Project Management
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Module No # 5
Lecture No # 25
Concepts of a Project Life Cycle

Good morning, good afternoon, good evening my dear friends. This is the twenty fourth lecture for the project management course and as you know by this time my name I am Raghunandan Sengupta from the from the IME department from IIT Kanpur, India. So in the twenty third lecture we wrapped up the concept of considering the criticality index. So this was basically the concept stimulating the job considering that you want to find out what are the set of activities which makes the critical path.

So the number of times a particular job comes up in those stimulation divided by the total number of stimulation which you have done or total number of such instances of experiment you may have done. So that ratio would basically the critical index and if you remember I did mention if you will rank them from the highest to the lowest take the source sets of activities or jobs which have got the highest criticality index.

But remembering the fact they make a sequence of events which add up and basically start from the source which is job number one or the node one and end on to the last job which is the Nth one or the sink such that you are able to complete and have a feel that how a work progresses.

Now also if you remember I did mention that due date is also important to consider that how we will consider the concept of due date along with the expected time for the set of all the activities which makes the critical path and how the variants can also be considered in order to find out what is the percentage of completion of any particular job.

Considering T which is the expected time and D which is the due date are coming into the picture. And I also mentioned in the last class and also beforehand central limit theorem will be used irrespective of the fact that whatever the distribution for PERT work considered. So we will

basically have the graph considering the central limit theorem to be true is this normal distribution where the central line.

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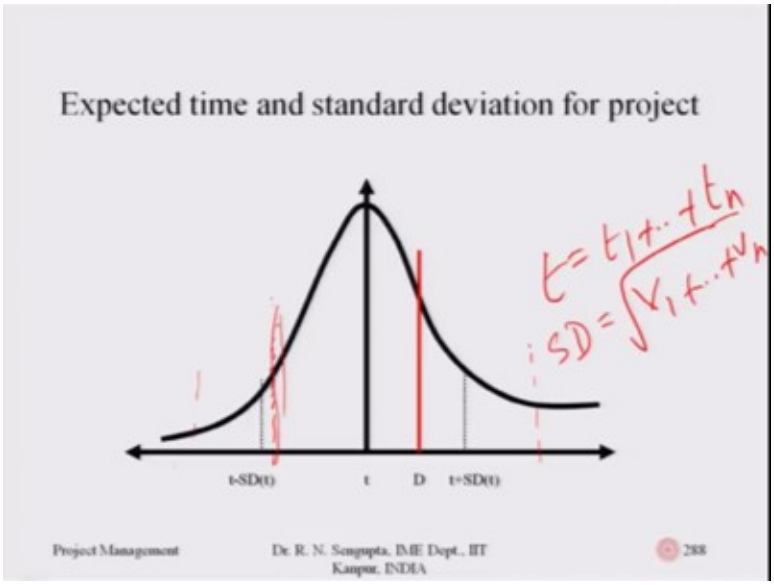

If you see it is T so T is, so this T if you remember is the summation of all the average time for the critical path and these standard divisions are basically the variances addition for all the parts and then you find out the square root and then if you go one sigma to the left, one sigma to the right if you see my this pointer this is hovering right hand side this is one sigma to the left.

So now see the red vertical line which is there, which is the due date. Now if you see it will give a feel the due date can also be here but, whatever concept I am going to mention just now would be true for both the fact that the due date D vertical line is on to the right or the left. But they would have different conceptual consequences that how to analyze the problem.

Now the due date can also be on to the right of T plus one standard deviation it can also on to be the left of T minus one standard deviation. So this idea of where the due date is does not matter if you are able to analyze the problem in its true perspective in practical sense. So this is what now I will discuss very briefly in the two eighty ninth slide.

