Project Management for Managers

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Lecture – 54
Cost Estimation

Good morning friends, as you are aware in previous session we were discussing about one of the important areas of project management and that was cost management and we have seen different processes of cost management, we have seen what is cost plan management, what is cost estimation cost budgeting and cost controlling. It is important for an organization to say one cost because there is saying that a penny saved is penny earned. So, if you save one cost then you would be in fact, putting much much less efforts rather than putting efforts in increasing sales. So, rather than increasing efforts on increasing sales you just put more and more efforts on decreasing cost or controlling cost because at the end of the day if you see then your profit would be more if you save one cost right.

So, it is an important area and the management of cost in many ways reflects the project organization strategic goals mission statement and business plan. So, you should control cost very carefully. We have already talked about what are different types of costs when we were talking about crashing of networks and we have broadly classified them as direct and indirect cost. Apart from this we have also seen that whenever you talk about cost of a product or a project then mainly you can classify them as direct labour, direct material, direct expenses and indirect labour indirect material indirect expenses right.

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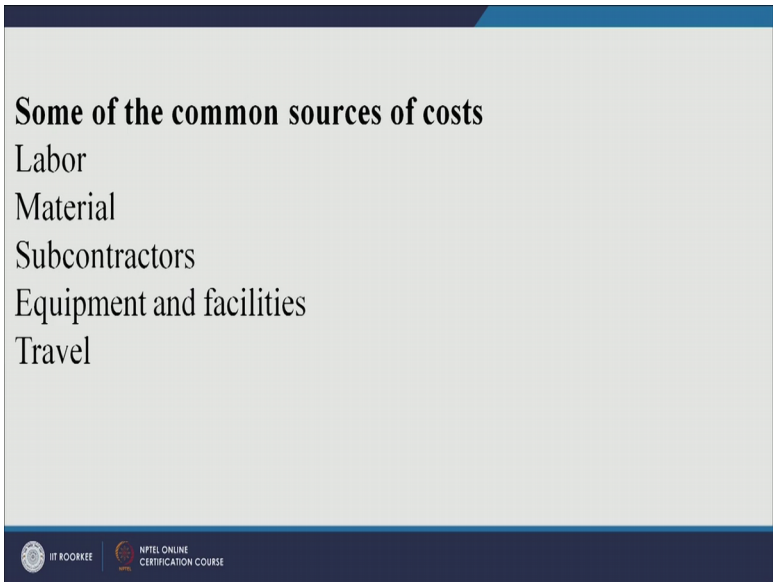

So, you can have different ways of classifying costs these are also some of the sources of costs though we have already seen labour and material. So, apart from these two sources you have got contractors equipment and facilities which you would be using to carry out your project travel and there are many more there are several cost right.

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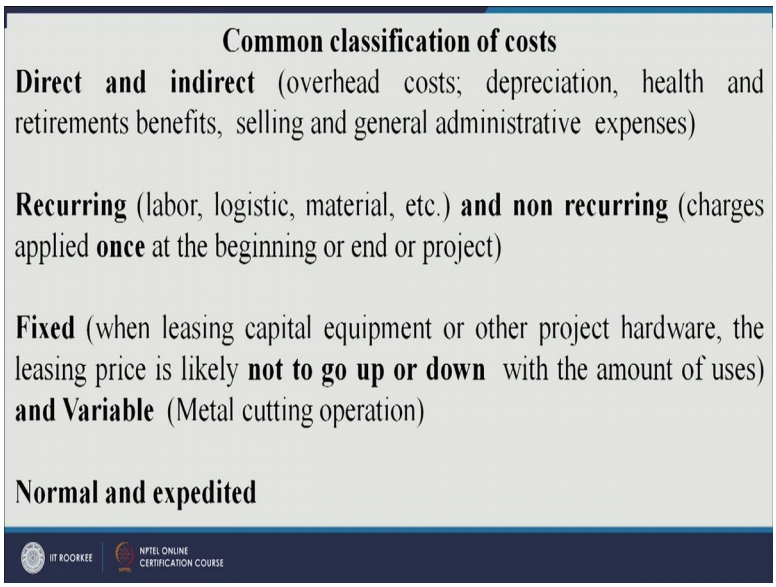

Let us look at some other classifications. So, we have already seen direct and indirect right let us look at one more classification it is recurring and non recurring cost. Recurring means which occurs after every month or after every 15 days or after every

year right. So, those cost are called recurring cost right and then we have got non recurring cost so those charges which you generally incur only once at the beginning of the project or at the end of the project right. So, non recurring cost do not reoccur right.

