Network Analysis for Mines and Mineral Engineering
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Lecture – 03
Construction of Network

Let me welcome you to the third lecture of Swayam NPTEL online certification course of Network Analysis for Mines and Mineral engineering.

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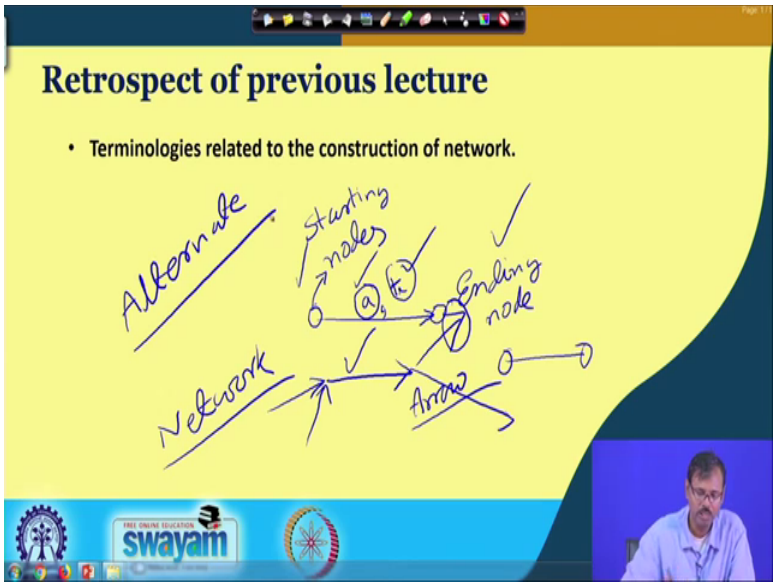

So, in last lecture we have discussed about the terminology related to the construction of network and that there we have discussed that a job or activity is defined with a number and with some arrow sign, which is limited with the circle at it starts and at its end which is called these are called nodes ok. So, this is basically starting node this is ending node and the activity or job or whichever it is.

It is denoted as the sign a or it may be a termed as a it may be small a it may be capital A it may be b c d whichever it is. And we mention its time of duration say t ok. So, basically by this way we represent a job and the project graph which is constructed comprising this job; that means, the complete work process is represent in a graph which is which comprising this different unit activities of different jobs. So, basically a project graph or network is a combination of a number of job.

So, basically will discussed how to construct a network in this lecture, but before that we are retrospective what we have learnt in the previous lecture. So, we know that arrow is basically representing a job it is must having an initial or starting node. Must have some ending node and it should have a fixed duration which is mentioned in this way; that means, there is a an arrow on that arrow we present the name of the job at the duration of the job ok.

This is essentially required do not forget this arrow is essentially, if you do not put the arrow if you put a line then this line cannot represent the job because we do not know which one will be the starting node and which one will be the ending node. So, arrow must be there and there must be a starting node and there must be an ending node so that we can represent the whatever are the previous jobs require to be completed prior of start this job and what are the successor jobs can be started after the completion of this job.

So, that is why this arrow is very very important. So, anytime if you are representing a job in terms of arrow that in arrow diagram then in that case the arrow must be there, a line cannot be accepted in the arrow diagram or the in the network as representative of a job. There are other way to define a job, we can in terms of alternate also we may define a job in this network analysis on the graph.

So, let us continue how we will start the how we will start the network.

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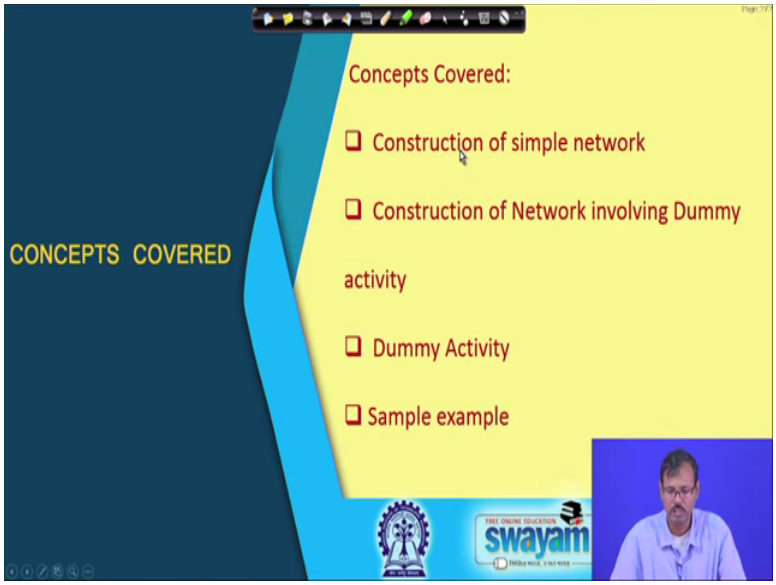

So, in this lecture the concept cover is construction of simple network, construction of network involving dummy activities and what are the dummy activities will learn and the sample example will be covered in this lecture.

