**Project Management**

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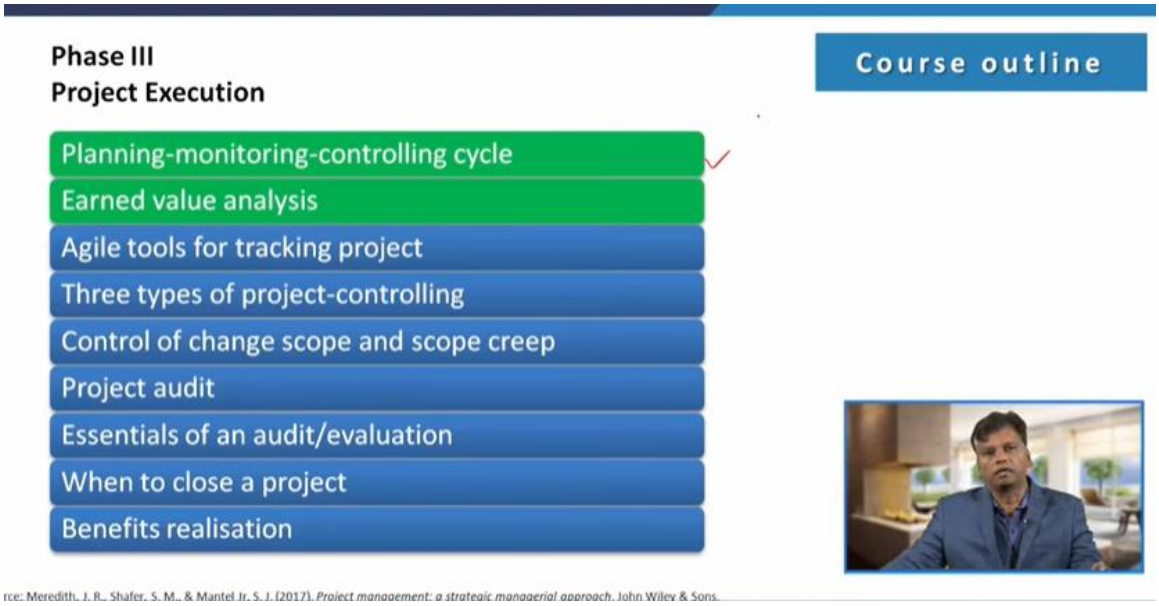
**Week: 6**

**Lecture 29- Earned value analysis**

Dear students, in this lecture I am going to discuss about earned value analysis. In the previous class I have discussed about planning, monitoring, controlling cycle. So, next topic is earned value analysis. So, the agenda for this lecture is I will explain what is earned value analysis, then I will explain various elements in the earned value chart and how to calculate various cost variances, schedule variances and so on. Next we will talk about estimating percent completion. When I am discussing this earned value chart, there I will discuss about various terminologies used and different variances.



## Agenda

- Earned value analysis
- Earned value chart and calculations
- Estimating 'Percent Completion'
- Earned Value chart
  - Terminologies used
  - Variance
  - Example
- Updating a Project's Earned Value

Then we will discuss about, take a sample problem, there I will explain how to construct or update the project's earned value analysis. First we will discuss about what is earned value analysis. So, far we have covered monitoring for parts of the project. Monitoring performance of the entire project is also critical, because performance is the reason for being of the project.

## Earned value analysis

- We have covered monitoring for parts of projects.
- Monitoring performance for the entire project is also crucial because performance is the "reason for being" of the project.
- Individual task performance must be monitored carefully because the timing and coordination between tasks are essential.

## Earned value analysis

- But overall project performance is the crux of the matter and must not be overlooked.
- One way of measuring overall performance is by using an aggregate performance measure called earned value (EV).

So, measuring the performance of the entire project is more important, inevitable. Individual task performance must be monitored carefully, because the timing and coordination between task are essential. Not only measuring the performance of overall project, also we should measure the performance of an individual task, but the overall project performance is the crux of matter and must not be overlooked. One way of measuring overall performance is by using an aggregate performance measure called earned value analysis. That topic only we are going to discuss in this lecture.

## Earned value chart and calculations

- A serious difficulty with comparing actual expenditures against budgeted or baseline expenditures for any given time period is that the comparison fails to take into account the amount of work accomplished relative to the cost incurred.

Next we will discuss about earned value chart and its calculation. A serious difficulty with comparing actual expenditure against budgeted expenditure or baseline expenditure for any given time period is that the comparison failed to take into account the amount of work completed relative to the cost incurred. So, what is happening? Many times we compare the expenditure, what is the planned expenditure and actual expenditure, but many times we fail to recognize, fail to measure the amount of work accomplished. So, in the earned value analysis, we will conclude, we will include this important element apart from budgeting requirement, amount of work actually accomplished for measuring the performance of your project. The earned value for work performed or value completed for those task in progress is found by multiplying the estimated percentage of physical completion of work for each task by the planned cost of those task.

## Earned value chart and calculations

- The earned value of work performed (value completed) for those tasks in progress is found by multiplying the estimated percentage of physical completion of work for each task by the planned cost for those tasks.
- Earned value = % of Physical completion of work x Planned cost
- The result is the amount that should have been spent on the task so far.
- This can then be compared with the actual amount spent.

## Earned value chart and calculations

- Making an overall estimate of the per cent completion of a project without careful study of each of its tasks and work units is not sensible—though some people make such estimates, even so.

So, if you want to write in the equation form, what is the earned value? When you multiply percentage of physical completion of the work, then multiply by planned cost. So, that will give you the earned value that also in the work done actually we are measuring terms of cost. So, the previous equation result is the amount that should have been spent on the task so far. This can then be compared with actual amount spent. Making an overall estimate of the percent completion of a project without careful study of each of its task and work units is not sensible, though some people make such estimate even so.

## Earned value chart and calculations

- Instead, it is apparent that at any date during the life of a project, the following general condition exists:
  - Some work units have been finished and are 100 per cent complete.
  - Some work units have not started yet and are 0% complete.
  - Other units have been started but are not yet finished, and we may estimate a per cent completion for this latter group.

So, what is important? The study of the or the completion of each task completed is also important, then only we can get an accurate estimate of the overall project completion. Indeed, it is apparent that any date during the life of your project, the following general condition exist. Sometime some work unit have been finished and are 100% complete, some work units have not started yet and are 0% complete, see either 0 or 100. Other units have been started, but are not yet finished and we may estimate a percent completion for this latter group also. So, here only the concept of percent completion comes, because it is easy to say whether the project is fully completed 100% or the project is not at all started, but there may be a task which has started but not yet finished.

## Estimating 'Percent Completion'

- As we said, estimating the "per cent completion" of each task (or work package) is nontrivial.
- If the task is to write a piece of software, per cent completion can be estimated as the number of lines of code written divided by the total number of lines to be written—given that the latter has been estimated.

