**Project Management**
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**Module No # 07**
**Lecture No # 33**
**Earned Value Management**

Welcome back my dear friends, students and many of you may be faculty members, hope everybody is fine and enjoying this course. My, I am Ragunandan Sengupta from the IME department IIT Kanpur, India. So as you know this is the thirty third half an hour session or the thirty third lecture for this project management program under the NPTEL mock series. So we were discussing about different type of project control techniques.

And if you remember in the thirtieth, thirty first and thirty second class we did discuss in quite detail going very slowly that how the crashing of the jobs can be done and how different marginal rate of decrease that means as the number of days decreases how the cost increases those were considered and how nonlinear costs were not consider so we considered only linear cost and we consider that how crashing could be done.

How the interdependence of the activities of the jobs would help us in trying to add up the variances for all the activities along the critical path and also help us in trying to find out the variance of the critical path the standard deviations. Then we also considered that that given the due dates what was the probability to find out that certain percentage of the jobs were finished. Then we also found out that given two dates how we could find out that, what was the probability?

Say for example seventy percent of the job or what was the portion of the job which would be finished between two due dates due one and due two. We also considered that how we can calculate that given a certain percentage what was the due date by which we were certain to finish that proportion of the job, considering that due date was an important factor then we also did discuss that the crashing of jobs and can also have the component of fixed cost,.

The variable cost in the later example even though the I went a little bit fast there considering that I, we had spent a lot of time in the first example that each and every jobs and activities work crashed considering one unit decrease in the number of days and how the cost increase on the other hand the time decreased and then we also mentioned at the end of the thirty second class that we will consider the GERT and Q-GERT.

We will do that so but from a very simplistic point of view and in the later part, last fag end of the course we will try to basically go through one or two simple problems. So some of the two simple problems. So some of the slides which we will be doing now maybe a little bit repetition but please bear with me because this has to do with a huge amount of accumulated concepts which we have learned and how they can be actually utilized in the real sense.

So we were going through the concept of the S-curves and also if you remember we did discuss before we did the crashing of the jobs the concept of resource balancing, resource allocation trying to find out the resource utilization for the amount of resources exceeding more than the maximum value which was basically R, capital R. I am just referring to the diagram which we discussed also trying to find out that, what was the underutilization was less than small r.

And if balancing has to be done what was the concept on how the early start late start early finish late finish concept can be considered that where the resource balancing could be done. So again I am coming to the fact of the S-curve. I will repeat that and then continuing considering the different type of concept of on value management and how the so called concept of expected value not in the sense what we mean by expected value if you remember the decision trees.

We will consider those concepts the variance concepts, the ration not the financial ratios just the ratios in a very simple way when you have the earned value concept coming into the picture.

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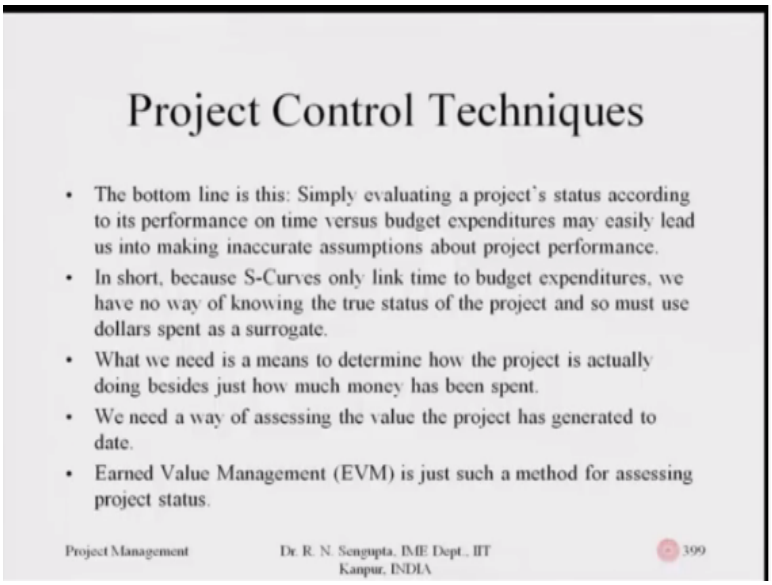


So the bottom line is simply evaluating a project status according to its performance on time versus budget expenditure may easily lead us in making inaccurate assumptions that what is the budget and how we are spending say for example the budget maybe hundred crores but if you have already spent a huge amount of that trying to finish few initial activities which means that as they go by the overall cost for the whole project would increase.