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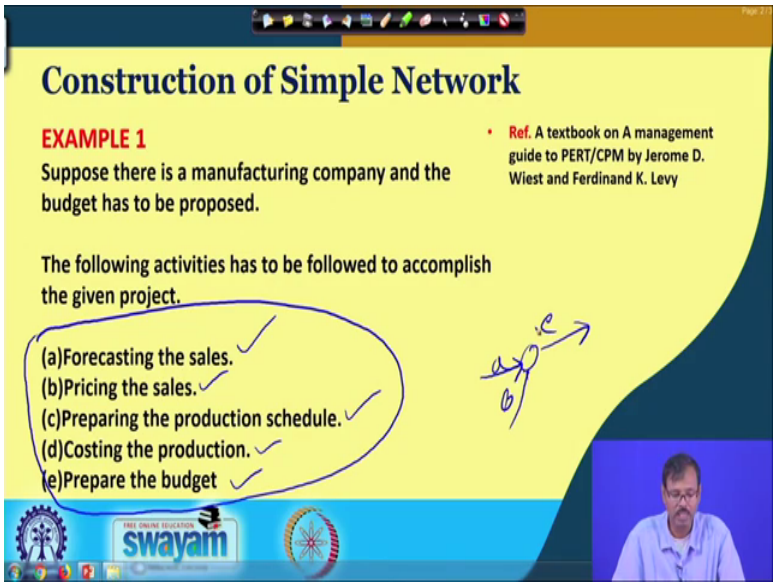

So, let us start the construction of network with a very very simply example ok. So, this example is taken from the book of Wiest and Levy, you can follow that book for this example also. So, what is there what is there in this example? Suppose a company is willing to schedule some production for selling those products into the market. So, what is the requirement that company manufacturing company need to be a carried out.

So, the those jobs are listed here forecasting of the sales, pricing the sales, preparing the production schedule, costing the production and preparing the budget. That means, the company carried out the analysis and found, what is the market available in which the company can sell its product that means, the sales possible sales are forecasted fast, then the pricing is carried out that what should be the price for achieving that one that production target the production scheduling has been carried out.

Then the as production is scheduled then the cost of production is calculated and based on that the budget is prepared, basically this portion is very very important where a person is defining which job has to be carried out fast and based on the result of the job the which job can be started.

So, basically construction of network is not that much problematic because once predecessors and successors are fixed then it is very easy for a person or it may be very easy for a labour also to construct the network, because you have to put the arrow diagram. If you know a is before c then you can place it like this, a is before c if you know a and b both are required before c then you can place it like this a and b before c. So, this part is very easy, but to know whether a is required before c or b is required before c this is very very important.

So, basically the person who is having very good technical idea or who is very very having vivid knowledge about the things about the complete process he can only make this fixing of which one job will be the predecessors and which one will be the successors.

So, basically this is the essential requirement where one can fix, one can fix which one is which one will be the predecessors and which one will be the successor.

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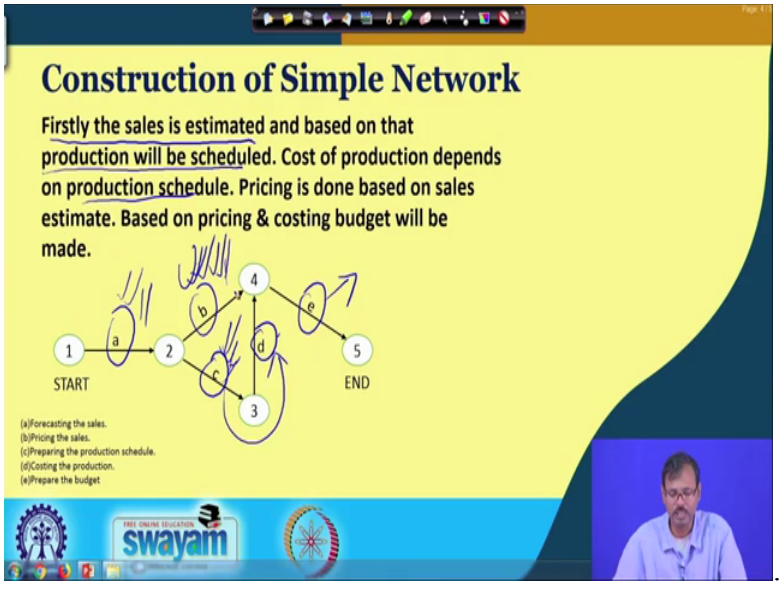