There the concept of percent completion of the task comes. So, as we said, estimating the percent completion of each task or work package is not trivial. If the task is to write piece of software, percent completion can be estimated as the number of lines of code written divided by the total number of lines to be written, given that the letter has been estimated.

So, this is the way to complete the percent completion. So, how much we have done it, what is the total number of codes, but what if the task is to test the software.

## Estimating 'Percent Completion'

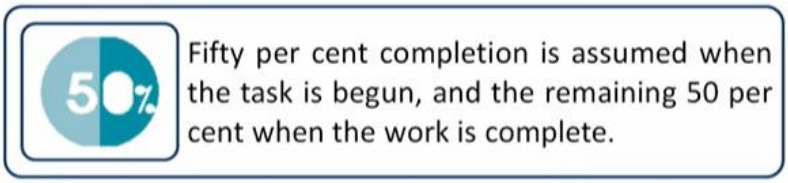
- But what if the task is to test the software?
- We have run a known number of tests, but how many remain to be run?

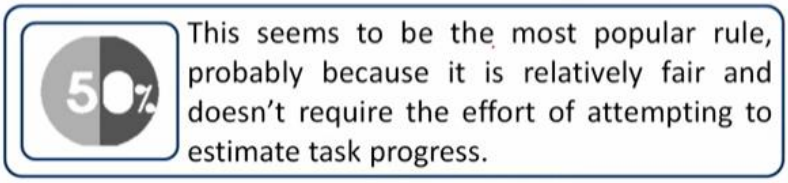
So, here we have run a known number of test, but how many remains to be run. So, known upon how many is remaining. So, that will give you the percent completion. So, estimating percent completion, there are different principles. So, there are different conventions used to aid in estimating percent completion.

## Estimating 'Percent Completion'

There are several conventions used to aid in estimating percent completion

### The 50–50 rule




The first rule custom is 50-50 rule. Here, the 50% completion is assumed when the task is begun and remaining 50% when the work is complete. So, that means 50% is completed, remaining 50% not yet completed. This seems to be most popular rule, probably, because it is relatively fair and does not require effort of attempting to estimate task progress. Since it gives credit for half of the task as soon as it has begun, it is excessively generous at the beginning of the task, then it does not give credit for other half until the task is finally complete.

## Estimating 'Percent Completion': The 50–50 rule

- Since it gives credit for half the task as soon as it has begun, it is excessively generous at the beginning of tasks.
- Then it doesn't give credit for the other half until the task is finally complete.
- It is excessively conservative toward the end of tasks, thereby tending to balance out on an overall basis.

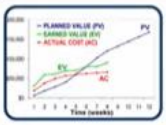
It is excessively conservative toward the end of task, thereby tending to balance on an overall basis. The next custom is 0-100% rule. This rule allows no credit for work until the task is complete. With this highly conservative rule, the project always seems to be running late until the very end of the project, when it appears it suddenly catch up. Consequently, the earned value line will always lag the planned value line of the graph.

## Estimating 'Percent Completion'

### The 0–100 percent rule

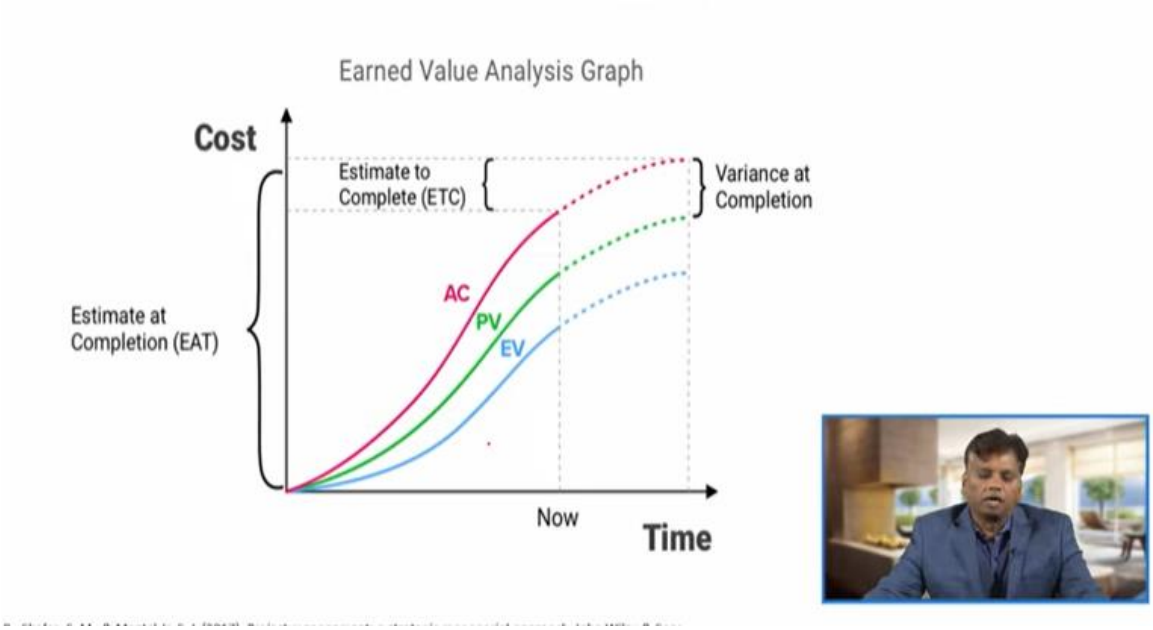

This rule allows no credit for work until the task is complete.

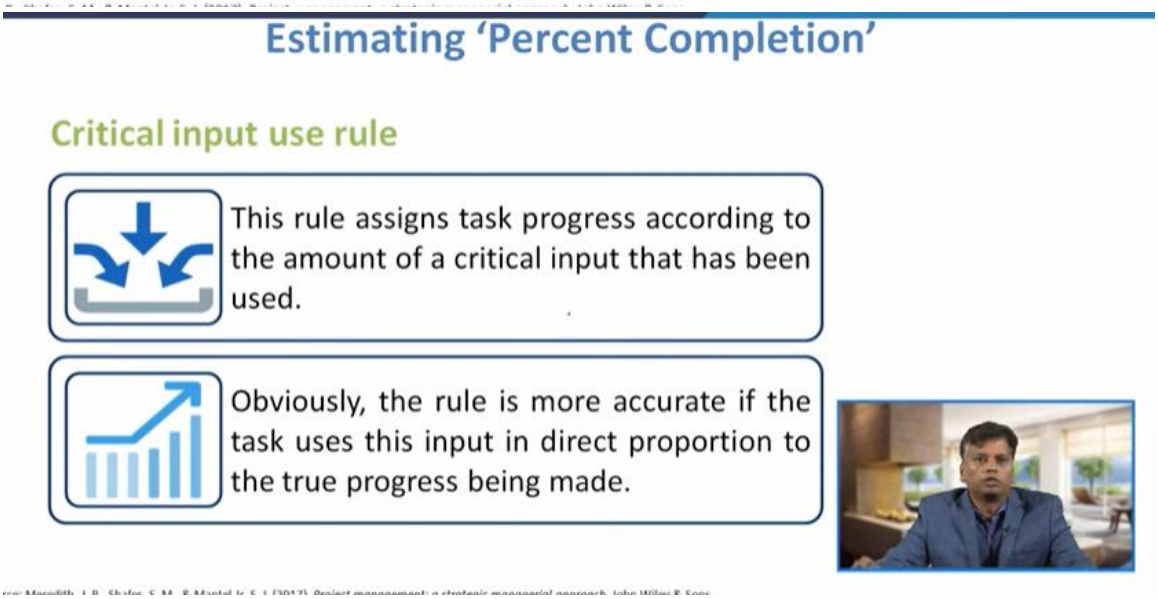
With this highly conservative rule, the project always seems to be running late, until the very end of the project when it appears to suddenly catch up.



