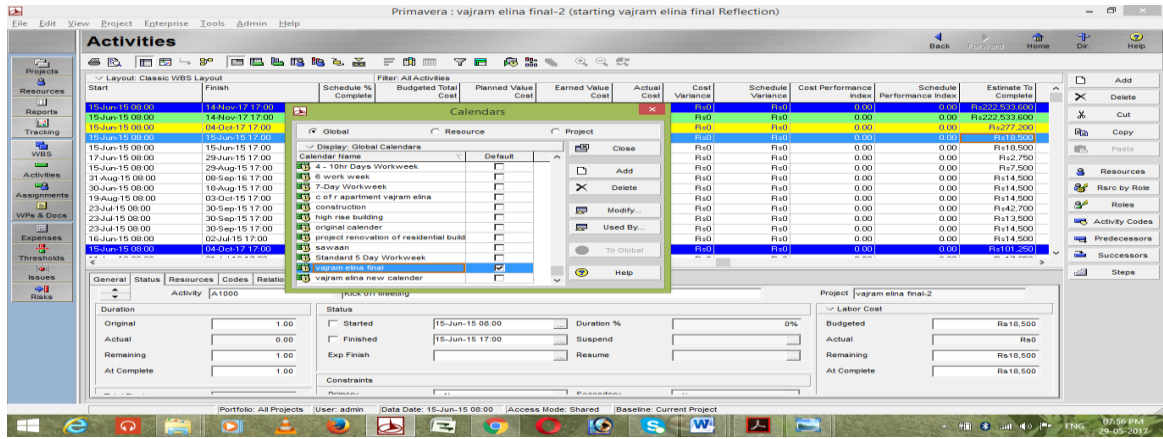**Fig 5.6 Selecting Calendar Option in Enterprise Tool**

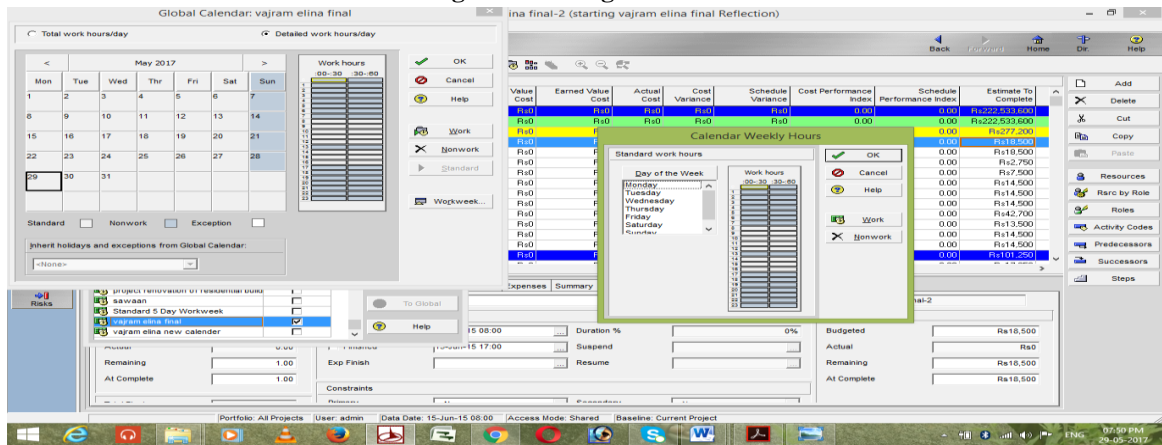**Fig 5.7 Selecting Calendar**

Fig 5.8 Changing Working Days and Working Week Option

5.4 DEFINE THE ACTIVITIES COMING IN PROJECT

The Activity is a particular effort essential for the achievement of a project.