Then you can also classify cost as fixed cost versus variable cost when I say fixed cost means for example, in case of project management when you are leasing a capital equipment or other project hardware the leasing price is likely not to go up or down with the amount of usage right. So, if you have taken an equipment lease let us say for a month now it is up to you for how many hours per day you want to use or how many days in a month you want to use right even if you do not use that equipment you will have to pay lease amount right.

So, that amount remains fixed right then you have got variable cost. Variable cost are those cost which increases with the quantity right in, in fact, this is one more example here metal cutting operations. So, if you let us say cut more and more metal then you will have to incur more and more cost right. So, variable costs are those costs which vary with the output then you have got normal cost and expedited cost those cost which occur in regular manner they are called normal cost, but when you want to do some activity before its time then you need to put some more resources and you need to expedite things. So, the cost which you incurring expediting things those cost come under expedited costs right.

Costs	Type		Frequency		Adjustment		Schedule	
	Direct	Indirect	Recurring	Non-recurring	Fixed	Variable	Normal	Expedited
Direct labor								
Building lease								
Expedite costs								
Material								

Let us look at this table and this table you have got different cost you have got direct labour cost you have got building lease you have got expedite costs and material cost right. So, these are different costs and these are different categories right. So, you have got let us say direct and indirect you can classify them only basis of frequency – so recurring and non recurring whether it is fixed or variable and normal and expedited right. So, this is based on schedule this is based on adjustment these two are based on frequency and direct and indirect cost are based on type of cost right. So, if I ask you direct labour cost is what is it is it direct type or indirect type - it is its very simple right direct labour cost is direct type right is this recurring and non recurring, labour cost is recurring cost or non recurring cost, it is a recurring cost right we will have to pay to workers every month is it fixed or variable it is ok let us look at this is it normal or expedited of course, it is not expedited, so it is normal right.

So, you just click on in all this sales of this particular row as for as this cost is concerned what about building lease is this direct or indirect. What about recurring and non recurring just think for a minute and give me answer. Let us look at expedited cost. So, of course, this would be right here right, so expedited cost. So, expedited expedited cost is not normal right that is for sure right what about fixed and variability is it fixed or variable cost. So, you should be able to identify these costs into different you know classes right you should identify them and put in to different classes this is the answer. So, direct labour cost is recurring cost as I said it is fixed and it is also normal right as far as building lease is concerned it is indirect cost right.

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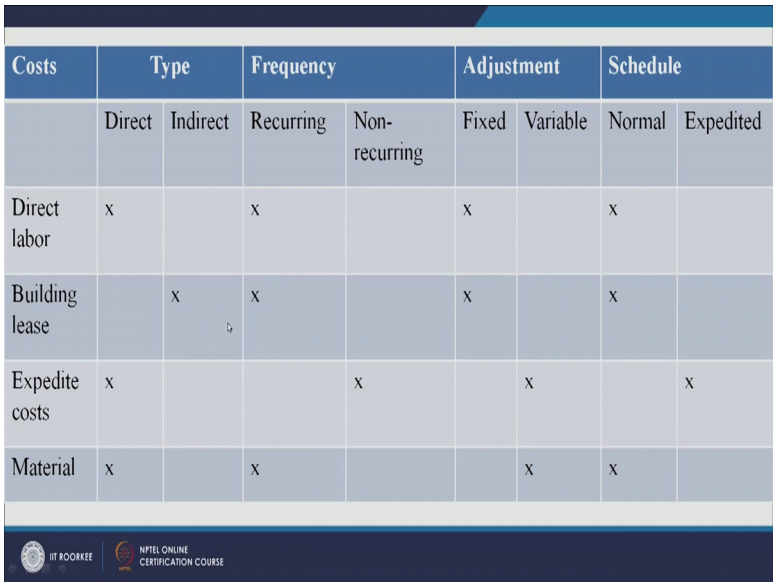

It is recurring it is fixed, but normal of course, expedite cost direct cost it is a non recurring type right because you will be expediting project just once right then it is variable it is expedited cost material cost is direct cost plus it is also recurring it is variable and it is normal right. So, you should be able to identify cost first and you should be able to put it in to appropriate classification.

Let us look at something called learning curves in cost estimation this is a another important point when I say learning curve I am trying to say whenever you do some work for the first time it takes lot of cost and it takes lot of time because you are doing it for the first time. Then you do it second time the time will reduced and cost will also reduced if you do it third time then time will for the reduced and cost will for the reduced right, so this known as learning curve or learning effect right.

So, let us take an example a time necessary to code a particular Software routine is estimated at twenty hours for the first time right.