Consequently, the earned value line will always lag the planned value (PV) line on the graph.

I will explain this concept earned value, planned value, but at present you take it that there will be that the earned value will always lag when you follow the 0-100% rule. I will explain the concept of earned value, planned value after some time. This is an example of earned value analysis graph. You see here there is an actual cost is there, there is a planned value is there, there is a earned value is there. So, when you follow 0-100% rule, so the earned value will always lag behind the planned value.




I will explain what this term in coming 2 minutes. The next one is critical input use rule. This rule assigns task progress according to the amount of critical input that has been used. Suppose if the critical input is amount is used more means the more quantum of work is completed. So, obviously the rule is more accurate if the task uses this input in direct proportion to the true progress being made.

## Estimating 'Percent Completion': Critical input use rule

- For example, when building a house, the task of building the foundation could be measured by the cubic yards (or meters) of concrete poured.
- The task of framing the house could relate to the amount of lumber used
- The roofing task could relate to the sheets of 4 × 8-foot plywood used

For example, when building a house, the task of building the foundation could be measured by the cubic yards of concrete pore. So, if there is a more concrete pore, then we can say the more work has been completed. Another example the task of framing the house could relate to the amount of lumber used. Another example the roofing task could relate to the sheet of 4 X 8 foot plywood used. So, based on the scarce material used, we can measure the progress of that work.

## Estimating 'Percent Completion'

### The Proportionality rule

This commonly used rule is also based on proportionalities but uses time (or cost) as the critical input.

It thus divides actual task time-to-date by the scheduled time for the task [or actual task cost-to-date by total budgeted task cost] to calculate percent complete.

urce: Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Sons.

The next convention is proportionality rule. This commonly used rule is also based on proportionalities, but uses a time as a critical input time or cost. This divides actual task time to date by the scheduled time for the task to calculate person complete. If desirable, this rule can be subdivided according to the sub activities within the task. For example, suppose that progress on your task depends on purchasing large expensive machine to do a long and difficult task.

## Estimating 'Percent Completion': The Proportionality rule

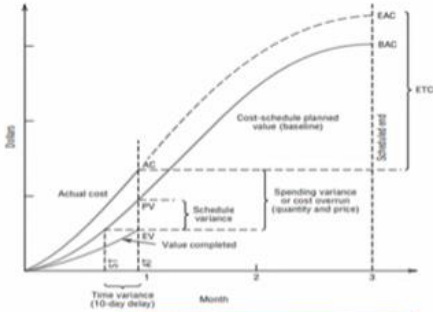
- If desirable, this rule can be subdivided according to the sub-activities within the task.
- For example, suppose that progress on a task depends on purchasing a large, expensive machine to do a long and difficult task.
- However, just having the machine does not contribute to substantial task progress.

ource: Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Sons.

However, just having machine does not contribute to substantial task progress. So, if there are two activities, the proportionality has to be done independently. Now, we will discuss about earned value chart. A graph illustrating the concept of earned value, such as that shown in the figure can be constructed using aforementioned rules that provides the basis for evaluating cost and scope to date. So, this is the things the figure which has given is the earned value chart.

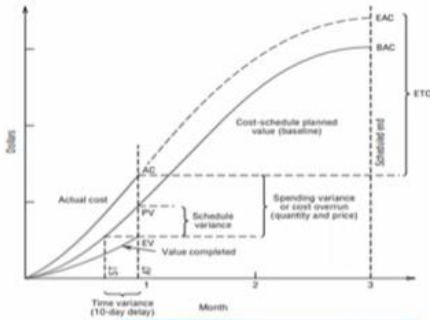
## Earned Value chart

- A graph illustrating the concept of earned value such as that shown in Figure can be constructed using the aforementioned rules and provides a basis for evaluating cost and scope to date.

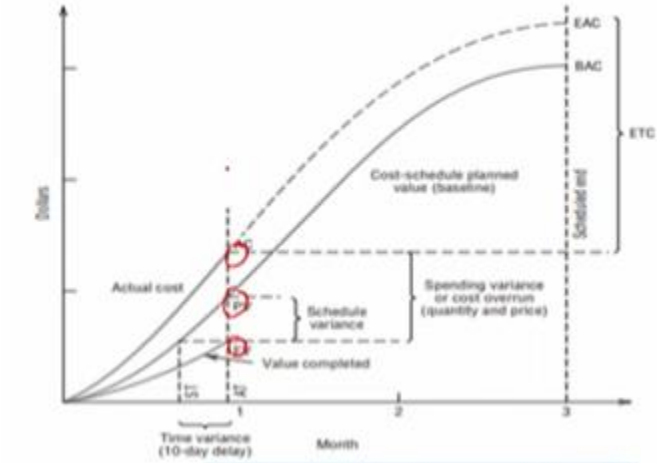



## Earned Value chart

- If the total value of the work accomplished is in balance with the planned (baseline) cost (i.e., minimal scheduling variance), as well as its actual cost (minimal cost variance), then top management has no need for a detailed analysis of individual tasks.

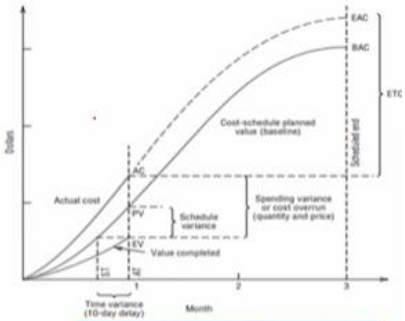



I will explain what are the element is there in this chart. If the total value of the work accomplished is in balance with the planned cost, as well as it is actual cost, then the top management has no need for detailed analysis of individual task. It implies, you see this represents the actual cost, this represents the planned value, this represents about the earned value. If all these points are merging, then there is no worry about for top management about measuring because the project is going as per the our plan. But I will explain what is this meaning of earned value.