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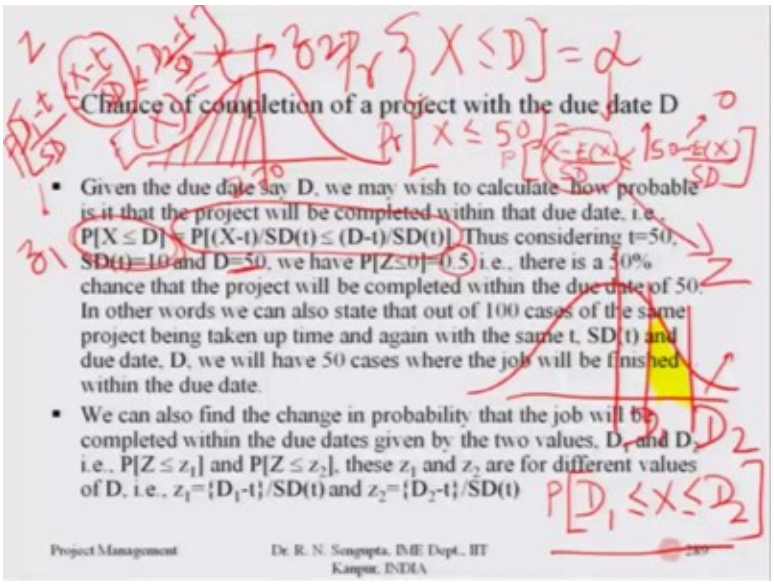

So now it sense the chance of completion of project within the due date. So due date is D, given the due date say D, we wish or we may wish to calculate how probable on the probabilistic sense on a non-deterministic sense is it that the project will be completed within that due date which is what we need to find out is this.

This is very important so what we need to find out is Pr, Pr is probability which is P here which does not matter. So we want to find out X is the random variable which denotes the overall distribution of the time for the overall projects for which the expected value is known to which is T as mentioned in the normal distribution as shown in the normal distribution and the standard deviations are SD in the bracket T.

So my main concern is this I want to find out what is the probability alpha if alpha is very high it means that I am able to finish on an average job before the due date on a very high probability note. Which would mean two things that I do not incur extra cost very simply mentioned here because I am considering cost can come due to more over time given if the job duration increases more than the due date because I want to assign more and more people in order to finish it or I want to assign more work to the same set of people giving them over time.

It may also mean that I have to resources extra machinery, extra some land, consider land utilized, it can be tried to utilize extra help from other organizations from vendors so these are

very simple points which I mentioned. The other important fact which may be negative is that if I am the vendor and I need to supply and deliver to the government of India a road, considering the road connects the city of Bhopal and Indoor now if I am able to finish that work within the due date of consider three months then obviously I do not pay any penalty.

But if I deliver the overall project after the due date then obviously as per the clause, as per the contract I may have to pay some penalty. So you may be asking that if that is the case if I am able to deliver the job before the due date. Obviously I should get some benefit also so those can also be brought into the picture considering the overall contract how it is signed.

So if I consider X as the overall random variable depicting the time and if I consider central limit theorem to be true then X would have random variable distribution as normal with an expected value of T and the standard deviation as SD bracket T or variants as calculated. So variants calculate word basically sum of the variants of all the paths which are on the critical path.

So using simple standard normal concept so this is the formula which I have which is X minus expected value divided by the standard deviation is less than equal to D which is the due date minus T which is again the expected value of T divided by standard deviation. Thus considering T as fifty and standard deviation as ten and D as fifty we would have basically that, now this is considering that SZ is the standard normal so how it came about is exactly this.

Probability of fifty sorry less than or equal to fifty is this one is equal to I want to find it out so what I need is probability X minus expected value divided by the standard deviation less than equal to fifty minus the expected value divided by standard deviation, this expected value EX is equal to T. So I am using in general notion so this expected value is also fifty then fifty, fifty becomes zero. So whatever it is this is now becomes standard normal deviate z so hence it is written as probability of z is less than zero.