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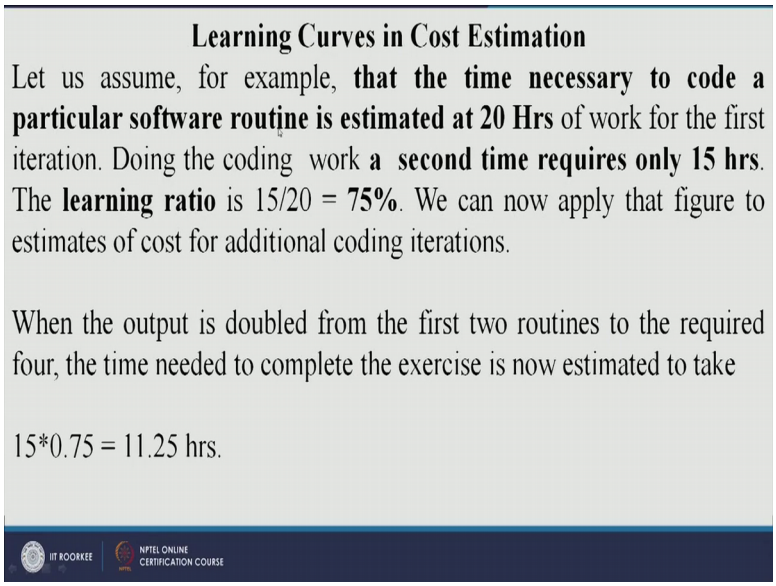

When you do the coding of the same software second time it requires only 15 hours. So, will say that you learning for the 75 percent or learning ratio is 70 percent right. We can apply that figure to estimate cost of additional coding iterations. In fact, we can not only know what would be the cost next time, but we can also know how much time it would be taking when we go for you know this coding of software third time right and so on right.

So, when the output is doubled from the first two routines to the required four the time needed to complete the excise is now estimated to take 11.25 hours. So, whatever is the learning ratio here you just multiply it by how much time it was taking second time right, its 0.75 into 15 hours. So, this is 11.25 hours next time what it would be because you know learning ratio its 0.75. So, just you multiply 11.25 and 0.75 you will get the time for next time when you are coding it right. So, this known as learning curve right.

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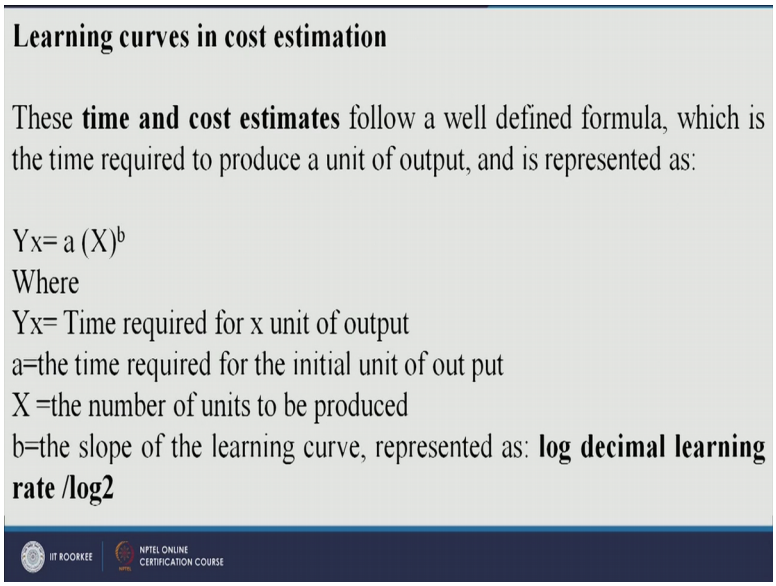

So, there is relationship between time and cost estimate and that that relationship follows a definite formula which is the time required to produce one unit of output and is represented as this right. So, Yx is equal to a into x to the power b. So, where Yx is what? Time required for x unit of output, Yx is time required for x unit of output and a is the time required for the initial unit of output means the time which you have taken to carry out an activity for the first time right, that is a x is the number of units to be produced how many units you want to produce right and b is the learning curve which is the ratio of log decimal learning rate and log two right.

So, let us look at an example and we will try to find out what is the value of a what is the time required for the initial unit of output. So, let us take this example.