So, as we have discussed let us see the first the sales has to be estimated, the first job is that we have to estimate the sale what quantity of sale can be made; that means, we are having some good idea about the market situation and based on that only we can schedule the production target.

Similarly, cost of production depends on the production schedule and pricing we can fix as considering the sale requirement. So that means, estimation of sale from which we can independently decide what will be the price and we can schedule the production considering the sales requirement. Let me give you some example suppose, you are the manufacturer of the cap of the cold drinks bottles.

Now, see it is having seasonal demand, in summer time the requirement is more, in winter time the requirement will be less. So, basically you are estimating the production scheduling based on the sales estimation, which is carried out by your market survey or something like that, you estimate a based on that you schedule your production at c at which month how much cold drinks bottle cap will be manufacturer.

Second one is that the price what will be the price in which you can sale, from that also you are estimating the sale you are similar simultaneously you are getting the market price of the product of that product and based on that your finding the possible pricing of that is possible in the winter time is this one in the summer time is this one.

So, these are the two jobs which are which you can carry out if you know the result of this sale estimation, from these two you can do this one these basically gives us the cost of production.

That means suppose we are running few machines for producing the cold drinks cap and this is the schedule, based on the schedule our pricing costing of that production depends because the more the production rate the cost will be in general reduce. So, when in the summer time your production cost will be less than the winter time because in winter time your fixed cost will be fixed, but only the variable cost will be differing. So, that is why your pricing per unit will be more.

And finally, we are coming to e that is the preparation of budget when we are preparing the budget to accommodate this profit which we are getting from b and d from which we are getting the profit based on that we are preparing the budget how we can carry out or total process.

So, basically this is the way the logically one person has to think that how it can be processed. So, based on this we can easily write at this position that the jobs a table, where we can write the jobs predecessors successors.

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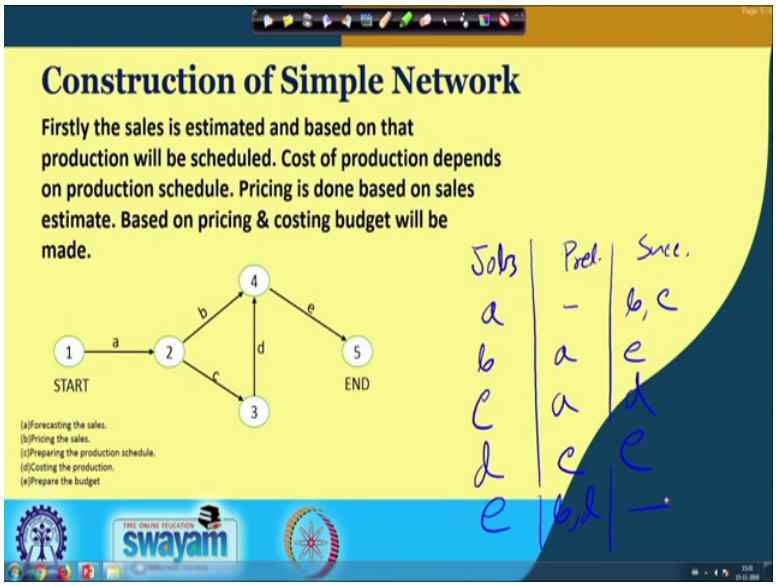

So, the starting job is a, does not have any predecessor and that is succeeding job b and job c. Similarly we can write job b which is having a successors a and predecessors of sorry predecessors of a and successors of e. Similarly we can have c job which is having predecessors a, successors d and we can have job d which is having predecessor c and successors e and finally, we are having job e which is having predecessors b and d and successors is none because that is the ending process.

