Project Management: Planning, Execution, Evaluation and Control

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Week- 06

Lecture- 26

Welcome to the course Project Management. In this lecture, we will be solving some numerical to demonstrate how to reduce project duration. The concepts that will be covered in this lectures are the reducing project duration to reduce project cost will be solving numerical as I have already told. So, this is the problem you just go through it we have to solve this problem. The problem says assume the network and data that follow that is given here compute the total direct cost for each project duration. If the indirect cost of each project durations is 400 dollar for 19-time units, 350 for 18-time units, 300 for 17-time units and 250 for 16-time units compute the total project cost for each duration.

Then plot the total direct indirect and project cost for each of this graph. What is the optimum cost time schedule for the project? What is this cost? So, we have to find out all this. Now to start with what we do? We have to first do the this is the your activities are given A, B, C, D, E, F, G. This is the normal this is the direct cost say normal time normal time and cost.

Here it is given your crash time and crash cost. So, we have to first find out what is your the maximum crash time that is delta t like normal time minus crash time is the crash timing and the slope we have to find out slope. Slope is what we have found the slope is this crash cost minus normal cost divided by this normal time by minus crash time. So, we know we have done in the last lecture what we have done we have to find out the this cost slope. Cost slopes will be if I do it will be like this.

What is the formula for the cost slope? We have found the cost slope equal to what that your cost the crash cost minus cost of normal cost of normal cost divided by time normal time minus crash time. This is the cost slope. So, what is the crash maximum crash time? Crash time is the normal time minus crash time 3 minus 2 it is 1 and what is the cost this thing 70 that is crash cost minus normal cost divided by. So, it will be what normal cost by it will be say a 70 minus 50 divided by 3 minus 2 is coming 20. So, crash cost is this is not the slope is 20.

Similarly, for B, B what is the thing? This is 2 5 minus 3 2 60 minus 180. So, it is become 120 120 by 2 is 60 then this is 3 minus 2 1 crash it can be crashed by 1 day and 70 minus 120 it is 40 divided by 1 x is 40 this is 10 minus 10 0 and this is 50 0. So, it cannot be crashed activity D cannot be crashed. So, that is why it has been marked as that cross it cannot be crashed. So, then E can be crashed by 3 days 6 minus 3 and 250 150 by 3 is 50 cost slope this is can be crashed by 3 days and 390 minus 90 it is 300 by 3 this cost slope is 100 then G is can be crashed by 1 day and this is 70 by this is becoming 70.

So, first what you do first you have to find out your maximum crash time and the you find out the slope also you find out have to find out what is the critical path they say A B E G what is the A B A there are A B E G how much A B E G how much time it takes 3 plus 5 8 8 plus 6 14 14 plus 5 19 19 say time units or days you put it then next one is A C F G it is a another A C F G what is this time 3 plus 3 6 plus 7 say 6 plus 7 13 plus 5 18 it is 18 days then A D G another is the A D G how much is it 3 plus 10 13 plus 5 18. So, which is the critical path critical path is A D E G this is the critical path and it takes 19 days. So, 19 days is the this is the critical path 19 days we have found out now if you go further now just to see what we have done this is also same know this is same now we will be crashing the problem now you look at it the three is you have to find out what is your direct cost and indirect cost indirect cost indirect costs are given in the problem it is 19 time units 400 350 18 time units 300 this these are the indirect cost now how do you find out the direct cost direct cost you have to find out direct cost are the summations of all activities normal cost of all activities you that is direct cost is the direct cost direct cost equal to sum of activity activities sum activities of activities normal cost. So, you sum these activities normal cost you when you sum it up how what you are getting you are getting some summations of these are it is dollar 470 470 is the direct cost. So, we got it now we will be going for crashing the project.