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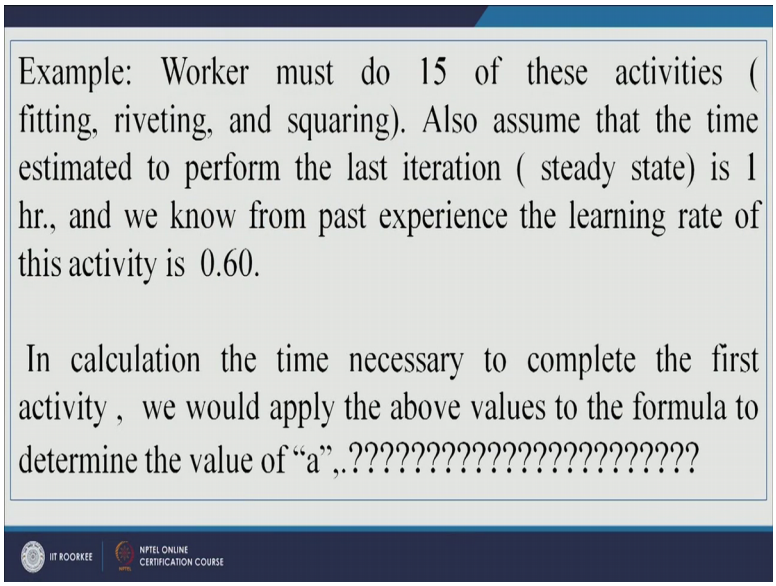

There is worker who has to do 15 activities let us say fitting riveting is squaring let us say welding soldering and so on right. So, 15 such activities are to be done by that worker. Also assume that the time estimated to perform the last iteration steady state is one hour. So, we have observe that the time it took in a steady state is one hour. Now we also know from the past experience that the learning ratio learning rate is, learning rate of activity is 0.6 or 60 percent.

Now we want to calculate how much time he will take to carry out the activity for the first time or how much time you would have taken to complete that activity for the first time. So, we want to determine value of a and what is a time required for the initial unit of output. So, can you solve this question just take some time and try to solve this question. So, first of all you should identify what information is there in the question right. So, we know learning rate is not it, we know a steady state time right and we know how many units are to be produce right.

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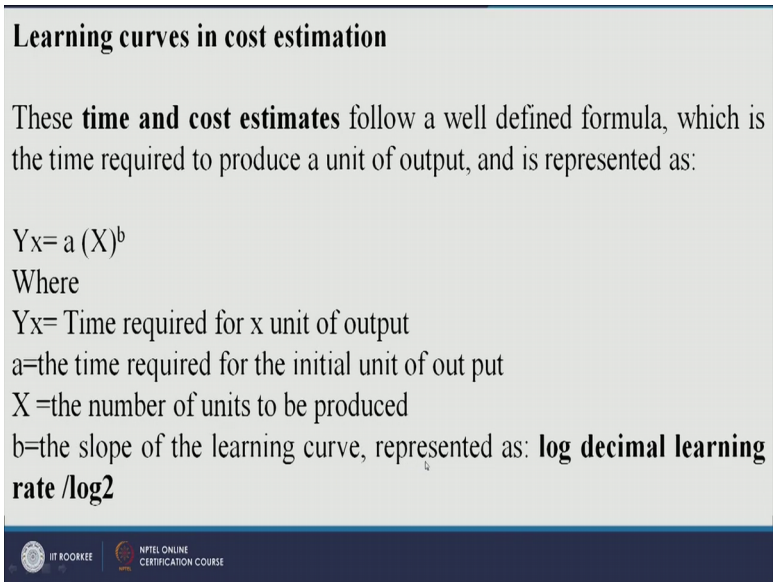

So, if you look at first of all in this formula try to find out value of b the slope of the learning curve this log decimal learning rate and log two right and take three out calculate the natural log right not just simple log. So, b value would is what it is.

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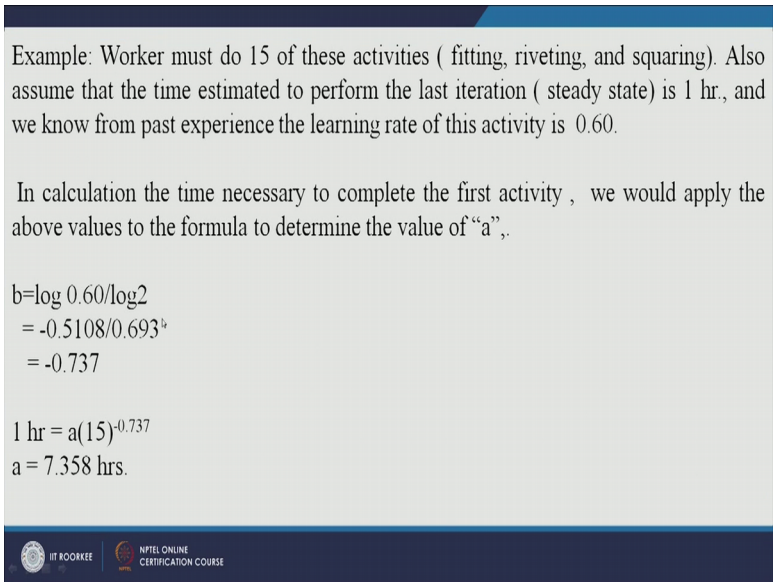