## Terminologies used in Earned Value Chart

- **EV**
  - Earned value is a way to measure how much value or progress a project has achieved compared to the planned or budgeted amount.
- **PV**
  - Planned value in project management is the amount of work that was expected to be completed at a specific point in time, based on the project plan and schedule.

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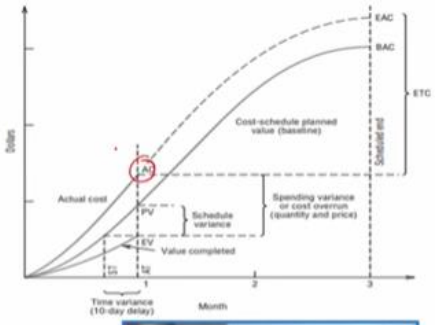
So, the concept of earned value combines cost reporting and aggregate scope reporting into the comprehensive chart. That is application of this chart. Now, we will discuss about various terminologies, which are used in this chart. The first one is earned value, EV that is about this chart. So, earned value is the way to measure how much value or progress a project has achieved compared to the planned or budgeted amount.

Now, we will talk about what is this PV, planned value. So, planned value in a project management is amount of work that was expected to be completed at a specific point in time based on the project plan and schedule. For example, you see the time variance on the 10th day, this much amount of work has to be completed that is the planned value. The next element in this chart is actual cost, this one AC actual cost. Actual cost in project management refers to the total amount of money spent or incurred on a project up to the specific point in time.

## Terminologies used in Earned Value Chart

- **AC**
  - Actual cost in project management refers to the total amount of money spent or incurred on a project up to a specific point in time.
  - It represents the real expenses associated with the project's activities and tasks.




So, within the 10th day, this much cost was incurred. So, this much amount of work is planned. Next, we will talk about estimate at completion, this one, this one. So, estimated completion is a projection of the total cost of the project based on the actual performance to date. So, what says that, so for the 10th day, the actual cost is this much.

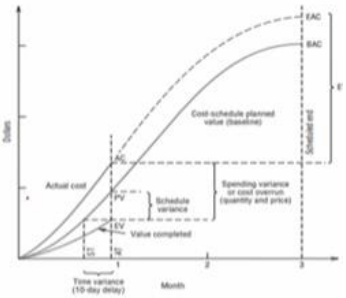
## Terminologies used in Earned Value Chart

- **EAC**
  - Estimate at Completion (EAC) is a projection of the total cost of the project based on the actual performance to date.

$$EAC = AC + (BAC - EV)$$

where,

- EAC is the Estimate at Completion
- AC is the Actual Cost
- BAC is the Budget at Completion
- EV is the Earned Value

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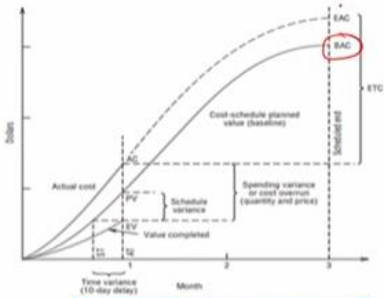
When you complete the project, so what will be the actual cost that is called estimate at completion. So, we are projecting for example, 10th day actual cost incurred is this much. So, at the time of completing this project, what will be the actual cost. So, estimated completion is calculated actual cost plus BAC, BAC is budget at completion. So, this one, this will be the budget at completion that means when you complete the project, what will be the planned budget.

So, actual cost plus budget at completion minus earned value, this earned value, what is the actual work done. So, that is the estimation at completion. The next term is budgeted completion, here this curve. So, budgeted completion refers to the total budgeted cost for

the entire project.

## Terminologies used in Earned Value Chart

- **BAC**
  - Budget at Completion (BAC) refers to the total budgeted cost for the entire project.
- **ETC**
  - ETC stands for "Estimate to Complete."
  - ETC represents the estimated cost required to complete the remaining work in a project.
  - It is a projection based on the project's current performance and expenses.

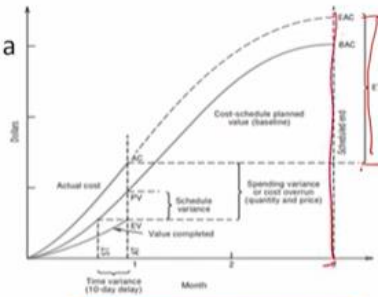



The next term is ETC, this ETC. So, ETC stands for estimate to complete. So, estimate to complete represents estimated cost required to complete the remaining work in the project. It is a projection based on the project's current performance and expenses, you see that. So, currently you are here this much cost. So, at the time of completion, how much cost is going to be incurred.

## Terminologies used in Earned Value Chart

- **ETC**
  - There are different ways to calculate ETC, but a common formula is:

    **ETC=EAC−AC**
  - ETC is the Estimate to Complete
  - EAC is the Estimate at Completion
  - AC is the Actual Cost
  - In simpler terms, ETC provides an estimate of how much more money will be needed to finish the remaining project work, given the project's current performance and expenditures.



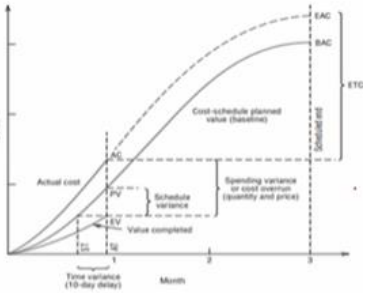

So, that is called estimate to complete, estimate to complete. So, this one, so this is nothing but estimate at completion, this one minus this one, actual cost. So, we will get estimate to complete. In simple terms, ETC provides an estimate of how much more money will be needed to finish the remaining project work given the project's current performance and expenditure that is your ETC that is estimate to complete. The next terminology is called schedule variance.

## Terminologies used in Earned Value Chart

- **SV (Schedule Variance)**
  - Schedule Variance is a measure that indicates whether a project is ahead of or behind schedule at a specific point in time.
  - The formula for Schedule Variance (SV) is:

**SV=EV−PV**

  - SV is the Schedule Variance
  - EV is the Earned Value
  - PV is the Planned Value



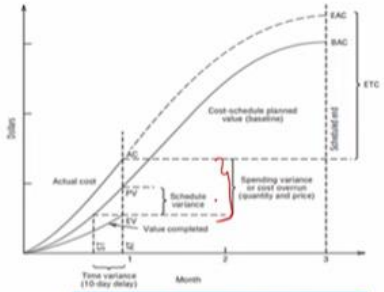

Schedule variance is a measure that indicates whether your project is ahead or behind the schedule at a specific point in time. So, scheduled variance is, you see this is our earned value, this is our planned value. So, when you subtract here earned value minus planned value, so that means we are lagging. So, what will happen, schedule variance will be negative. So, here SV is the scheduled variance, EV is the earned value, I already told you how to get the earned value, the PV is the planned value that will be given to you.