To create an activities in project select activity option in directory button afterwards press add the activities in command bar button it will create with individual activity Id.
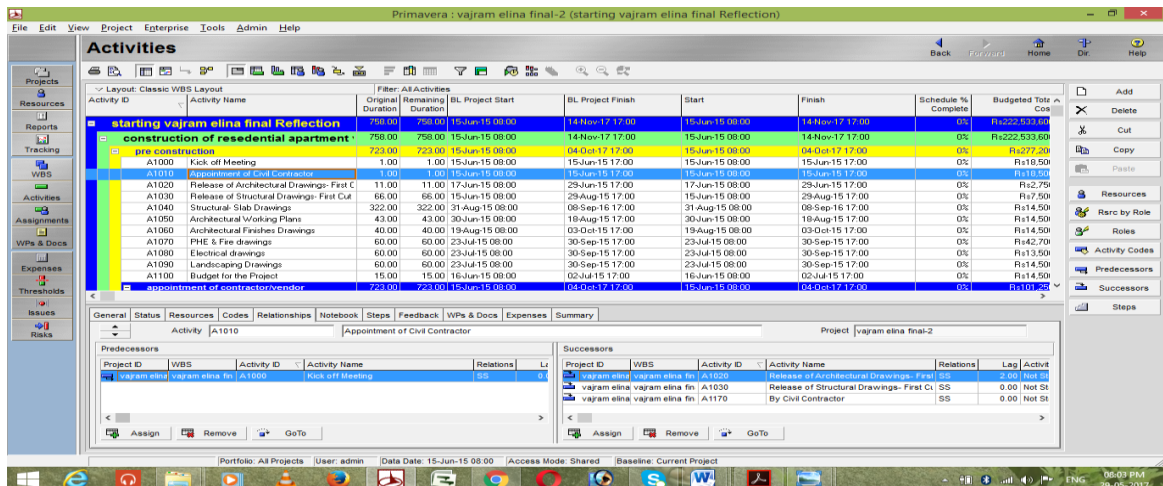

Fig 5.9 Activities List of a Project

5.5 APPOINTING ACTIVITY DURATIONS

Activity duration specifies the length of the time that it takes to complete an activity.

After creating activity in activity duration column enter the duration for each activity.

5.6 ASSIGNING LOGIC LINKS

Assign logical links is nothing but assigning interdependency of each activity.

Select an activity and in bottom layout select relationship button it will show predecessor, successor, lag and relation. If we want to assign the predecessor select, select button all activities are appear in a wizard in that assign a required activity.

Predecessor

The preceding activity for an a specific activity is called predecessor

Successor

The succeeding activity for an specific activity is called successor

There are four type of relationship are available they are as follows

Finish to Start (FS)

It is the default relationship followed in primavera; here the activity starts the completion of the previous activity.

Start to Start (SS)

It indicates that the current activity and its predecessor will start on the same date.

Finish to Finisha(FF)

Finishato finish indicates that the current activity and its predecessor will finish on the same date.

Start to Finish (SF)

SF indicates that the current activity finish date and the predecessor activities start date will be same.
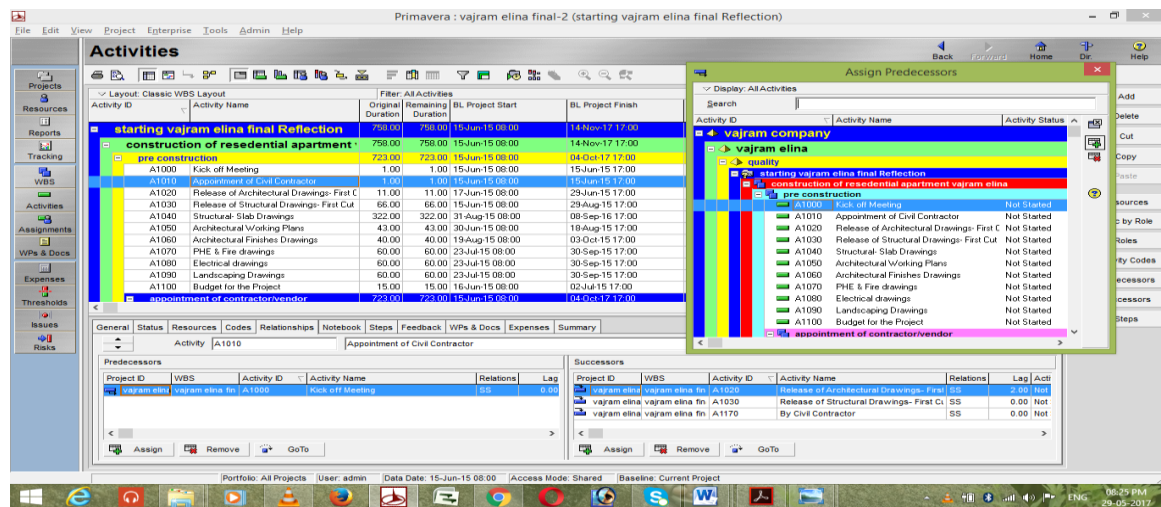