So if you consider the normal distribution the overall area of some of all the properties for any distribution considering from the minimum value to the maximum value we know it is one and normal distribution and symmetric distribution above and below its mean medium and mode. So

this value Z is equal to zero which is the mean of the standard normal deviate is zero, standard deviations for this is one so the overall coverage till mean value is fifty that is why it is written as fifty.

So this is point five so its fifty percent so the chance the project will be completed within the due date of is fifty percent. In other words we can also state that out of these hundred such stimulations we need to do before you basically commit your resources and you want to find out where the over runs could have happened or where they can happen. So out of the hundred such cases two hundred can be one thousand can be or one million.

So I am just giving an example, hundred of the same project have been taken up time and again with same time which is again expected value of X which is fifty standard deviation which is given as ten and due date D which is given as fifty. We will have fifty chance cases with the jobs will be finished within the due date and fifty chances of fifty such cases job would not be done by the due date.

We can also find the chance in probability that the job would be completed within certain due dates which are given by two values D1 and D2 consider like this, you are the vendor and again coming back to laying on the road city of Bhopal to Indore the overall average time decided due date is three months and within that three months if it exceeds that three months less than say for example four months you pay a penalty of consider two lakhs per day

Now after the four month your penalty increases to five lakhs per day so what you want to find out is that what is the probability that I would finish I as a vendor would finish the job within that time frame of three to four that means am not able to deliver the job within the three months but I am able to deliver within four months so I know on an average what is the cost which is two lakhs per day.

I want to find out that what is the probability of paying that amount because incase if I exceed the four month the overall cost structure the penalty structure cost structure in the negative sense for me would now become not two lakhs but five lakhs per day. So in that case I need to find out

that what is the probability that I exceed finishing the job for a time period for more than four months and what are the consequences I have to face.

Based on such practical examples let us just give the concept very briefly so we can also find the chance in probability that the job would be completed within the due dates given by two values D1 and D2 as just mentioned. So I need to find out that what is the probability so technically it is like this, my job would be completed with some D1and D2 this due dates are given I need to find it out.

So again going through the same simple concept of central limit theorem and the concept of standard normal. So what I do is this, so I will now just write down the formulas which would absolutely make very simple sense to all students who are well versed in the concept of probability. So it will be basically D2 minus T which is which is the expected value by the standard deviation less than equal T, X which minus T by standard deviation which is less than equal to D2 minus T by standard deviation.

Now these value D1 is known T is known, standard deviation is known, so what I have is one small Z1which is the standard normal deviate value realize value which I know and I can check in the standard normal table here also D2 is known T is known and the standard deviation is known from there I find out Z2. So this value which is X minus T by the standard deviation is basically the standard normal deviation Z.

So I basically check given D1 and D2 and T and standard deviation I check the small Z1 value small Z2 value I find out what is the over all probability such that will be able to finish the job within the stipulated time D1 and D2. So if I go back to the graph this is becoming a little bit cluttered but please bear with me so what I actually have is this graph this t and these are D1 and D2 so based on that I have this formula which I have given here.

So if I highlight what I need to find out is that what is the probability inside the region as shown between D1 and D2. So based on that I can find out that what is the probability that I am able to deliver because based on that I will basically recalculate my overall budget and take a decision

whether I can delay or whether it is best to finish off that job before the D2 period using some extra man, material, giving overtime trying to take help of other vendors, trying to pay them extra amount of money.

Such that I am able to overcome the overall laws which I may face if I do use these extra resources of man, material and other things. Such that in that case the overall time taken to finish the overall project now is more than D2 because if it is more than D2 what happens is that it will go into this region where if I mention in the example that trying to finish of the road connecting two different cities in India the overall cost is now five lakhs per day.

So if it exceeds four months which is D2 then the overall cost that I have to bear is very high. With respect to the fact that if I am able to deliver before the time period of four months then my overall cost to be paid by me per day is two lakhs such that I am able to offset that utilizing extra amount of man, materials such that my overall cost budgeting is under control. So I am sorry for cluttering this two eighty ninth slide but I am sure you would have understood the two important concepts.