So, basically this is the requirement where we are preparing a table which gives us the idea that sales estimation is the first job, then the second job the pricing of the sales can be carried out based on the sales estimation. So, it must be predecessors and using the pricing we can go for the budget. So, the successors is the budget, similarly the job c has the predecessors requirements sales estimation. Job d has the predecessor estimation requirement of the production scheduling and job e which is the budget requirement is requiring the b and d both the job as the predecessor.

So, this table can be prepared based on this and from there we can finally, draw this network.

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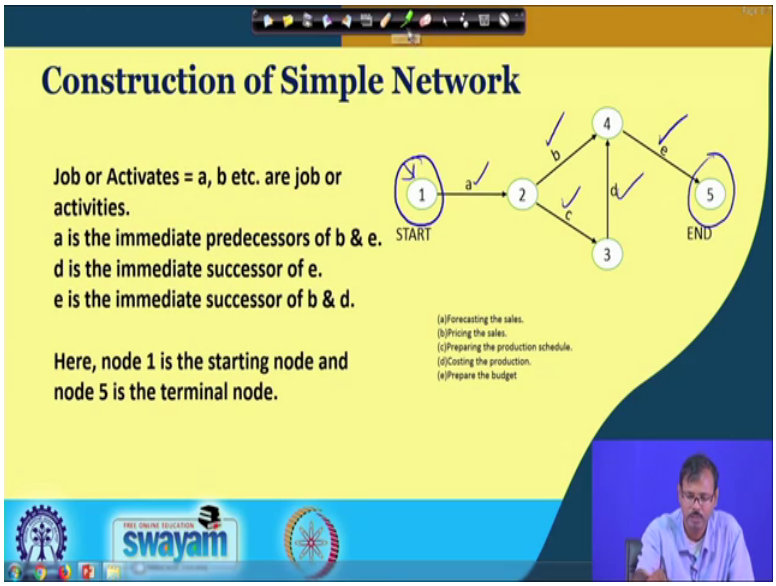

And this network is showing the first initial node is the starting node, this is the job a which is basically the forecasting of sales, this is job b which is pricing of sales this is production scheduling this is costing and this is budget. So, different activities are having some predecessors and those immediate predecessors are already listed in the previous slide. And you can see the starting node is this one and ending node is this one is this is a very very simple example where a simple network is prepared with 5 activities or 5 jobs.

So, this type of network formation is called project graph and by the way we are presenting it where the jobs are given on the arrow this is that is why it is called arrow diagram and using this arrow diagram we are preparing the network.

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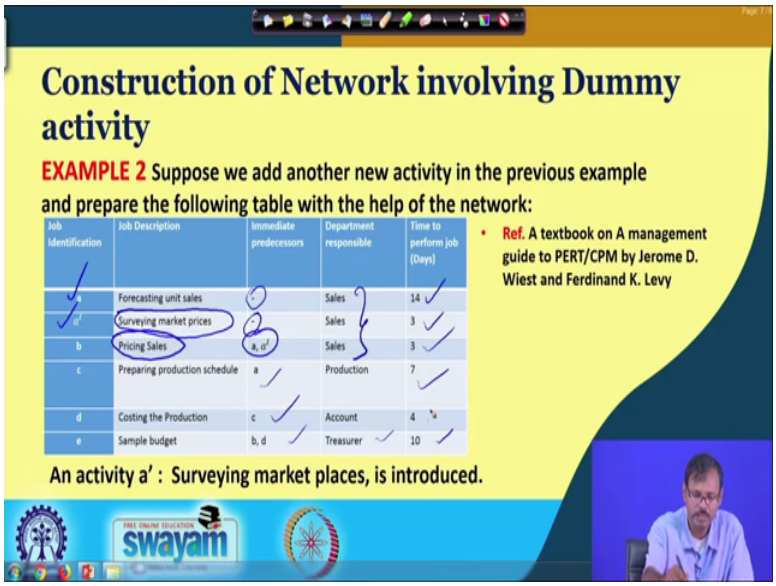

But there are some drawbacks on these, let us see how those problems are carrying out the when you are going for preparing the network based on the arrow diagram. Let us consider the first example, but let us add another job in this that is the market survey.

So, we are adding just along with forecasting of sales we are adding another job market surveying which are independent; that means, there is no predecessors, there is no predecessors for these jobs and the department on which this is depends, that the sales department will carry out this budget. So, in this case we are considering the duration of that, so sales department is asked to carry out forecasting of sales and the market survey for the prices in 14 days and 3 days and both are independent job.