Is this - it is a 0.60 divided by this. So, you have to take natural log of this you will get minus 0.5108 divided by 0.69 and this value of b is minus 0.737 right. Now you need to calculate a and you have been given Yx right you have been given time required for x unit of output right. So, this is one is equal to a which is unknown this is x right what is x

x is number of units to be produced, x to the power of b which is minus 0.737. So, value of a is 7.37 8 hour it means the worker would have taken to complete that activity for the first time 7.35 8 hours right to this is an example on learning curve right.

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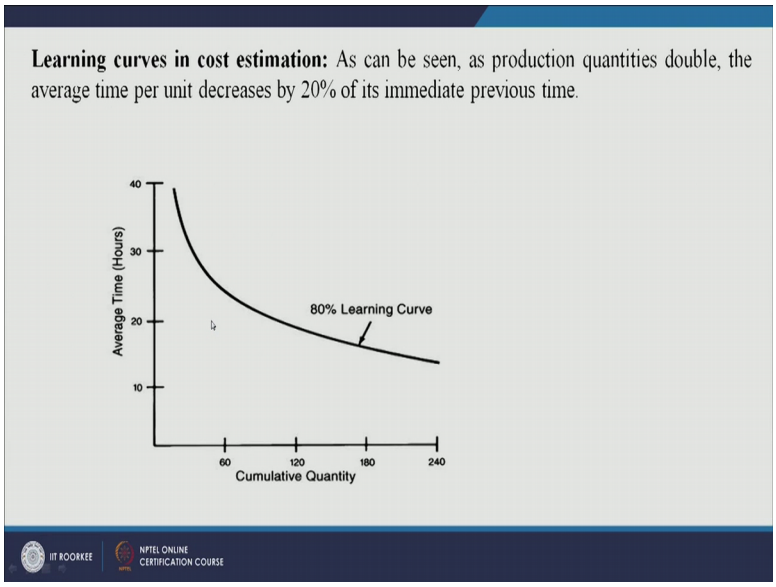

So, you can have different types of learning curves is sometime you have active person learning curve sometime you have 60 percent learning curves sometimes you have 40 percent learning curve and so on right. So, the point is whenever you do something for the first time let us say if you have got cost 100 rupees and time one hour when you do its second time cost might come to let us say 50 rupees and time might come to 30 minutes right. So, when you do it third time then again the cost and time will come down in that ratio right. So, this is an example on learning curve.

Now, let me tell you some more points related to project budget this is a very simple problem. So, there are different activities in a project you have got survey you have got design you have got clearing of site foundation framing plumbing and wiring. So, these are different direct costs and you have also been given budget overheads for each of these costs right. So, the total cost is you can simply calculate by adding these two columns right. So, this is your total cost column right.

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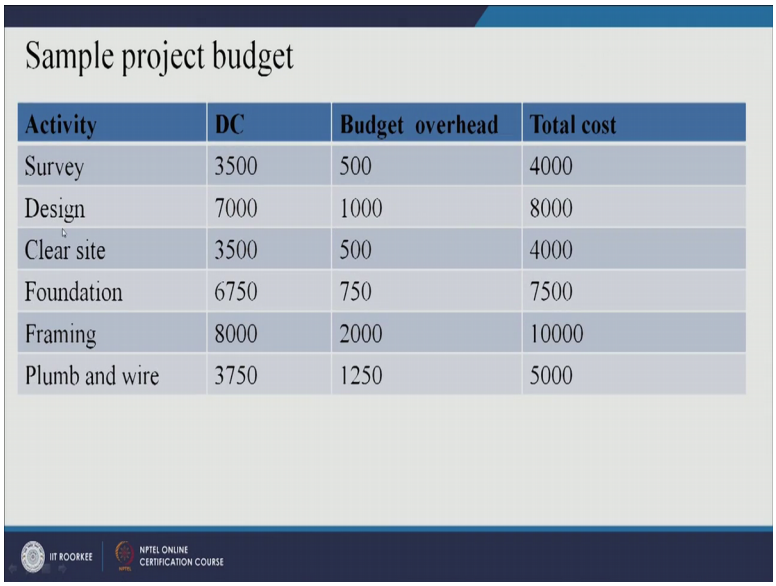

Sample budget taking planned and actual activity cost. So, the same same project different activities, these are different planned costs and these are actual costs. So, you have to find out variance right. So, variance is positive here right. So, there is a saving of 250 rupees right there is no saving here are you have just planned was this much, but actual is 3500. So, there is negative variance right similarly for all other activities right. So, you can have at the end of the day this is total variance which is positive right.