Because we may be happy so the work is going on very fine but you have to basically balance that fact that time duration decreasing has been due to the case that the resource utilization has been more than the average so you have to basically make a balance according to that and take decisions accordingly if obviously the deadlines are sacrosanct or if breaking the deadline means a huge penalty we at a disposition to take decision such that trying to utilize resources are or trying to hide resources.

From vendors from outside sources may be feasible considering the cost benefit analysis which we are as a project manager trying to take. So in short because S-curves only link time to budget so if you remember the S-curves and if you go to the last set of slides in the thirty second class. So we had the cost component whether cumulative or over their individual cost component that does not matter.

It can be off from the point of view of resources also because resources can be converted in the concept of cost. And along the x-axis we have the time of the concept of time being measured such that we can draw the curves accordingly, so continuing the discussions which is the second bullet point here in short because S-curves only link time to budget expenditure we have no way of knowing the true status of the project so must use dollars spent as a surrogate.

So as I was mentioning the resources utilization has to be converted in the concept of some dollars some yen. Some rupees, some pounds, some dirham, some Canadian dollars, some pesos. Whatever it is based on that we try to analyze that with respect to the time what is the utilization of amount of money.

So now if you remember just few minutes back I mentioned that amount of money being spent is very high would make us very happy that we are able to finish the act set of activities well before time but a comparison with the budgetary allocation would actually give us the real picture how things are going.

So what we need is the means to determine how the project is actually doing besides just how much money has been spent so, we will try to analyze two important fact. One is time and one is resources converted into some monetary value with respect to what should be the time and what should be the resources utilization. So trying to gain time that means gain time in the sense trying to finish up the work before time for each and every steps, we as we proceed with the job.

May be valuable provided the resource allocation have not been compromised in the sense we are not trying to utilize more than the resources or try not trying to basically use too much resources or too less a resources with the view that the work schedule is basically getting hampered would also have a detrimental effect so balance has to be made. We need a way to effect of access, accessing the value of the project which is as generated till date, or till the certain time period of time.

And take a stock of the situation so what we do is that as we proceed we take the decision and if you remember that when we initially started trying to analyze the activity on arc and activity or

not concept we did mention they would be some decision gates. So those decision gates can be utilized in this perspective also and if you remember we did that during the solution of two different flavor of problems for the decision trees one was basically the moped problem.

One was basically the oil rig problem. So we will try to basically analyze and see that how the work is going on with respect to the different due dates and the deferent resources allocation. Now on value management EVM, is basically a method of trying to assess the overall utilization of the resources with respect to time. So how you utilize the resources on a macro level or a micro level or have the concept of the resources converted into money and then try to analyze per unit utilization.

So they can be walk down on a very detailed basis as that we understand how the utilization is going on with respect to the project. So the following, obviously I will come to the explanation of the key points later on so it is more qualitative discussion and it will give you a field that whatever we have discussed under utility under expected of the utility under the certainty concept of utility under the expected value in the decision tree analysis if you remember under the different types of financial concept.

Which we did the return on investment or say for example the IRR on or on the fixed interest rate or on the floating interest rate and all these things would basically make sense when you are trying to go through the following concepts which will just now cover.