One is what is the probability of finishing within the deadline or D and what is the probability of finishing the certain percentage of the job between two deadlines D1, D2 such that I am able to recalculate my overall cost structure for the project.

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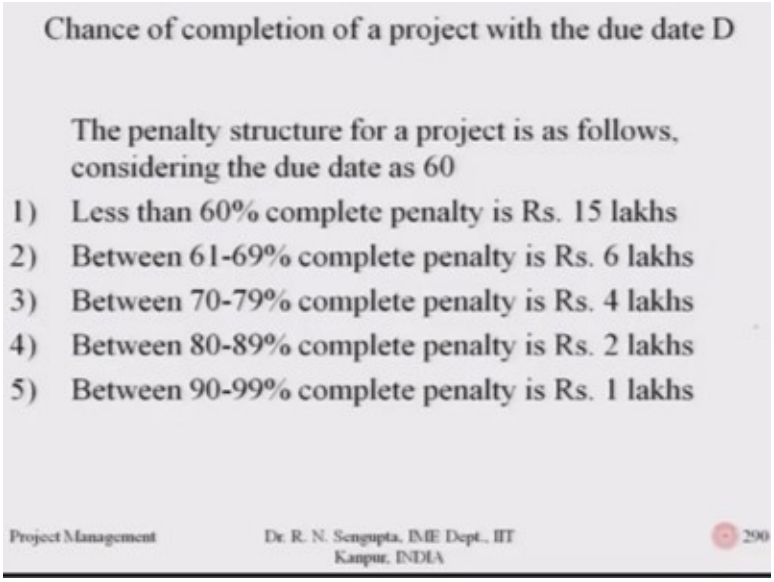

So the penalty structure for the project can be say for example as follows that if you finish less than. Coming back to the exact example which I finished in the two eighty ninth slide between D1 and D2 deadlines and the due dates, so if you are able to finish only sixty percent completion of the jobs you pay a penalty of fifteen lakhs so exactly there is a fixed penalty in that case what I mentioned it was two lakhs per day.

Between sixty one to sixty nice percentage is complete you pay a penalty of six lakhs, between seventy to seventy nine you pay a penalty of four lakhs, if between eighty to eighty nine is complete you pay a penalty of two lakhs, between ninety to ninety nine percent complete you pay a penalty of one lakh which means which is more complete less the penalty.

So we could also have added if you see this slide sixth seventh point accordingly that you are able to finish it before the deadline obviously you do not incur loss you do not basically pay a penalty but it would be a negative of penalty in the sense you gain some from the actual customer to whom you are supplying that project or to the government of India considering you have signed a contract that you get some benefit.

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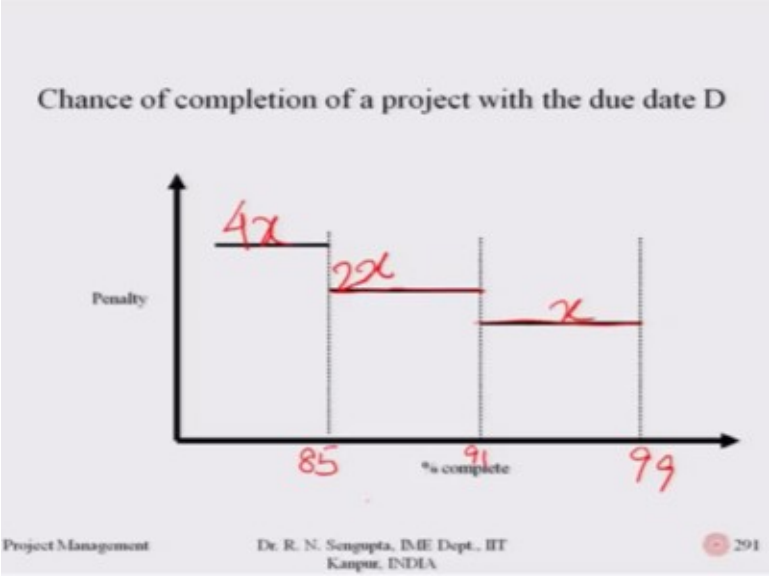