Let us look at example of time phased budgeting though I have already talked about time phased budgeting. So, these are different activities to the budget for activity survey in January is 4000 right. For design budget in February is this march is 3000, total 8000.

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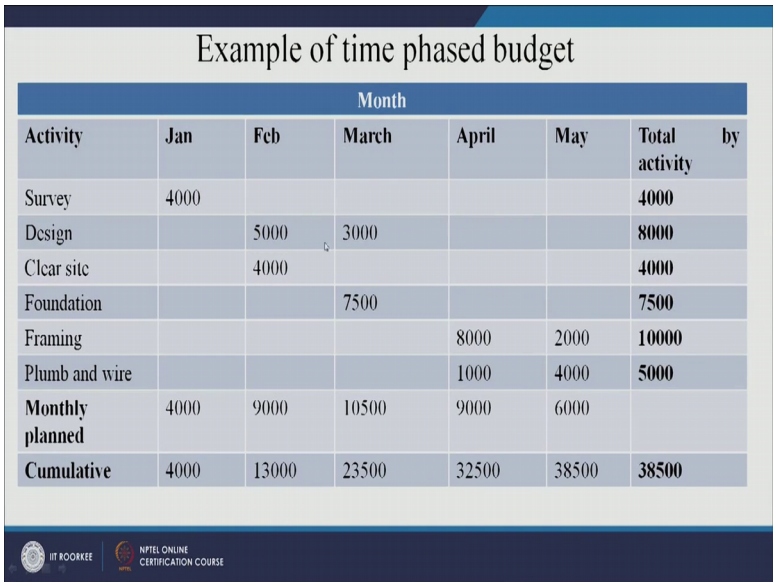

So, similarly for plumbing and wiring you have got 5000 right its total by activity rights the total budget by activity right. Similarly you have got monthly budget also for all the activities for January you have got 4000, for February 9000, for May 6000 right. So, you can have a cumulative budget right like this ok.

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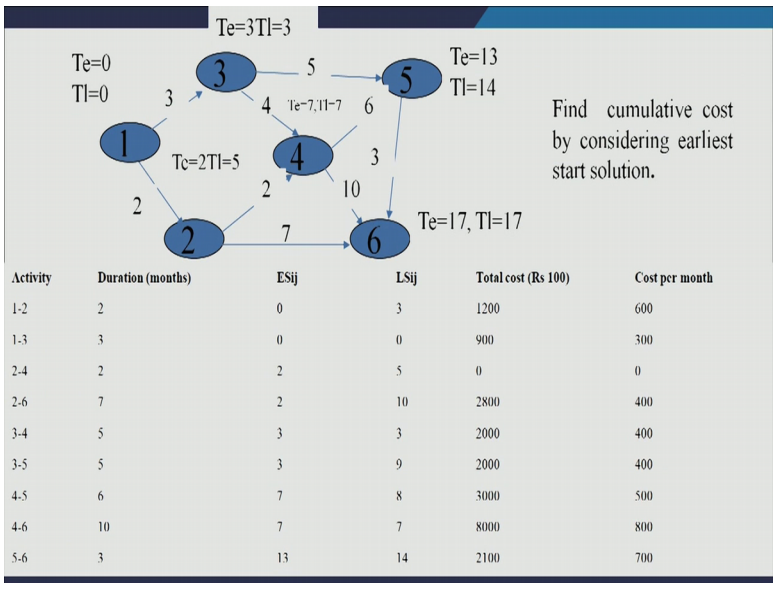

Now let us move on to very important point which we are going to talk about it is always said that you should complete the project in time right it is good to complete project in time, but there are people who would like to complete project before time. It is good to

complete project before time if you are getting some let us a bonus from your client right are if you are saving and resources then it is good to complete project in time. But if you do not want to complete project in time if you want to complete project in time if you do not want to complete it before time then it is also fine there is nothing wrong in completing project in time it is good that you complete project before time, but nothing wrong if you complete project in time right.

Now, when you complete project in time you can have different time estimates we have already discussed those time estimates. Let us look at a situation where it is advisable not to follow the earliest start time in a project, but try to follow latest completion time or latest start time right so that you can save some money I will tell you one very good example. So, let us take this network which is got six nodes and different activities. So, you have got a duration of activity 1 to 2 hours and for five six it is 3 hours and you have been given other time durations right. We want to find the cumulative cost by considering earliest start solution or earliest start time. So, find out what is earliest start at node one the earliest start is 0 earliest started node two is 2 right earliest started node three is 3.