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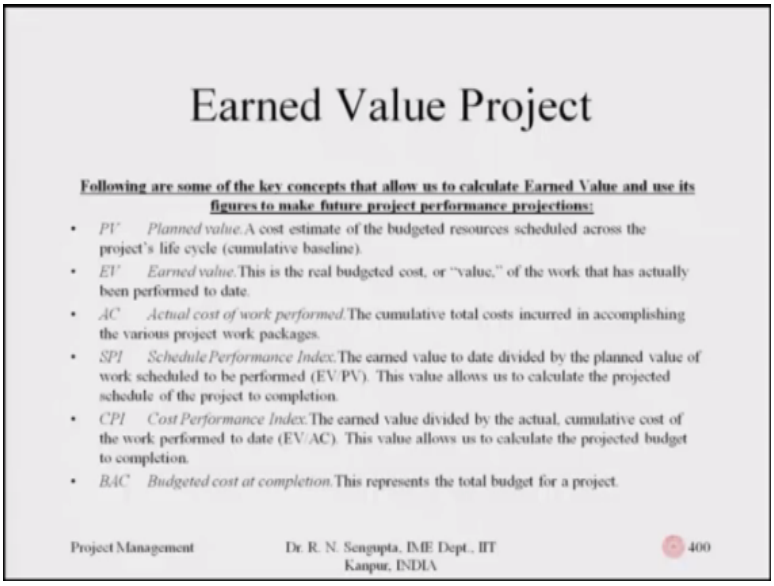


So the following are the key concepts that allow us to calculate the on and use its figure to make feature project performance, projections and evaluate them with respect to what we want and how things are going. So the six bullet points are planned value which is PV, the on value which is EV, third one is actual cost of work performed is AC. So I am just using the short AC for actual cost then the scheduled performance index which is SPI.

And then the cost performance index which is CPI and the budgeted cost add completion, with respect to or to the cost over overflow or underflow or no flow means we have a fixed budget where you have basically exceeded that or you are bellow that. So let me read it and try to explain it in very simple words such that when you go through the different type books. Again I am referring the set of books or the references which were discussed in the first as we started the project management.

They are quite good books which will give you a very holistic picture of trying to understand how project management can be tackled can be learnt both from the quantitative as well as the qualitative point of view. So obviously it would mean that if you know some techniques then trying to analyze them from the actual experience would really make sense but only knowing the techniques is not the actual goal or only trying to analyze the problem from very qualitative field would not also serve the purpose.

So you have to basically make a balance accordingly such that you understand the overall concept and try to utilize some tech mathematical texting techniques in order to understand or those concepts, into real sensors that they make some meaning for both for you and your project team so the plan value means this is the cost estimate of the budgeted resources schedule across the project lifecycle. So which basically a cumulative baseline, so you have basic.

As you remember if you can recall that the thirty second class I have mentioned about the concept of cumulative cost which was in some way even though not directly but somewhere related to the concept of cumulative distribution function which means that the overall sum of the probabilities was zero to one. So what you have is the overall budgetary constraints for the cost so is it is limited between, say for example hundred to two hundred corers to hundred and fifty crores.

We know that whether the cost increase is actually justified or not justified considering that how the per day cost or utilization for the project is going on. The on value means this is the real budgeted cost or value of the work that has actually been performed till date or till a certain time. So say for example you had planned to utilize hundred crores, till say for example, end of three months and if you see the earned value with respect to the, what was the completion of the job is not hundred crores.

But is more than hundred crores. Say for example one twenty five crore then you will basically take a decision whether those extra twenty five crores which you have utilized actually work plan out of control or they were the so called effects on the environment versus that you had to spend them. In case if it was not then obviously it mean that you are basically made some wrong judgement based on the calculations which were basically given to you.

So it was not realistic, so you will again go back to the drawing board try to analyze the problem and then proceed. The actual cost of the work performance it basically is the cumulative total cost incurred in accomplishing the various project work packages or the overall project. So the third is that if you compared to the first one is basically the budgeted cumulative cost and the third bullet point is the actual cost on a cumulative basis.