So, what we found out this is we have already got it know these are the activity id this maximum crash times are given and slope we have found out and also, we have found out the direct cost direct cost we have found out what equal to sum total of activities normal cost normal cost and for this problem it is 470 dollar. Now how to crash it now we have also have found out your critical path we have found out what a b e g is the critical path a b e g is the critical path which takes duration 19 days this is the critical path we have found it out in the last slide. So, in the last slide we have found out a b e g is the critical path this is the critical path and these are the direct cost we found out and indirect cost are given here. Now to crash what we do we take activities from the critical path because if the critical path is crashed then only the project duration will crash otherwise the project will not crash. So, the activities on critical path have 0 slack.

So, a b e g these are the critical activities which activities you will choose we will choose the least cost slope with a is 20 b is 60 cost slope e is e is 50 g is 70. So, which one will choose we will choose a because a is the least means you direct cost if you reduce by this if you reduce one day your direct cost of the project will increase by only 20 not 60 and all. So, we do it here. So, it becomes 2 3 we do it one day because it can only be crashed one day. So, when we crash one day it cannot be crashed further.

So, now, we make a table here we put it duration this is the duration then the we put direct cost then the indirect cost ok, then the total cost then the activity crashed we make a table. The durations of the project are critical path is 19 days 19 days. So, direct cost is what direct cost is the activities of the total activity direct cost is activities normal cost. So, it is we have found out the 470 direct cost for 19 days is 470 dollar. Now, the indirect cost is what indirect cost in the problem is given how much it was given 400 know we have seen it this indirect cost you just remember for each project 400 for 19-time units then it comes down to 350 for 18-time units.

So, 50 dollar it is decreasing 300 250 it is decreasing. So, what we find out indirect cost for 19-time units is how much 400. So, total cost comes down 400 plus direct plus indirect cost is the total cost the direct cost if it is an indirect cost is B total cost is A plus B we all know that ok. So, 870 activity we have not crashed any activity. Now, we have crashed we wanted to make 18 days for that we have crashed A because A is the least slope.

So, what is will be the direct cost? Direct cost will be 470 plus 20 because when you are reducing the one day it will be increased by 20. So, what is the indirect cost? Indirect cost for 18 days we have found out from that it is given is 350 it is reducing by 50 dollar. So, what is the total cost A plus B 490 plus 350 it is 840 40. So, what do you do? We activity crashed is A 20 we did it 20 is the cost slope. Now, the so now we have to crash one more day.

So, when this was the A was common to all 3 paths. So, the ABEG which one is the critical path ABEG remains critical path it is now 18 days and this ACFG becomes 17 days because it has reduced by 1. So, and ADG is also become 17 days. So, ABEG remains the critical path. So, to crash it further for 17 days then which one you will which activity you will take there are critical path ABEG remains.

So, you will have to have to select one candidate from BEG. Now, which one is you will choose B is which one has the least cost slope B is 60 then E is E is 50 G is 70. So, which

one you will choose BEG. So, so 17 which one you will choose that B 60 E is 50 E is the least.

So, we will choose E. So, it is become 470 plus what is the E is 50 plus 50 it is the least. So, this indirect cost is 300. So, how much it becomes 470 plus 50 5 20 490 this is 490 sorry 490 plus 50 540 plus 300 this is 840. So, what do you do we did E by 50 E we have crashed no we have crashed E. Now, E has been E can be crashed 3 days no.

So, we have crashed E to 5 days. So, still E can be crashed another 2 days. So, now, see which one is the critical path now if you see the critical path is 2 plus 5 7 plus 5 12 plus 5 17 this is also 2 plus 3 5 7 12 this is also 5 17 this is 2 plus 10 12 plus all 3 are critical path. Now, all 3 are critical path now to make it 16 days further this is 490 no 16 days we have to which one we have that we have to take one activity from each path otherwise if you take only one path other activity will become the critical other path will become the critical path. So, you have to do 2 or 3 iterations for.

So, E is say then B and E is the least. So, you choose here if we choose E then C and F C F G C is 40 F is 100. So, you have to choose C. So, is 40 only and D cannot be crashed. So, for A D G Only G can be G you have to choose G now.