So, you just calculate earliest start and latest completion time set all these nodes right. So, latest completion time at node number 6 is 17 right. So, you need to calculate Te in forward pass and Tl in backward pass right. Now in this project you have also been given some cost related information. So, for activity one two its duration is how much two days right its earliest start time is 0 right you can start is earliest 0 unit of time. So, for activity one two its latest start time is 3, how did you get this 3; activity one two you can a start as late as three unit of time how did you get this any idea? You know that at node two Tl is 5 Tl is what latest completion time right. So, whatever is your latest completion time if you subtract the duration of the activity you will get latest start time isnt it. So, this is 5 minus 2 is 3 very simple.

Let us look at this for activity 2 4 or let us look at 1 3 earliest start time of 1 3 is 0 right latest start would be got latest start would be Tl is here right 3 minus its duration. So, 0 similarly for activity let us look at this 4 6 what is earliest start of 4 6, 4 6 is here right. So, earliest start is 7; 4 6 earliest start is 7 right latest start is latest start is what the latest completion time minus duration of the activity right it will give you latest start time. So,

17 minus 10 is 7. So, this is latest start time. So, in this way you can calculate earliest start time and latest start time for all the activities right.

Now let us look at the cost related information here activity one two is taking total cost of rupees 1200 right and its duration is two it means a cost per month is 600 right. So, all these durations having months right not in days. So, for activity 1 2 the total cost is 1200 and its duration is 2 months. So, cost per month is 600 very simple. For activity 1 3 its duration is 3 months cost is 900 for 3 months. So, cost per month is how much 300 right. Similarly for let us look at this 5 6 total duration is 3 days total cost is 2100 cost per month is this divided by 3 right.

Now I know that the I have to complete this project is 17 days right if I start all these activities are there earliest times then I will complete this project in 17 days and I will be incurring this much cost right for each activities I can you know do the cumulative cost analysis here right. So, I let us look at what is the output or what is the out lay on very positive for this project. What you are doing? For activity 1 2 its duration is 2 days right and sorry 2 months right its duration is 2 months. So, first month what is your expenditure 600 right. So, just look at this.

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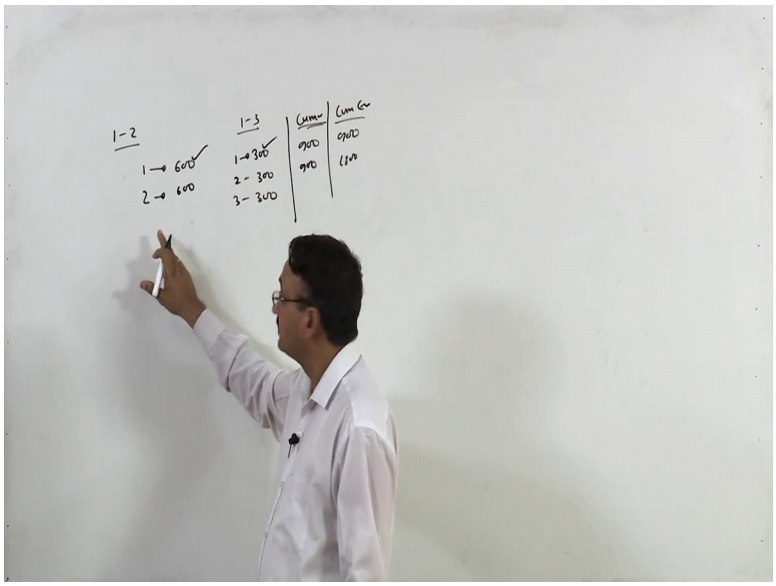

So, for activity 1 2 first month what is the expenditure 600 right similarly on in second month what is the expenditure for activity 1 2 also 600 right. What about activity 1 3 what is the expenditure for activity 1 3 on first day sorry in first month? It is 300 right

isn't it, similarly second month for activity 1 2 300 for third month also 300 right. Now if I want to know what is the cumulative, cumulative expenditure for this particular project and first day sorry an in first month it would be this and this 900 isn't it. Then what would be the total expenditure in second month for these two activities again 900 isn't it and cumulative expenditure would be cumulative expenditure would be 900 then it is 1800 right. Similarly, you need to do it for all other activities right.