So at the end of the day, what you will try to analyze is that what is the overall cost spent for the whole project with respect to the overall budget which you are sanctioned for yourself. And if you want to basically analyze the per day, per week, per month or per unit utilization, the cost you will basically go along the x-axis which is the time and trying to basically analyze that what is the total cost for that particular period of time.

Now the schedule performance index and the cost performance index are some sort of ratios. So if you remember which I did mention as we started this thirty third lecture. The return of equity was one concept or the concept which we use as an efficiency or the concept of trying to find out the ratios of the expected value to the variance or the ratio of variance to expected value whichever you think is the right way of trying to analyze a decision a project as we proceed.

So those are basically are some sort of efficiency of the system which is also being reflected in these two important concept which is the schedule performance index and the cost performance index so basically we have an index based on that you take a decision that how your project is going. Now if you go back to one of the important concepts that concept would not make much sense from the point of view of the on value of the project.

But what I am trying to highlight is that there are some sort of index based on which you can find out that how your work is going on. If you remember we had done some very briefly to=though, the concept of the how simulation can be utilized and how we can use the critical D index based on which we can say that say for example job or activity B would come in the critical path, say for example thirty number of times.

Which means if we basically simulate the total set of activities to find out the overall path, then that job or that particular activity would be coming thirty percent number of times in the number of solution immolations we do. So they basically gives you some sort of efficiency. So the schedule performance index is basically the ratio of on value to plan value. Basically means the on value to date divided by the plan value of the work scheduled is that ratio what we are discussion.

So this guy is allows us to calculate the projector ship projected schedule or the projects to completion and based on which we can understand that how it is proceeding. So if you consider the on value and the plan value of they are of the same value or the same level of utilization of resources and obviously you would understand that ratio which we just discussed the schedule performance index would give you how the work is going on based on the budgetary as well as the actual utilization of the resources.

The cost performance index which is basically the on value divided by the actual cumulative cost of the work performed to date which is EV which is second bullet point here which is there on the slide divided by the third bullet point which is the actual cost of the work performed. This value allows us to calculate the projected budget to completion based on which we can basically take our decisions. So these are in some way two different ratios which give us an idea that how the work is going on a theatrical sense.

And a practical sense based on which we can understand from the ratio perspective as I mentioned that what is the difference or what is the gap based on which you should take some corrective actions. And the budgeted cost completion which it means that the represents the total budget of a project such that you can take a decision whether you have exceeded or not accelerated either at the end point or at different initial points as you proceed with the work.

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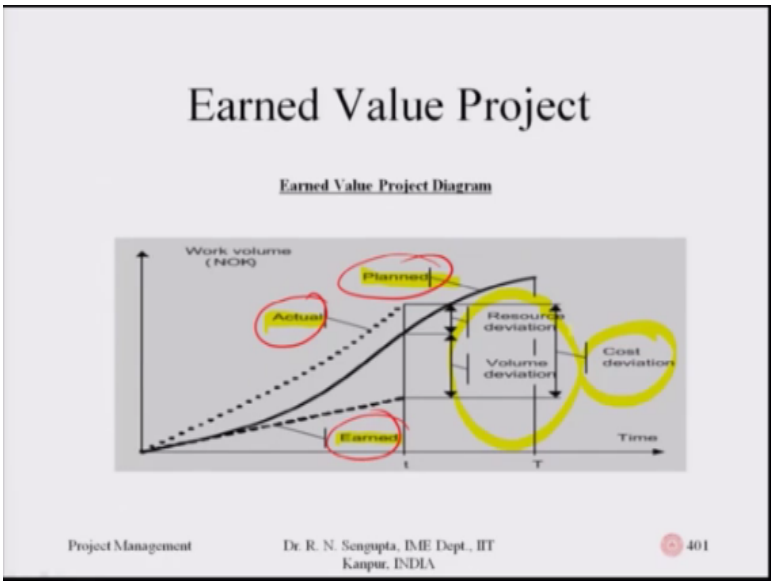


So if you see this graph so this graphs gives you as I mentioned the time is basically calculated along the x-axis and along the y-axis. I am trying to find out what is the work volume or the resource allocation whatever it is that is the matric based on which you will take a decision. Now you have basically three different curves, two are dotted and one is basically bold so, I will try to now mark them accordingly such that it is clear.