## Terminologies used in Earned Value Chart

- **CV (Cost Variance)**
  - Cost Variance is a measure that indicates whether a project is under or over budget at a specific point in time.
  - The formula for Cost Variance (CV) is:

**CV=EV−AC**

  - CV is the Cost Variance
  - EV is the Earned Value
  - AC is the Actual Cost



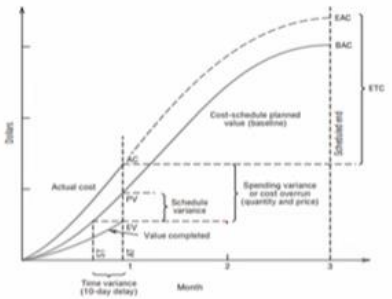

The next terminology is the cost variance CV, you can see this, this one. So, cost variance is the measure that indicates whether your project is under or over budget at a specific point in time. So, the formula for cost variance is earned value minus actual cost. Here also it will be negative because the actual work done is less, but the cost is more. When you do AV minus AC, you will get a negative.

As per this graph, we are not doing as per the cost that has to be incurred. And what is

the implication of this cost variance, schedule variance and time variance. So, cost variance as I told you this is earned value minus AC. So, here cost over run is negative. Suppose if you are getting cost variance is negative that mean you have exceeded the cost to complete the task.

## Earned Value chart - Variance

- Cost variance (CV) = **EV – AC**
  - Cost overrun is negative
- Schedule variance (SV) = **EV – PV**
  - SV, behind is negative
- Time variance (TV) = **ST – AT**
  - TV, delay is negative




Now, scheduled variance, we know that it is EV minus earned value minus planned value. So, SV is negative, it is behind the schedule. So, schedule variance is negative means it is behind. So, time variance, so time variance is you see this is scheduled time, this is actual time. So, what is happening here, scheduled time is less, actual time is more.

## Earned Value chart-Variance

- Typically, variances are defined in such a way that they will be negative when the project is behind schedule and/or over cost.
- As we have noted, however, this practice is not universal either in the literature or in practice.

So, if the time variance is negative that means there is a delay in the project because ST minus AT will be the negative. Typically variances are defined in such a way that they will be negative when the project is behind the schedule or over the cost. That is why we start with always EV minus PV for scheduled variance. For cost variance, we are writing EV minus AC. As we have noted, however, this practice is not universal either in the literature and practice, but in this class we are going to follow this way.

## Earned Value chart -Variance

The variances are also often formulated as ratios rather than differences

- CV becomes the cost performance index (CPI) = **EV/AC**
- SV becomes the schedule performance index (SPI) = **EV/PV**
- Time variance becomes the time performance index (TPI) = **ST/AT**
- Where values less than 1.0 are **"bad."**

The variances are also often formulated as ratios rather than difference. So, cost variance become the cost performance index CPI. So, instead of subtracting EV minus AC, we are going to divide by AC that will become cost performance index. Schedule variance become your earned value minus planned value that will become scheduled performance index.

## Earned Value chart -Variance

- Use of ratios is particularly helpful when an organization wishes to compare the performance of several projects (or PMs), or the same project over different time periods.
- As we just noted, however, the accuracy and usefulness of all these performance measures depend on the degree in which estimates of percent completion reflect reality

So, the time variance become time performance index. So, scheduled time upon actual time. So, instead of subtracting, we are dividing by that. So, wherever this ratio is less than 1 that is not desirable. Use of ratios is particularly helpful when an organization wishes to compare the performance of several projects or the project managers or the same project over different time period because it is in terms of percentage it is easy to compare. As we just noted, however, the accuracy and usefulness of all these performance measures depends on the degree in which estimates of percent completion reflect reality.

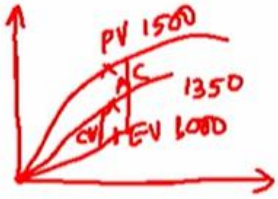
So, we talked about different customs for measuring percent completion. So, how accurate that percent completion based on that only your cost variance, scheduled variance or other indicators will be so accurate. Now, we will take an example for doing this earned value analysis. Assume that operations on your work package were expected to cost $1500.

## Earned Value chart -Example

- Assume that operations on a work package were expected to cost $1,500 (PV) to complete the package.
- They were initially scheduled to have been finished today.
- At this point, however, we have expended $1,350 (AC) and estimate that we have completed two-thirds of the work (Percent completion).
- What are the cost and schedule variances?

## Earned Value chart -Example

$$\begin{aligned}
\text{cost variance} &= EV - AC \\
&= \$1{,}500(2/3) - 1{,}350 \\
&= -\$350 \\
\text{schedule variance} &= EV - PV \\
&= \$1{,}500(2/3) - 1{,}500 \\
&= -\$500 \\
CPI &= EV/AC \\
&= \$(1{,}500(2/3)/1{,}350 \\
&= 0.74 \\
SPI &= EV/PV \\
&= \$(1{,}500(2/3)/1{,}500 \\
&= .67
\end{aligned}$$




So, the planned value is $1500 to complete the package. There were, they were initially scheduled to have been finished today, but at this point, however, we have expended $1350 that is the actual cost and estimate that we have completed two third of the work. So, the percent completion is two third of the work. So, what are the cost and scheduled variance? So, first what we do, first we will find out the cost variance. So, the cost variance is earned value minus actual cost. So, in our problem, you see that the earned value is at the bottom, the middle is the actual cost, the top one is planned value, because the planned value is 1500.

So, the actual cost is 1350. But when you find the earned value, what will happen it will be 1000 because two third of 1500 will be 1000 minus 1350, it will be minus 350. So, the cost variance is negative, that means we are spending more money than scheduled variance. So, scheduled variance is EV minus PV, EV is 1500 multiplied by two third, you will get 1000 minus 1500. Again, it is minus $500 that is scheduled variance. So, cost performance index, EV upon AC, EV we know 1500 multiplied by two third upon actual cost is 1350, we are getting 0.74 and scheduled performance index. So, EV upon PV, we are getting 0.67, two ratios are less than one, it is not desirable. In other words, we are spending at a higher level than our budget plan indicates. And we are not as far long as we should be, because we are lagging. We can also use scheduled performance index to calculate the time variance, if you realize that scheduled time should conceptually be in proportion of EV upon PV.