Fig 5.10 Activities and it Relationships

5.7 PERFORMING SCHEDULE

Schedule is the activity of choosing when extend exercises will occur depends upon on characterized terms and point of reference exercises.

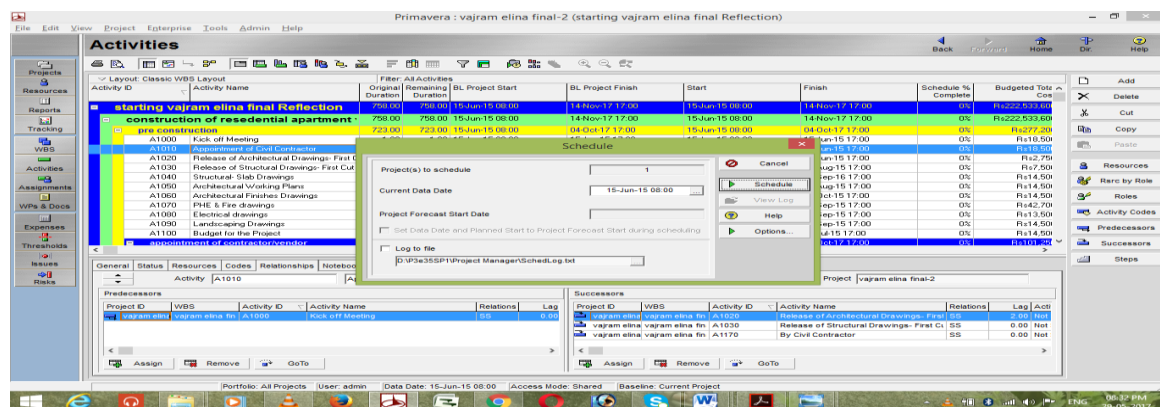Scheduling is done by pressing the F9 button.

Fig 5.11Scheduling of a Project

5.8 ALLOCATING RESOURCE/BUDGETING

A resource is all that is attached to an activity or essential to complete an activity. Resources are of three types they are labor, equipment & material.

To create resource, select resource option in directory layout button. Then we have to select type of resource labor, material and equipment in a resource wizard
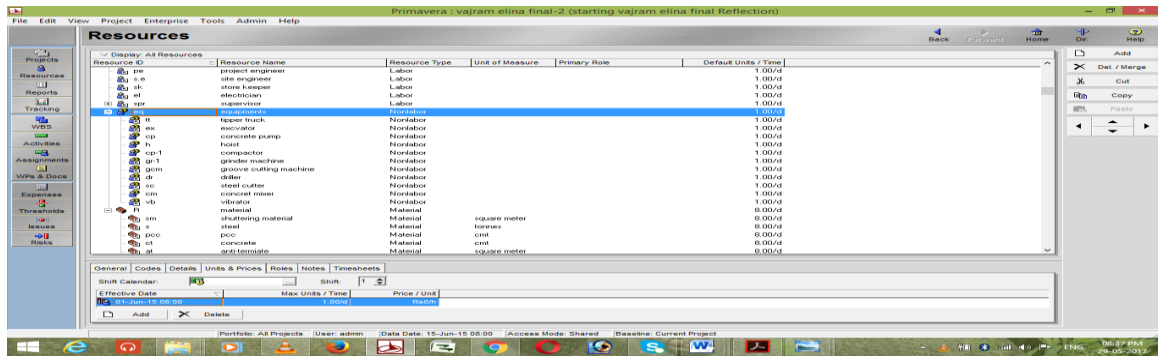
Fig 5.12 Resource Wizard