So the chance of the completing the project whatever it is there now this is percentage completions are given on a penalty on a linear scale or a step five function which means that if percentage completed say for example between ninety one to ninety nine percent the cost is I am not giving the value which I have written I am just giving some orbit variables. So this is X so you would basically pay an amount of X if it is less than ninety one, say for example greater than eighty five.

So these quantum which you are taking percentage complete are just arbitrarily they can be equally dispersed or not depending on how here frame the problem or what information which you have this would be higher say for example it is two X and in this case it is less than eighty five percent complete it can be say for example for X. So this X to X for X again arbitrarily so what is important to note is that in this region between eighty five to ninety one or in this region from ninety one to ninety nine the cost overshooting remains fixed.

That means if you are able to finish that particular percentage of work either it is ninety one point five percent complete or ninety eight point nine percent complete you basically pay a fixed amount but it may so happen that this fixed amount may not be true in some of the contracts where they would try to basically find out that what is the overall percentage you have finished and based on the percentage change it may be a nonlinear function.

It can also be a fact that depending on the percentage they may also be like they means the customer to whom you are supplying the project they would also like to know that what is the number of days which are left to finish the project based on that the cost structure for the penalty may be calculated or it may so happen that percentage-wise is important but they may like to look into the fact that what are they critical jobs that are finished.

So if the critical jobs are finished then the rest assured job would definitely be completed within a certain deadline a new deadline of d3d for whatever it is. So if those critical jobs are finished then your total penalty structure which you as the vendor are going to face would be much less in case if those critical jobs in that critical path are not finished so there can be different scenarios by the way of which the overall cost structures can be calculated based on which the overall cost for the projects can be calculated.

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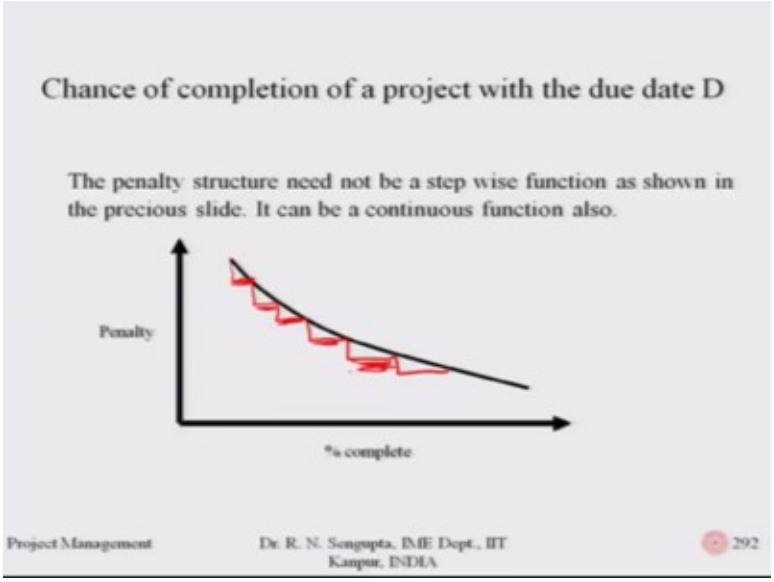

A penalty structure need to be a stepwise function as I just mentioned so as shown in the previous slide so it was step function so within ninety one to ninety nine some within eighty nine to eighty ninety nine some cost and based on that you calculate but incase if you have a cost structure which is nonlinear so what would be important is on two accounts.