So, this is 50 plus this is for 40 E and E and C is 40 50 plus 40 90. Now, if you see G is only 70 and G is common to all 3 paths the A B E G A C F G A D G is common to all it will cost only 70 and if you do E and C it will together it will take 40 50 plus 40 90. So, we choose G this is 540 plus 250 indirect cost. So, we choose what G. So, what is becomes 540 plus 250 is 250 no G is 70 540 plus 70 you are crashing G is 70 plus 250 it becomes 860 here we do G by 70.

So, see this has again gone up. So, what we do the 17 days they say both 18 and 17 days are having only 840, but as a manager 18 days also cost 840 17 days also cost 840. So, which one you will take you must take the maximum crashing. So, 17 days it will 840 then again 16 days it is going up. So, so, so, so, it is going up means you can see a control T going up means here you have this this point you have reached when you further this is the 17 days this point you have reached that if you go further crashing this is 16 days it became 860 from 840 to 860 it is it will increase.

So, you have reached this optimum project duration time that is 18 17 days. So, we have reached here. So, this is this is that the problem there you can do answer is what you can do it by 17 days optimum. So, now optimum so, control optimum thing you have reached it is the answer for your problem is 17 days and the cost is 840 dollar and remember whenever you are finding out you must go one step beyond the beyond the that optimum things otherwise you will not be knowing which one is the optimum it will again go up. So, we have solved this problem I think you have the knowledge the concept will be is cleared for the crashing now.

Now, we will be solving one more problem then let us go through this problem we will be solving this problem two go through the problem ye what does this problem says this problem says that if the indirect cost if each durations are 500 dollar for 25 days these are indirect 450 for 24 days 400 for 23 days 350 for 22 days 300 for 21 days and 250 for 20 days it is coming 50 dollar per day overhead cost is coming down. What does it say compute the total cost for each duration what is the optimum cost time schedule of the project network whose details are given below ok? This is also it is activity A B C D E F is given what you have given normal time and cost has been given crash time and cost has been given. So, what you have to do we have to find out maximum crash time and slope and this is the diagram it has been given. So, we have to do that now find out the slope and the critical path first what is the slope the slope how can you find it out you can find out the slope this will be how much 3 minus 2 maximum crash time is here sorry maximum crash time here is 3 minus 2 1 this is 2 this is 10 minus 9 1 11 minus 7 4 this is 2 8 minus 6 this is 1 this is 0 because it cannot be crashed crash time equal to the normal time.

Now you have to find out slope 70 minus 50 by it is 20 160 80 by 4 80 by 4 is 2 no not 4 this is 80 by 2 it is 40 this is 90 minus 60 30 30 by 1 this is 150 that is 100 by 4 25 this is 160 60 by 2 80 a 30 60 by this is 60 by 2 it is ye 30 this is 30 minus 30 by 1 30 and this is 0 we have find found out that. So, let us let us so, we have found out at 20 40 30 25 30 30. So, this is same now we have to find what we have to do we have to find out the critical path which is the critical path. So, let us find it out C p is a b e g how much is that 3 plus 6 9 9 plus 8 9 plus 8 is 17 plus 6. So, plus 6 23 days then a c f g how much is it is becoming 24 days then a d f g it is becoming 25 days.

So, which is the critical path critical path is a d f g this is the critical path ok. So, we have found out a d f g is critical path now we have to choose the one now let us go to the yeah. So, critical path we have found out a d a d f g knows a d f g C p equal to a d f g and it takes 25 days hm it takes 25 days ok. Now, we have to so, we have to crash from a d f g now we have to find out the direct cost what is the direct cost for this we have to find out from here direct cost is how much is the direct cost direct cost equal to sum total of this normal cost. So, normal cost sum total of normal cost is coming how much 450 hm 450 dollar.

So, direct cost we got 450 ok direct cost 450 dollar and indirect cost we got it we have got. So, now, we have to make out that table duration then direct cost indirect cost total cost in activity crashed ok. Now, 25 duration is 25 days that is the critical path direct cost was 450 indirect cost is given 500. So, total cost becomes 950 no activity crashed now we will crash one day it is always better you do 1 by 1 1. So, which one we will take a d f g a d f g which one is the least a is 20 d is 25 f is 30 g cannot be g cannot be crashed.