5.9 CREATING BASELINE

Baseline is a standard benchmark based on this the performance of a project is measured. To create a base line select project option in activity tool bar and then select maintain base line. After creating baseline assign baseline to the project.
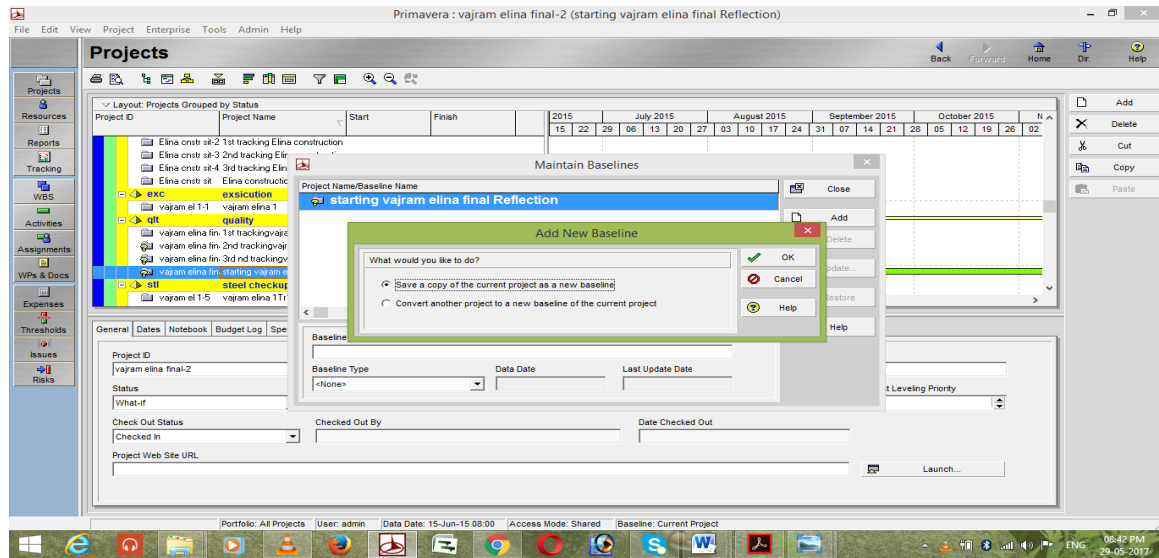

Fig 5.13 Creating A Baseline

5.10 UPDATING SCHEDULE

After assigning a base line again made a schedule to update the project baseline to project for analysis

5.11 TRACKING / EARN VALUE ANALYSIS

Earn Value Analysis (EVA) is a venture execution evaluation methodology that has been balanced for application in venture organization. Earned esteem investigation (EVA) is the way toward measuring execution of venture struggle with a pattern task. Earned esteem investigation (EVA) application helps in giving execution standard to the assessment of propel report of venture and it comparatively go about as a control gadget to oversee time and cost arrange. It gives better execution photograph of a wander and gives better point of view of the last fulfillment cost.

To perform earn value analysis goes to customize column option and introduce earned value elements for analysis of a project.