So, this actual one here, small dots are there, the earned one is basically ash dots, so the dots are much bigger in length and the bold one is basically the planned one. So what you are trying to find out is that you will basically have the plan in front of you which are now mark with the highlighter. So this epsilon and the plan one so actually you have planned something but based on which you are trying to basically get the benefit of the work as it proceeds and you basically see it on a daily basis on or weekly basis.

And you will try to basically compare with your plan concept, the day you started of the project. So this would basically give you if there is any gap and if the gap is actually justify barely, so what you do is that you find out the total amount of resource deviations at any point of time so, the resource deviations would basically be given the by the deviations on the number of projects which is happening plus considering what is the unit cost for each project or each activity which is there or the delay which is happening.

If you remember in the resource, constrained problem which we solved which was very simple, again I am mentioning it, but I am sure as I went through it very slowly it would definitely, given all candidates on the participles the very good field that how you can tackle those problems to any depth which you want considering the concepts are clear. Now the earn value and if you compare the earn value the projected the actual value and the plan values in hint here it is basically work value bit I.

As I mentioned it can be total cost or the cost or the man powers whatever it is. So, this amount or the different value which you have which is the volume deviations of the resource deviation would give you an idea that put two important points that which of the activities that are deviating without going into detail and then days so which are the activities that are deviating then you will basically understand the amount of deviations of the amount of delays or amount of actually finishing of a particular activity.

More than its actual utilization time or it may be possible on a positive note that you have been able to finish a particular job before its completion time so that is important which are the activities. Number two you will also try to analyze that what is the marginal cost increase and decrease as you are able to finfish that work either before time or after time and also you will try to understand that, what is the actual resource allocation which has been utilized on a negative or a positive basis.

Negative means that you have not utilized the resources or positive means you have basically being able to utilize the resources more than the actual budgeted or the planned one. Then you will come to basically the marginal rates on the number of days the deviations are, because marginal rates will give you an idea that, what is the, per unit time utilization of the resources and what is the cost. But if the number of days is very high, obviously the total cost for the deviations for that particular activity of job will be very high.

So basically you have to balance or try to find out in a very practical sense, what is the total number of days of delays both positive and negative. I am using the word positive or negative to

imply that whether you have over shooted your time or you have not over shooted your time. For the, for completing that particular activity. Point number one and point number two is that you will also find out that if you do not overshoot due time obviously you should get some benefit as I mentioned.

If you are able to deliver the project beforehand obviously you should get some benefit. And in case if you deliver the product after the deadline there is a penalty. So, this penalty which is negative cost and benefit which is a positive cost for you, positive means you get, gain some profit. So those should be considered in such a way that you actually understand that what is the balance happening or what is the difference happening between the actual and the planned total cost which you have in front of me again.

I am saying the earned value project diagram which is given here, time is definitely along the x-axis but along the y-axis it can be the total cost, it can be the cumulative cost, it can be resource allocation, utilization it can be work boiling whatever it is, based on which you can take a decision that what are the variables based on which you are trying to find out the overall feedback for the earned value project concept which we just discussed in the last line.