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Day	1-2	1-3	2-4	2-6	3-4	3-5	4-5	4-6	5-6	Cum Cost
1	600	300								900
2	600	300								1800
3		300	0	400						2500
4			0	400	500	400				3800
5				400	500	400				5100
6				400	500	400				6400
7				400	500	400				7700
8				400		400	500	800		9800
9				400			500	800		11500
10							500	800		12800
11							500	800		14100
12							500	800		15400
13							500	800		16700
14								800	700	18200
15								800	700	19700
16								800	700	21200
17								800		22000

Let me show you how to do this right. So, for activity 1 2 these are expenditures in this is not day this month right in doesn't matter whether it is day months or year isn't it. So, so first two months first month this is output are this is your k shout flow are expenditure whatever you call it this is for second month right this is for activity 1 3. So, its duration is three days right. So, on very first day the total cumulative cost is 900 second month or second day it is 1800 and so on right if you look at activity 2 4; 2 4; 2 4 its cost is 0. So, that is why this is 0 right for activity 2 6; 2 6 its earliest start is what for activity 2 6 earliest start is two and its duration is two it means on third and fourth day for activity 2 6; 2 6 is this right yeah.

So, its duration is 7 days right. So, on third fourth fifth sixth seventh eighth and ninth day just see this third fourth fifth sixth seventh eighth and ninth day. So, this is your cost right. So, if you take this cumulative cost then this is cumulative cost is 22000, 22000 rupees right. So, this is the total cost for 17 days if you consider earliest start time. Let us

look at what will happen if you look at latest start time rather than earliest start time. So, we will take this same example and we will find out cumulative cost by considering latest start time latest start time means we will look at this particular column not at this particular column.

So, for activity 1 2 I know its duration is 2 for activity 1 2 its latest start time its latest start time is 3 right. So, you just for activity 1 2 you just start from here right fifth day and fourth day because you have to complete it by fifth day. So, why it is start at first and second day why to go for earliest start time right why you are doing this on fifth and fourth day because you can save a cost because here in this case the total cumulative cost in first month or in on first day it is 300 only while earlier it was just see 900.

So, let us say if you are taking let us say loan every month then you can say at least on interest isn't it. So, it is sometimes good to schedule your activities according to latest start time rather than earliest start time, but keep in mind that when you go for second option latest start time then you do not have any slake or any float right you must have to complete and those activities and latest completion time period right. So, this is the case in this is the to cumulative cost in case of latest start time I will tell you how to do it for let us say activity 5 6 right.

So, activity 5 6 is this latest start time is 17 right. So, start from 17th day and move on 16th and 15 15th day right because it is duration is three. So, 17 16 and 15 just see for activity 5 6, activity 5 6 just see this is 17th day 16th day and 15th day. Similarly for 4 6 you just start from latest start time right. So, at the end of the day if you look at the total cumulative cost remains same, but what you can save is you can save on at least on interest because on first day the total out flow is 300 in this case in earlier case it was 900.

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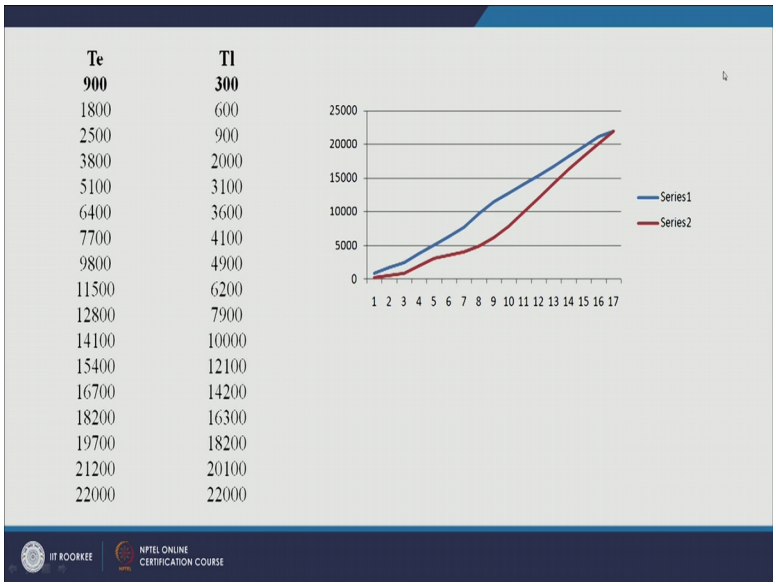

So, if you look at the these two cost curves, cumulative cost curves by earliest start time and latest completion time just see if you go by earliest start time then this is the cost out flow right or these are the expenditures. And if you go by latest start this is the expenditure. But at the end of this at the end of the day you will have total cost as 22000 in both the cases.

So, with this let me stop here and we will start a new area in next session.

Thank you very much.