It will give the performance picture of a project by knowing that we can improve perceptive behaviour of a project in terms of cost and schedule. If needed remedial action should be taken
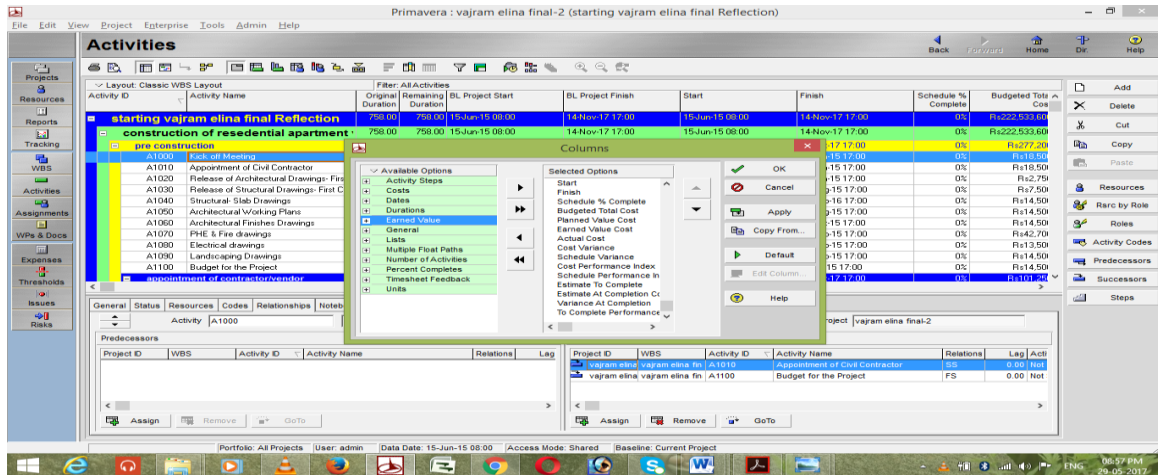
Fig 5.14 Earned Value Customizing Column

5.12 PUBLISHING REPORTS

The primavera project management software package helps in making a customized report from the report wizard that extract a specific data from the data base.

To create report in primavera select report option in directory button layout that opens the report wizard in that we can take a required report.
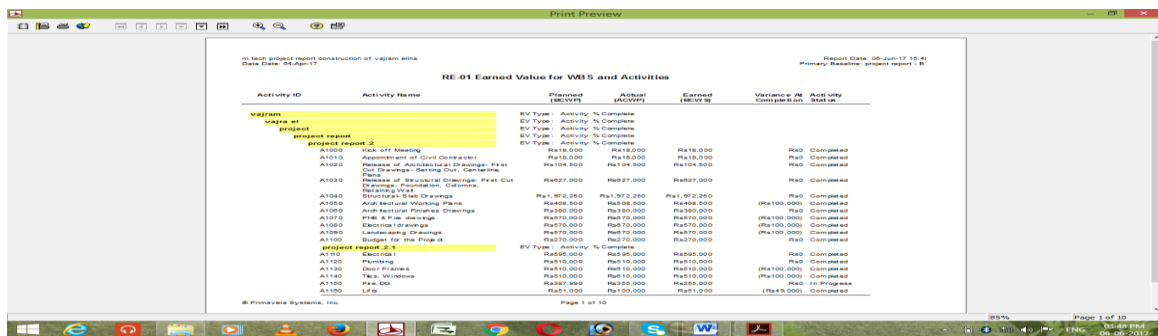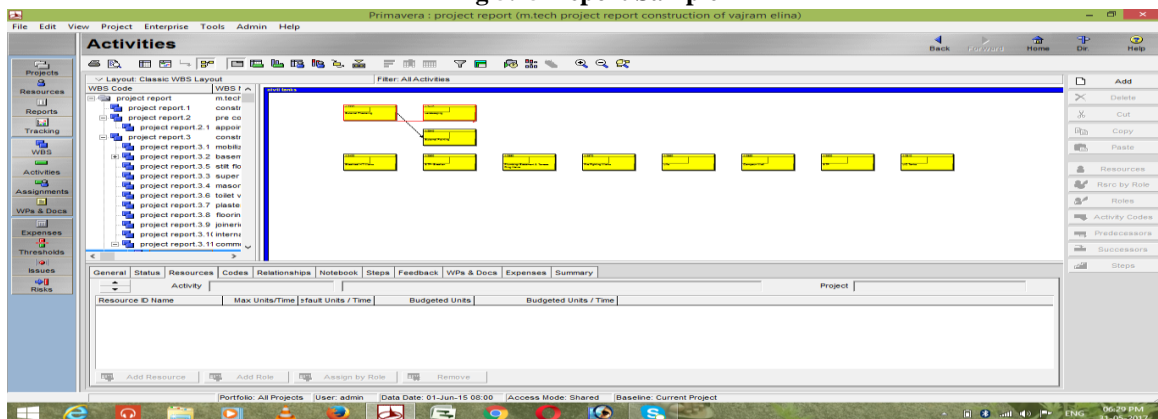