Number one whether we are able to replace this non-linear cost structure bias step function so closer your step function is to say for example so what will be required is that whether these lines

are able to replicate this horizontal lines are able to replicate your overall storage cost structure which is nonlinear in nature so if you are able to do that then trying to find out the calculations for the small quantum increase or decrease of the overall percentage finish of the job or the due date being exceeded can be calculated in much better way, that is one.

Another can be say for example if I know the marginal rates of increase in the cost for the whole projects if that is known to me that means increasing and increasing rat, increasing and decreasing rate or increasing at a fixed rate. Fixed rate is basically the concept which we generally try to utilize in order to make our life simple and try to find out good results for the overall projects which are complicated in nature.

So incase if the marginal cost are increasing and increasing rate and increasing at a decreasing rate the trying to find out the dydx of the cost structure needs to be brought into the picture such that we are able to calculate the overall cost structure which is there for the project or for each and every activity based on which he can proceed.

Another important fact is that if you see in the three slides before I did consider one critical path and one set of noncritical paths but showed that of the variances of the noncritical paths or the set of activities which are there or not critical paths which are high then it may so happen they are trying to exceed the overall due date may have an effect such that the noncritical path activities or the set of paths which are they are not in the critical path may come into the picture.

Such that we need to calculate that over all extra cost for those non critical paths also and also see whether the noncritical path does really affect the overall critical path and the cost if it does then your cost would be twofold number one coming from that fact and the noncritical paths are being affected due to overrun delays, due to say for example high cost of some labor or high cost for some input material and such things plus the fact that if it affects the critical path then two things would happen.

Number one if I need to utilize resources then it the cost would increase as it would be for those noncritical paths plus the effect is that if the critical path is exceeding in the sense that the time

deal is happening then the as per the contract what are the actual cost which have to be borne by the vendor which is you would also be considered in the picture.

And then the critical index may change because if the variations are happening in such a way due to external factors are happening in such way that it may affect the overall working of the project based on which you want to do your scheduling for the set of activities which are there in front of you. So now I will just consider very simply the concept of the project's lifecycle and how it affects the overall planning of the project and cost would basically come into the picture as a sub part of the overall project lifecycle and how it is considered.

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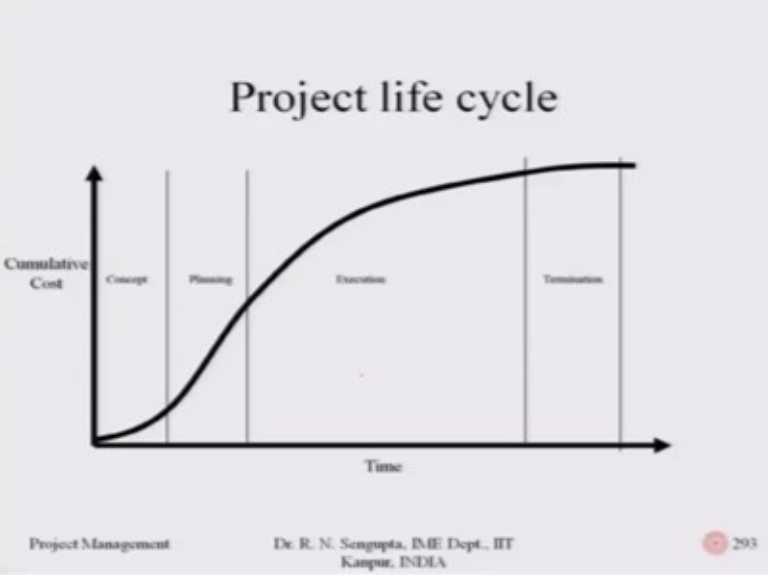

So if I consider the concept of time along the X axis and the concept of cumulative cost or the cost along the y axis generally the project overall development and how it happens is like this as shown in the two ninety third slide in the initial stage you basically conceptualize try to find out what is the effect of the project and how it should be taken into consideration then you go into the planning stage and obviously as you proceed from the concept which is the left most or the vertical line which you have.