## Earned Value chart -Example

- In other words, we are spending at a higher level than our budget plan indicates, and we are not as far along as we should be.
- We can also use SPI to calculate the time variance TV if we realize that the scheduled time, ST, should conceptually be in proportion to (EV/PV):

AT x SPI

**ST = (AT)(EV/PV)**

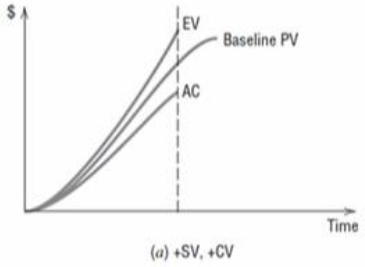
- Since TV = ST – AT, then

**TV = (AT)((EV/PV) – 1) = (AT)(SPI – 1)**

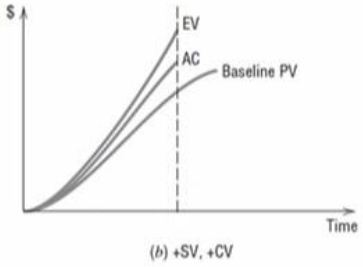
(This can be derived through simple trigonometry)

So, what is the scheduled time? So, scheduled time we can write, so actual time multiplied by scheduled performance index. So, instead of this, we know time variance is equal to ST minus AT. So, instead of my scheduled time, you can substitute this. So, we will get AT EV upon PV minus 1, this is a whole bracket here, whole bracket. So, when you simplify that, so this will be AT, then scheduled performance index minus 1.

## Six possible arrangements of AC, EV, and baseline PV resulting in four combinations of positive and negative schedule variance (SV) and cost Variance (CV)



(a) +SV, +CV

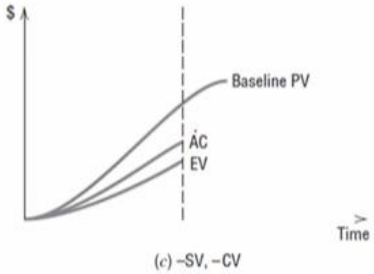


(b) +SV, +CV

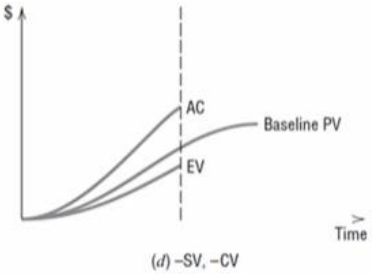
Now, there are different possibilities, this arrangement of your actual cost, earned value and baseline planned value and resulting in four combination of positive and negative scheduled variance and cost variance. The first situation, so the actual cost is less, earned value is more. See, we can find out scheduled variance. Scheduled variance is EV minus PV, it will be positive because EV is above top.

So, cost variance is EV minus actual cost. So, both are positive. The second situation, actual cost is more than the baseline planned value, but the EV also more. So, in this situation also, suppose if we are finding scheduled variance, so EV minus PV will be positive, then cost variance EV minus AC also will be positive. This is the two possibilities. Other two possibilities, you see the baseline is here, actual cost is more, but the EV is less. So, here scheduled variance will be EV minus PV, it will be negative, cost variance will be EV minus actual cost, here also it will be negative.

## Six possible arrangements of AC, EV, and baseline PV resulting in four combinations of positive and negative schedule variance (SV) and cost Variance (CV)

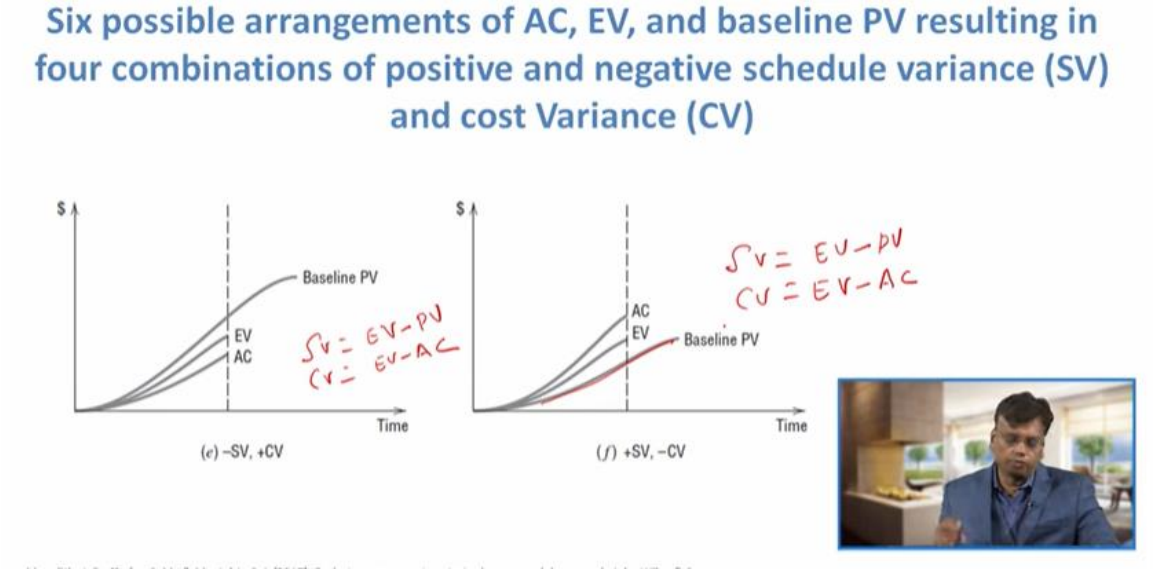


(c) –SV, –CV



(d) –SV, –CV

The next situation, this is what I have shown previously. Here the scheduled variance, scheduled variance, so EV minus PV, obviously it will be negative, then cost variance EV minus AC, this also will be negative. This is the one situation. Other situation, see the baseline PV is there, EV is more, AC is less. So, what is the SV scheduled variance? We know EV minus PV, so that will be negative, EV is below the PV, but what is the cost variance? EV minus AC, so this will be positive. The other situation that baseline is at the bottom, EV just above that, but AC is on the top of that.




So, here SV scheduled variance is EV minus PV, this will be positive, then cost variance is EV minus AC, so this will be negative. So, there are 6 possibilities where we can get different combination of scheduled variance and cost variance. Now, from there what we have continued in that example, we can find out the cost schedule index. What is that cost schedule index? When you multiply cost performance index and schedule performance index, we know the formula EV by AC upon EV by PV.

## Cost–Schedule Index

$$
\begin{aligned}
CSI &= (CPI)(SPI) \\
&= (EV/AC)(EV/PV) \\
&= EV^2/(AC)(PV) \\
&= \$(1{,}500(2/3))^2/(1{,}350)(1{,}500) \\
&= \$1{,}000{,}000/2{,}025{,}000 \\
&= 0.49
\end{aligned}
$$

CSI < 1 is indicative of a problem

When you simplify that, you will get EV square upon AC and PV. $EV^2$ we know how to find out, 1500, then percent complete (2 / 3) whole square upon actual cost is 1350, plant value is 1500, so we are getting 0.49. So, cost schedule index, if it is less than 1 indication of the problem. From there, we can find out estimated cost to complete, ETC. So, we know we have studied estimated cost to complete is baseline cost that is 1500 minus EV, earned value 1000 upon CPI, cost performance index.