Fig 5.15 Report Sample

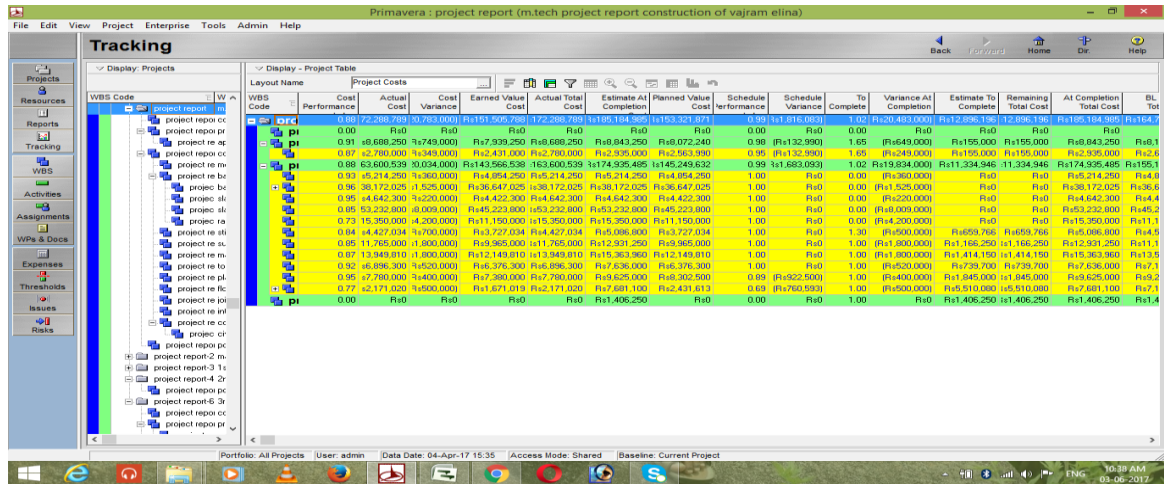**Fig 5.16 Activity Network Diagram**

Fig 5.17Tracking Values of an Activities

VI. FINDINGS AND OBSERVATIONS

The Vajram Elina construction project is a 716 days and 16,47,01,985 rupees budgeted project estimated to complete on September 2017. The project is tracked in 3 duration to know about the performance picture of project, the founded results are all listed in below tables.

Table 6.1- Primavera results after tracking

EVM Parameter	1st Tracking	2nd Tracking	3rd Tracking
Tracking Date	1-Jan-2016	1-Aug-2016	4-Apr-2017
Original Duration	716	716	716
Remaining Duration	532	349	138
Budgeted Total Cost	16,47,01,985	16,47,01,985	16,47,01,985
Planned Value	2,29,62,344	7,28,36,242	15,33,21,871
Earned Value	2,22,18,184	7,02,18,484	15,15,05,788
Actual Cost	2,37,86,283	7,61,57,143	17,22,88,789
Schedule Performance Index	0.97	0.97	0.98
Schedule Variance	-7,44,160	-26,17,758	-18,16,083
Cost Performance Index	0.93	0.92	0.88
Cost Variance	-15,68,099	-59,38.660	-2,07,83,000
Schedule % Complete	13.94%	44.2%	93.09%
Budget At Completion	16,47,01,985	16,48,01,985	16,47,01,985
Estimate At Completion	16,47,01,985	16,93,24,985	18,51,84,985

Variance At Completion	0	45,23,000	-2,04,83,000
Estimate To Completion	14,09,15,702	9,31,67,842	1,28,96,196
To Complete Performance Index	1.01	1.02	1.02