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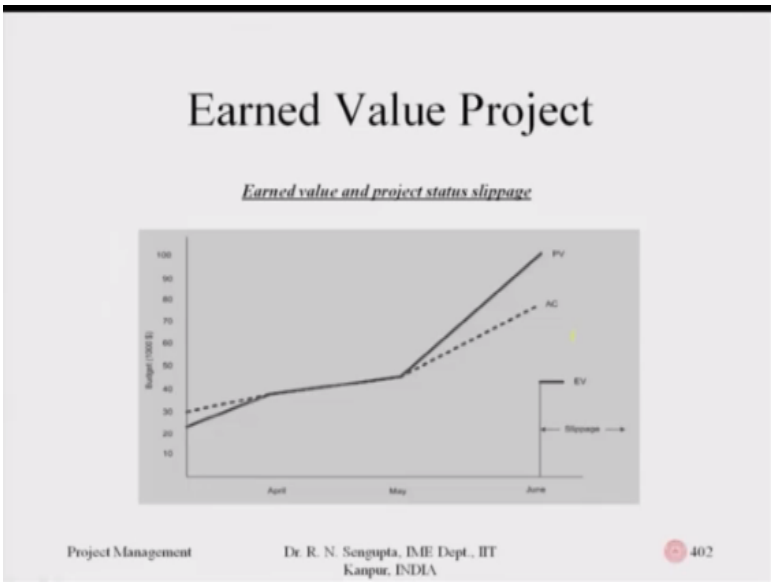


Now continuing with the earned value discussion again we come into the realm of trying to analyze the overall slippage which may can have occur so again whenever I try to discuss a

problem or try to basically give you a qualitative feel I always try to give both the positive and the benefit things such that it will at least give you a flavor that, there may be cases where you are not able to meet the deadline they would may be cases we are where you are able to meet the deadline beforehand.

So obviously you should understand that do not making it as per the norms which is laid down in the project concept or trying to meet that deadline before as laid down in the project concept would basically have two different consequences, point one. And point number two you should also be mentioned that the overall cost and benefit analysis which you have for overshooting or undershooting a particular project, overshooting means trying to basically take more number of days.

Undershooting is that basically you are trying to use less number of days may not have the same consequences. So, I will try to basically give you from very simple point of view, considering utility analysis even though it may not immediately make sense but I am sure people will understand or I appreciate the way I am trying to basically put this example, consider that a person is very risk averse, consider that risk averse person would definitely give you give a much better feel that how I am trying to analyze the issue and the person in one case loses hundred rupees or one thousand rupees.

And in another case gains one thousand rupees or hundred rupees, whatever it is now, the net worth is basically hundred rupees is basically hundred rupee note in Indian rupees it can be hundred euros in Europe it can be US dollars whatever it is now when you convert that in the actual utility, the actual person is getting then the net utility of losing or gaining that hundred rupees or hundred euros may be different for the same person that means I may be much sad interact in when I see that.

I lose a one thousand than my overall actual happiness which you would get in trying to win a thousand rupees. So thousand rupees losing and thousand rupees gaining would have different consequence in my over utility function so that, those should also be analyzed in a very practical sense, when you are trying to find out the different type of concept which I mentioned another

earned value project concept. So, in under the earned value project concept what we have in front of us in this slide.

The bold one is basically the actual value of the project. Which is PV as I mentioned in the last row last slide and the value of AC is basically the dotted lines which you have. And any positive or negative value would basically be considered as slippage which would be positive or negative depending on how you are trying to view the overall cost benefit analysis for the project.

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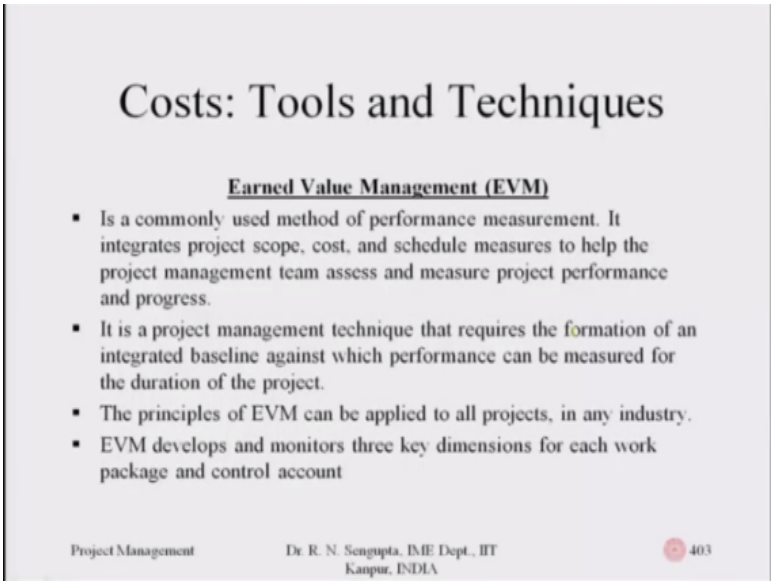