## Estimated Cost to Complete (ETC)

$$\begin{aligned} ETC &= (BAC - EV)/CPI \\ &= \$(1{,}500 - 1{,}000)/0.74 \\ &= \$676 \end{aligned}$$

## Estimated Actual Cost to Complete (EAC)

$$\begin{aligned} EAC &= ETC + AC \\ &= \$676 + 1{,}350 \\ &= \$2{,}026 \end{aligned}$$

rather than the original estimate of $1,500

So, we are getting ETC, this is additional cost which is required to complete the whole project. So, from there estimated actual cost to complete we can find out. So, already we got ETC, we know what is actual cost, so this will be the total budget required to complete the task. Initially, we plant it is only 1500 dollar, but because of this delay, so the instead of 1500, now the cost will be 2026.

## Updating a Project's Earned Value

- We use a simple example to illustrate the process of determining the baseline budget and interim EV and actual costs for a project.
- Table presents the basic project information and updated information as of day 7 in the project.

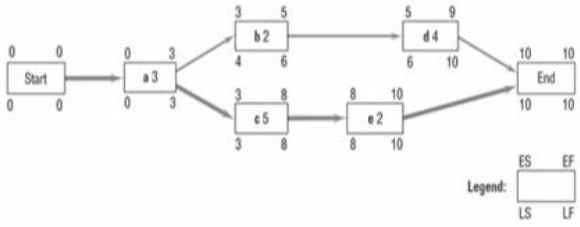
Earned Value Example (today is day 7)

| Activity | Predecessors | Days Duration | Budget, $ | Actual Cost, $ |
|---|---|---|---|---|
| a | — | 3 | 600 | 680 |
| b | a | 2 | 300 | 270 |
| c | a | 5 | 800 | |
| d | b | 4 | 400 | |
| e | c | 2 | 400 | |

Now, I have taken another example to construct the earned value chart. So, now we are, what we are going to do, we are going to update your projects earned value, I have taken one sample problem, from there I will explain. So, we use a simple example to illustrate the process of determining the baseline budget and interim earned value and actual cost for your project. So, the table on the right hand side presents the basic project information and updated information as of day 7 in the project. So, there are activity A, B, C, D is there, predecessor is there, days duration is there, this is budgeted, but this is actual expenditure. For example, you say activity A, the planned is 600 dollar, but the actual is 680 dollar, it is increased.

## Updating a Project's Earned Value

- The planned AON diagram is shown in Figure, where path a–c–e is the critical path, with project completion expected at day 10.

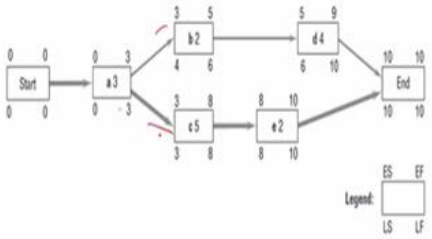



But activity B, the planned budget is 3000, but we have decreased the budget requirement by 30 dollar, so it become 270. By using this table, I am going to construct the earned value analysis chart. So, for the given problem, the planned activity on node diagram is

shown, here it is shown, where the path A, C, E is the critical path. So, this one, start A, C, E. See the legend the ES on the left side of this rectangle says earliest start, earliest finish, latest start, latest finish.

## Updating a Project's Earned Value

- What has actually happened in the project is that the first activity, a, took 4 days instead of the planned 3 days to complete, delaying the start of both activities b and c.
- Activities b and d are proceeding as expected, except of course for their 1-day delay in initiation, but anyway, path a–b–d was not the critical path for the project.




urce: Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Sons.

So, after the letter English alphabet, we return the duration. For example, critical path, what is duration 3 plus 5, 8 plus 2, 10 days. What was actually happened in the project is that the first activity A, this A took 4 days instead of the planned 3 days to complete, delaying start of both activities B and C. So, activist B and D are proceeding as expected except of course, for their 1 day delay in initiation. But anyway, path ABD was not critical path for the project. So, activities A and B are both completed, this completed and their actual cost also shown here.

## Updating a Project's Earned Value

- Activities 'a' and 'b' are both completed, and their actual costs are shown in Table
- The costs to date for activities 'c' and 'd' are not known.
- However, due to its delay, activity 'a' cost $80 more than budgeted.

Earned Value Example (today is day 7)

| Activity | Predecessors | Days Duration | Budget, $ | Actual Cost, $ |
|---|---|---|---|---|
| a | — | 3 | 600 | 680 |
| b | a | 2 | 300 | 270 |
| c | a | 5 | 800 | |
| d | b | 4 | 400 | |
| e | c | 2 | 400 | |

## Updating a Project's Earned Value

- Hence, the PM is trying to cut the costs of the remaining activities, and we see that activity 'b' came in $30 under budget, which helps but does not fully offset the previous overrun.

Earned Value Example (today is day 7)

| Activity | Predecessors | Days Duration | Budget, $ | Actual Cost, $ |
|---|---|---|---|---|
| a | — | 3 | 600 | 680 |
| b | a | 2 | 300 | 270 |
| c | a | 5 | 800 | |
| d | b | 4 | 400 | |
| e | c | 2 | 400 | |

The cost to date for activity C and D are not known to us. However, due to its delay, activity A cost 80 dollar more than the budgeted becomes 680. Hence, the project manager is trying to cut the cost of remaining activities and we see that activity B become 30 dollar under budget, which helps but does not fully offset the previous overrun. So, now this is the baseline budget using 50-50 rule, we are going to use 50-50 rule. So, activity A, so activity A has 3 days duplication. So, as soon as it started, so we are dividing this is 300, allocating 300 dollar, here it is a 300 dollar.