**Table 6.2- Cumulative Cost after Tracking from Primavera P6**

EVM Parameter	1st Tracking	2nd Tracking	3rd Tracking
Tracking Date	1-Jan-2016	1-Aug-2016	4-Apr-2017
Planned value cost	2,29,62,344	4,98,73,898	8,04,85,629
Cumulative Planned value cost	2,29,62,344	7,28,36,242	15,33,21,871
Earned value cost	2,22,18,184	4,80,00,300	8,12,87,304
Cumulative Earned value cost	2,22,18,184	7,02,18,484	15,15,05,788
Actual cost	2,37,86,283	5,23,70,860	9,61,31,646
Cumulative Actual cost	2,37,86,283	7,61,57,143	17,22,88,789

- **1st Tracking on Jan-1-2016**
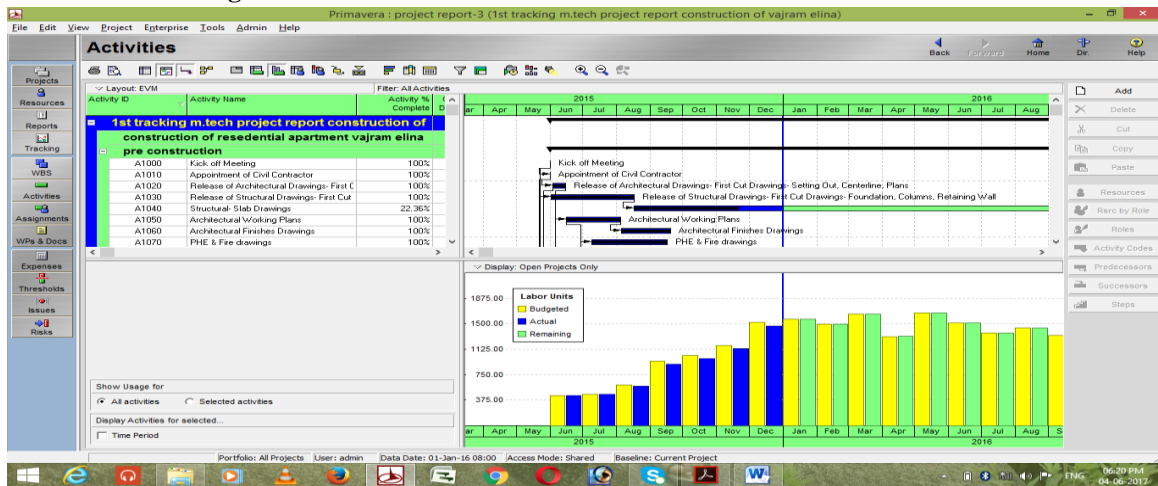
Fig 6.22 Activity usage profile of 1st tracking up to Jan-01-2016