Then you go to the planning stage then slowly the overall cumulative cost increases and the cost increase may not be in a linear shape it has to be basically nonlinear each. And then we go into the execution phase there would be fixed cost, there would be some cost, there would be variable

cost, there will be marketing cost, they would cost related to man to labor to design to intellectual property and all these things have to be taken into consideration.

So as the execution phase ends and the overall work for the project starts considering is a ongoing project then obviously it will taper down, taper down in the sense the increase would basically become stagnant and they would be a straight line, almost a straight line that means the cost are on a fixed scale and if the project ends then and there then obviously the project has to be wound up and then the cost structure of the overall project would basically start decreasing.

So here if you see my hand so after the termination phase the actual cost of the project should basically start decreasing and should technically be zero

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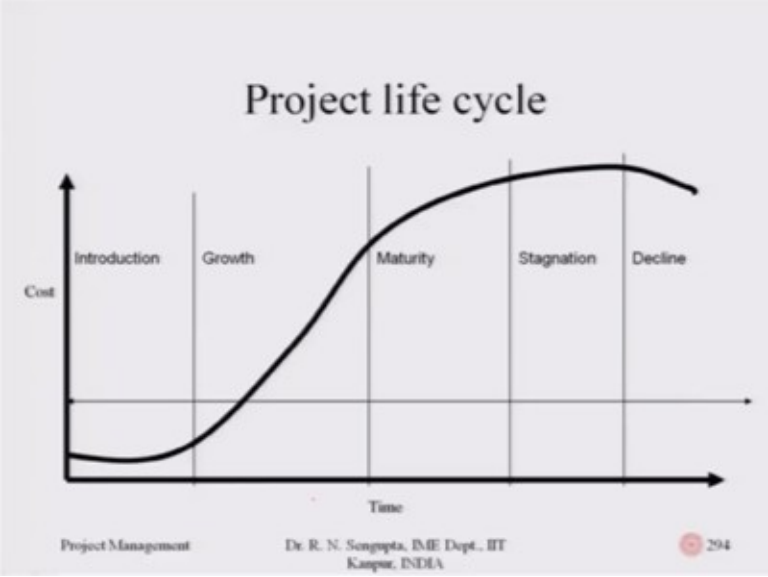

So if I consider the cost structure, considering the introduction the growth the maturity the stagnation and the neckline of the project then again you will see the overall characteristics of the curve is exactly the similar what you saw in two ninety third slide. So here the cost structure on the left hand side or the y axis is the cost there it was the cumulative cost so they are generally the one was the same, total cost cumulative cost whatever it is.

Here also it starts slowly and then exponentially rises then and the stagnation and the decline phase it starts decreasing. So the project life cycle basically consists of I will come to the project

life cycle in detail with one or two simple ideas and readings to be done. So project life cycle basically comes through concentration of the project the planning which needs to be done the execution part and the termination of the project

So basically if you have a big project which is one time like building a bridge, building a factory or trying to basically you rig the oil or end either in Gujarat basin or in north sea or in say for example Assam or you want to build a tank consider for the Indian army or you want to basically start of a school, it can be won as a standalone project or it can be a continuous project.

So they can be execution phase how you execute it and then once the work is done considering the overall the benefit of the project from the project point of view from the organization point of view, from the social point of view you will basically terminate the project and see overall cost structure the benefit of project has accrued to the society as such so with this I will end the twenty fourth lecture.

And continue in the discussion using the project life cycle and how the concepts are used in the twenty fifth and there are twenty sixth lectures onwards and then later on come to the concepts of GERT Q GERT and other things and in between if you remember I did mention I will do few problems in the area of trying to utilize the financial concepts trying to basically rang a project or try to find out what are the returns for the projects based on which you can take the decision. Have a nice day, thank you very much.