So, we make a because it is 0 maximum crash time 0 it cannot be. So, a d f so, which one is the least a is least. So, we crash a by 1 day with then it cannot be crashed further because it can only be crashed 1 day. So, what will be your direct cost 450 plus 20 470 indirect cost is given as 450 then what is your total cost becomes 920 what did you crash a and cost log 20. Now, which one is the critical path this critical path is say this is a was common to all 3.

So, the critical path remains the same a d f g remains the critical path because 1 day has been reduced from all. So, 23 days which one you will this is 470 plus d f d f are the candidate which one you will choose d is the 25-day cost slope f is 30. So, we will choose do so, d can be can be crashed 4 days. So, we crash it by 1 day you always better you do 1 day because if you do more than 1 day you will become the other path will become also critical path 470 plus how much 20 20 25 25 d this is 400.

So, this is 25 25. So, how much it becomes 4 4 95 plus 400 it will become 8 95 what did you crash we crashed how d 25 ok then. So, d has been done now which one is the critical path if you see 2 plus 10 12 12 plus 5 17 17 plus 6 23 this is also 23 2 plus 6 8 8 8 16 16 plus 6 22 2 plus 6 8 8 6 8 8 16 plus 6 22 this is 2 plus 10 12 12 plus 5 17 this is 6 17 plus 6. So, 23 then no here we have this is 23 this is this is also now this this a d f g remains the critical path. So, now, which one you will choose that d f the no this is also critical path 2 plus 10 12 12 plus 5 17 plus 6 23. So, there are 2 critical path now that is a d f g a c f g both are critical path now.

So, you have to take one candidate from each. So, but which one say c f and d f d f d is how much d is 25 c is how much c is 30. So, but f is the common for both. So, f is how much 30 only and if you take c and d the you have to take one from each c is becoming 30 and d is the d is 25 it will become 30 plus 25 55. So, we will choose f is the common to both. So, how much there its f can be done by one day.

So, it will become 4 days it cannot be further reduced. So, 22 days it will become. So, it will become 4 95 plus 20 not 20 f is 30 plus 30 plus 30 and these will become 350. So, how much it is becoming 875 what did you crash f by 30 we have crashed.

So, you see this cannot be crashed now. So, now, which one is the critical path now all 3 has become critical path this is say how many days 2 plus 10 12 plus 4 16 plus 6 22 this also is 22 and a b e g is also 22. So, to further crash what you have to do you have to have to take one from each. So, what so b and e which one is having list b is 40 e is 30. So, we will choose e can be done one day. So, it can be do then this a c f cannot be only a c is there c can be done by one day we will choose that and d can be also can be done by another 3 days.

So, we have to choose we are choosing this 3 activities e c d then 21 days how much it will become 525 plus e is how much 30 plus then c is how much c is a 30 plus d is 25. So, it becomes how much it becomes 610 and this is 300. So, 610 plus 300 how much it is 910 it is increasing. So, what did we do e by 30 we crashed then c by 30 we crashed then d by 25 we crashed.

So, you can say it is again increasing. So, we can found the optimum duration is 22 days and the cost are 875 this is the. So, duration is 22 days and the this cost is cost is 875. So, we have got it since it has increased you can see we have reached this point here that is 22 days and it is 875 further doing it is further reducing it is going up. So, we have reached the critical that the optimum project durations for the problem. So, this is all for the and now generally I get questions from the students why do you do all one each from each path why do not you do.

Suppose if you do not do it what happens once you only you do e then it crashes by 7 then these two becomes critical path in the next iterations you have to again crash c because c remains 22 this becomes 21 this become 22. So, you have to crash once. So, then again you have to crash another iteration d. So, all these are being done in one iterations here if you choose 3 ok. So, we have seen the now you can solve this problem by yourself.

Now to conclude in whatever we have learnt in the earlier lectures in this session we solved few numerical to explain and to demonstrate how to crash activities and reduce the project durations these are the references books you have you must go through it and solve some problem enhance the knowledge and thank you very much for attending today's lecture.