- **2nd Tracking on Aug-1-2016**
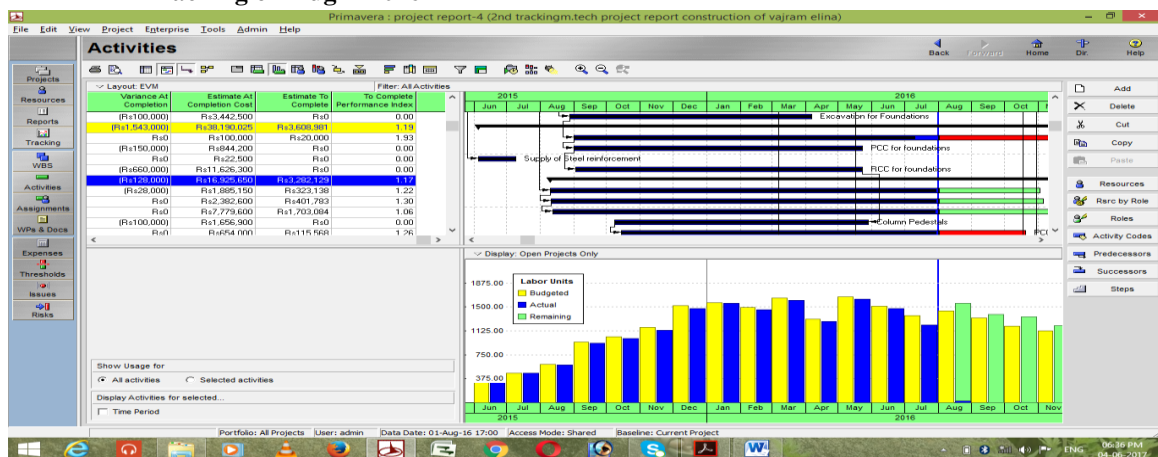
Fig 6.23 Activity usage profile of 2nd tracking up to Aug-01-2016
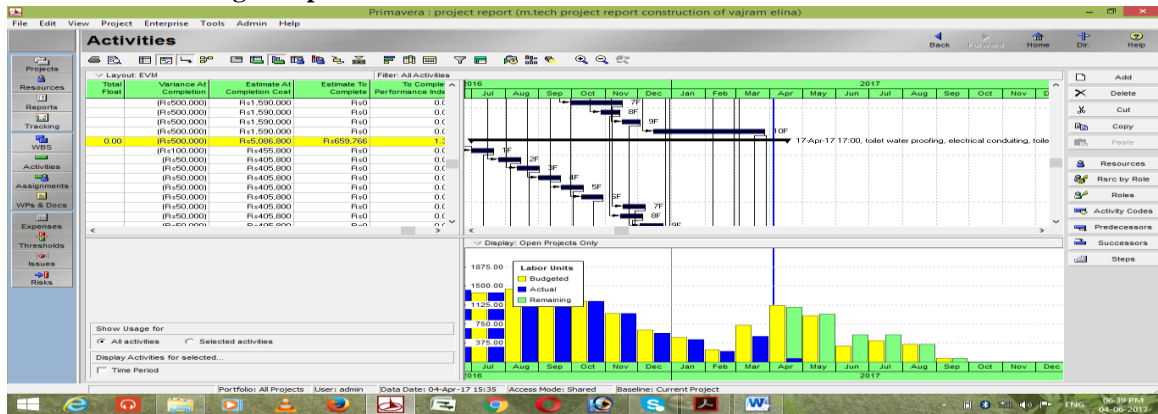
- **3rd Tracking on Apr-4-2017**

Fig 6.24 Activity usage profile of 3rd tracking up to Apr-04-2017

VII.   CONCLUSION

The Earn value management is a program evaluation approach which is evaluated and tracks a project in better manner. This project report indicates significance, execution and particular components of earned value management that advantages extend director &eventually brings about project achievement.

The project is tracked on 3 durations from 1-June-2015 to 1-Jan-2016, 1-Jan-2016 to 1-Aug-2016 and 1-Aug-2016 to 4-Apr-2017 in all that we obtained Plan Value (PV), Earn Value (EV) & Actual Cost (AC) from these 3 basic specification the Earned Value Performance measurement indices obtained. The Earned Value Performance index shows the performance of a project.

- As on third tracking 138days are remaining to complete the activities, the schedule performing 98% (SPI 0.98) as planned value under 1 show the project is under running from planned schedule value. And cost performing 88% (CPI 0.88) as budgeted cost, it shows the project cost is overrunning.
- Cost variance of project is -2,07,83,000 the negative sign shows the project cost is over run. If the cost variance is positive the project is underrun from planned value. And if the cost variance is negative project is overrun from planned value & troublesome condition.
- 93.09% of planned schedule is completed
- Cost requires to complete remaining activities is 1,28,96,196
- To complete project on scheduled time the project has to perform in 1.02% speed of planned value.

VIII.   SCOPE FOR FUTURE WORKS

The future research when all is said in done will incorporate most likely new measurements in the EVM analysis to consider Quality and technical performance for an effective project control and issues alike Risk Analysis. EVM analysis habit makes part of additional work where it is hard to mix of company's planning, scope, scheduling & budgeting. So, future research ought to be expected to diminish the additional work. And to eliminate the uncertainties as to carried through a various stages of project.

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