## Updating a Project's Earned Value

Example baseline (PV) budget using the 50–50 rule.

| Activity \ Day | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | | 300 | | | | | | | |
| b | | | | | 150 | 150 | | | | | |
| c | | | | | 400 | | | | 400 | | |
| d | | | | | | | 200 | | | 200 | |
| e | | | | | | | | | | 200 | 200 |
| Total | 300 | | | 300 | 550 | 150 | 200 | | 400 | 400 | 200 |
| Cum. Total | 300 | 300 | | 600 | 1150 | 1300 | 1500 | 1500 | 1900 | 2300 | 2500 |

Earned Value Example (today is day 7)

| Activity | Predecessors | Days Duration | Budget, $ | Actual Cost, $ |
|---|---|---|---|---|
| a | — | 3 | 600 | 680 |
| b | a | 2 | 300 | 270 |
| c | a | 5 | 800 | |
| d | b | 4 | 400 | |
| e | c | 2 | 400 | |

So, first 50 percentage of the work, we are allocating 300 dollar, the next 50 percent of the work, allocating another 300 dollar, but the duration is 2 days. For example, B, the duration is 2 days. So, we are allocating 150-150 because we follow 50-50 rules, then C, duration is 5 days, so here also initial 400 dollar, remaining 400 dollar. Similarly, for D, it is start on the sixth day, 1, 2, 3, 4, 5, 6th day, here beginning 200 dollar and the end 200 dollar. Similarly, for activity E, the beginning 200 dollar, end 200 dollar, we know it is

going to take totally 10 days.

## Updating a Project's Ear

Example baseline (PV) budget using the 50–50 rule.

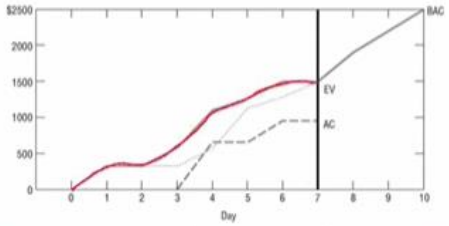
| Activity | Day 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | 300 | | | | | | | | |
| b | | | | 150 | 150 | | | | | | |
| c | | | | 400 | | | | 400 | | | |
| d | | | | | | 200 | | | 200 | | |
| e | | | | | | | | | 200 | 200 | |
| Total | 300 | | 300 | 550 | 150 | 200 | | 400 | 400 | 200 | |
| Cum. Total | 300 | 300 | 600 | 1150 | 1300 | 1500 | 1500 | 1900 | 2300 | 2500 | |

e: Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Son

Now, we are going to find out the total cost for each day. So, day 1, 300, day 3, 300, day 4, 550, day 5, 150, day 6, 200, day 8, 400, day 9, 400, day 10, 200. Then we are finding this cumulative cost, 300 plus 0, 300, 300 plus 300, 600, 600 plus 550, 1150, like this we got cumulative baseline cost. So, this, the thick line in this figure says about baseline actual cost, but our concern is we are going to consider seventh day. So, this is the baseline budget.

| Activity | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | 300 | | | | | | | | |
| b | | | | 150 | 150 | | | | | | |
| c | | | | 400 | | | | 400 | | | |
| d | | | | | | 200 | | | 200 | | |
| e | | | | | | | | | 200 | 200 | |
| Total | 300 | | 300 | 550 | 150 | 200 | | 400 | 400 | 200 | |
| Cum. Total | 300 | 300 | 600 | 1150 | 1300 | 1500 | 1500 | 1900 | 2300 | 2500 | |

| Activity | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | | 300 | | | | | | | |
| b | | | | | 150 | 150 | | | | | |
| c | | | | | 400 | | | | | | |
| d | | | | | | | 200 | | | | |
| e | | | | | | | | | | | |
| EV | 300 | | | 300 | 550 | 150 | 200 | | | | |
| Cum. EV | 300 | 300 | 300 | 600 | 1150 | 1300 | 1500 | | | | |
| Actual Cost | | | | 680 | | 270 | | | | | |
| Cum. AC | 0 | 0 | 0 | 680 | 680 | 950 | 950 | | | | |

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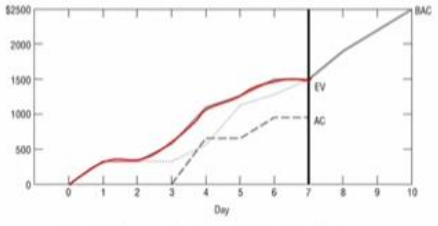
So, on the seventh day, we are going to measure our earned value and actual cost. So, on the seventh day, so what has happened, the activity A is delayed by one day. So, what is happening instead of the third, now it is pushed to fourth day. So, the earned value also 300. So, the cumulative earned value is 300. But on the fourth day, see, because we pushed one day late and that means one day ahead on the right hand side.

Day

| Activity | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | 300 | | | | | | | | |
| b | | | | 150 | 150 | | | | | | |
| c | | | | 400 | | | | 400 | | | |
| d | | | | | | 200 | | | 200 | | |
| e | | | | | | | | | 200 | 200 | |
| Total | 300 | | 300 | 550 | 150 | 200 | | 400 | 400 | 200 | |
| Cum. Total | 300 | 300 | 600 | 1150 | 1300 | 1500 | 1500 | 1900 | 2300 | 2500 | |

Day

| Activity | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | 300 | | | 300 | | | | | | | |
| b | | | | | 150 | 150 | | | | | |
| c | | | | | 400 | | | | | | |
| d | | | | | | | 200 | | | | |
| e | | | | | | | | | | | |
| EV | 300 | | | 300 | 550 | 150 | 200 | | | | |
| Cum. EV | 300 | 300 | 300 | 600 | 1150 | 1300 | 1500 | | | | |
| Actual Cost | | | | 680 | | 270 | | | | | |
| Cum. AC | 0 | 0 | 0 | 680 | 680 | 950 | 950 | | | | |




So, now instead of third day, so activity A will be finished on the fourth day, but the additional cost is instead of finishing on third day, it is pushed on the fourth day. So, the cost is allocated on the fourth day. So, what is happening, the additional cost is $80 more, instead of 600, now it become $680. Now for activity B, see activity B should be in the fourth day, now it is gone to the fifth day, because of delay of activity A.

Activity C also pushed on the fifth day. So, 400 plus 550, then the cumulative value 600 plus 550 is 1150. Then activity B 150, the earned value is 150 only, but activity D, it is

200, the earned value is only 200. Now, after finding the earned value, we have to find the cumulative value. But what has happened here, here $80 is increased, but the actual cost for activity B is 270 instead of because there is a $300 less, so 270.

So, when you find cumulative actual cost, so 680, 680, 680 plus 270, it is 950. So, we got again 950. So, what has happened, so this thin dotted line is the cumulative earned value, then the thick dotted line is the actual cost. So, what I have explained here, here I have explained with the help of an example, if there is a delay in activity, that much delay will be pushed on the right hand side on this table. And due to that delay, what is the additional cost that also has to be added to the your actual cost column.

So, then we can find out the actual cost curve, earned value and baseline actual cost. By using this graph, we can find out further analysis, cost variance, schedule variance, cost performance index, schedule performance index, ETC and so on. So, in this lecture, I discussed about earned value analysis, then earned value chart and calculation also I have explained, then I have explained different customs for measuring the work completed that is called person completion. Then I have explained various terminologies, various variances, then with the help of an example, I have explained how to construct the earned value chart. Thank you. Thank you.