Now, I will again, as I mentioned that I did go through the earned value management concept is that it is commonly used method of performance measurement it integrates project scope cost schedule measures to help the project management team access the measure project performance and progress. So measure how it is going on and try to basically analyze the project which is there.it is a project management technique that requires the formation of integrated baseline.

Against which performance can be measured for the duration of the project. The principles of EVM can be applied to all projects in industry and based on that we can get both qualitative as well quantitative feed of how the work keeps going on. EVM develops and monitors three key dimensions for each work packages and control accounts such that it is able to analyze the overall project from the cost benefit analysis. So if you remember I did mention the plan value again I repeat that.

A little bit more detail. So the slides would basically explain that in detail but I have already discussed what we did about few minutes back.

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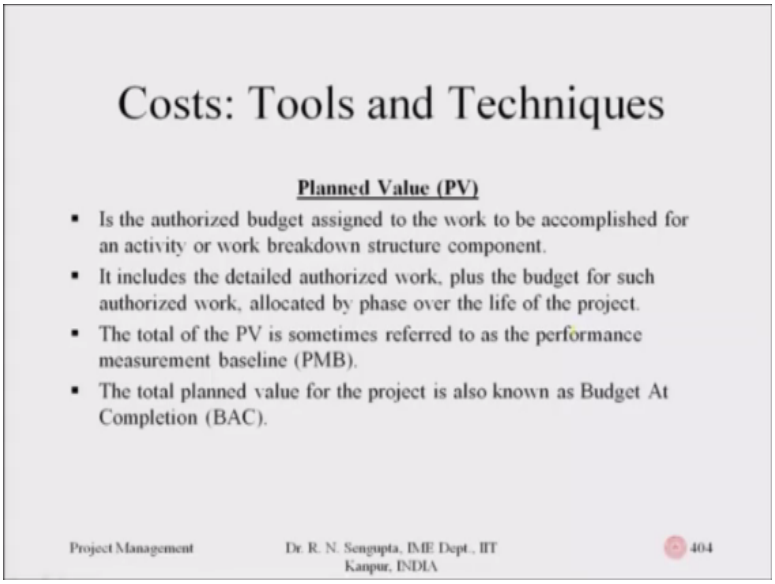


In the authorized budget assigned it is basically authorized budget assigned to the work to be become accomplished for an activity or work breakdown structure component. So you break down the work going to the micro level and then try to analyze. It includes the detailed authorized work plus the budget for such authorized work, allocated by phase over the life of the project.

So basically as I have mentioned you derive the decision making points which you have or try to analyze the decision making points. Then go into the depth try to analyze on the micro level and then either go backward and cumulatively find, what is the overall plan value of the project, or the group of projects of the group of activities which you have.

The total of the plan value sometimes referred to as the performance measurement baseline so that the baseline which you analyze your project whether it is going good or bad and the total value planned value of the project is also known as the budget at completion lines. Such that you are able to take your decisions accordingly.

So with this I will close this thirty third session of the lecture but with the note that we are still to finfish the detailed discussion of the concept of earned value management concept and try to wrap it up in the thirty fourth class or else start the GERT and Q-GERT, in such a way that in the thirty fourth class we are able to balance that accordingly. Have a nice day and thank you very much.