So, they can carry out them simultaneously together and it requires the third job is pricing of sales also will be carried out by the sale department, but that need the results of a and a dot. That means, the result of forecasting of sales and surveying of market prices are essentially required for the pricing of the sales.

The next jobs are also known to us and for that three days are given to the sales department then production scheduling needs the forecasting of sales and production department is given costing is given to the accounts department which needs the production schedule and the budget is given to the treasurer which need 10 days for this. So, in this case this survey is the additional job which does not have any predecessors, but having a successors of pricing of sale. So, let us try to draw this network.

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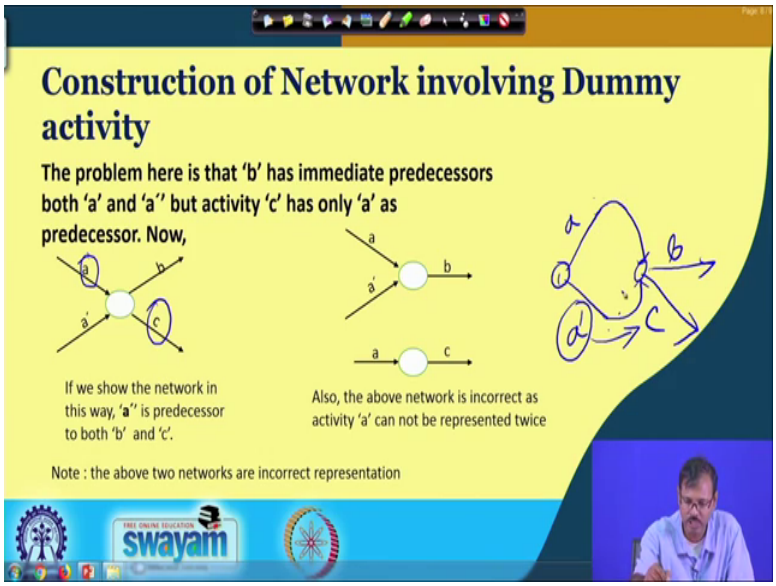

If we try to draw this network; if we try to draw this network like this, say this is our starting node from that we can carry out a and a dot both. Because they can be started from the very starting node, but we need their both output for the job b which are presented at this.

So, what we can do? We can say we are trying to place it in a different way. So, instead of that let us try to put it as this then it is giving that both a and a dot are immediate predecessors for b job, but the problem is we are having another job c which is having the immediate predecessors of a only. So, in this case if we try to put a here, put c here then the problem is this is showing that a dot is also predecessors of c, but which is not truth.

So, this is not a possible way to represent and further this type of arrow diagram is not permitted in this. So, instead of that if we go for this one.

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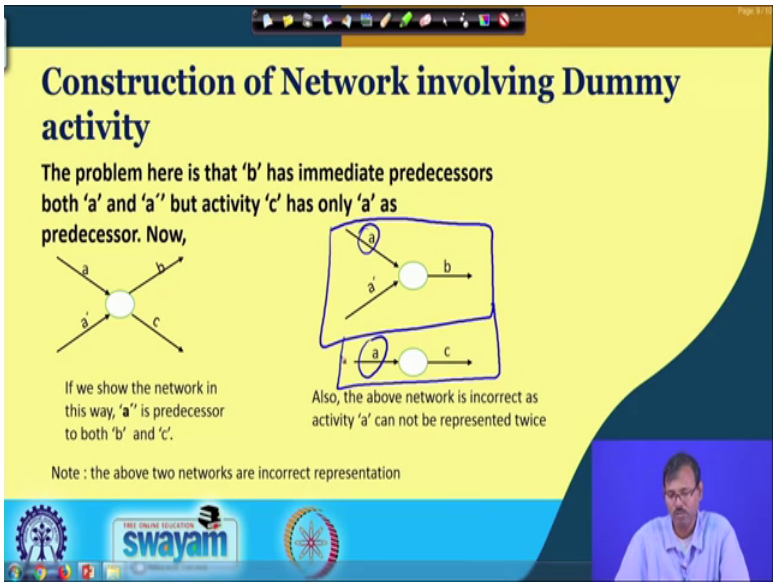

Then probably this is good, but if you look at to place the c like this, this is not accepted because in two places a jobs are reflecting. So, that can confuse the network. So, basically if we are having this type of precedence where if one precedence is required for a number of successive jobs, but that is not very easy to depicted in a network or you can say in the arrow diagram, that is a critical condition in the construction of network.

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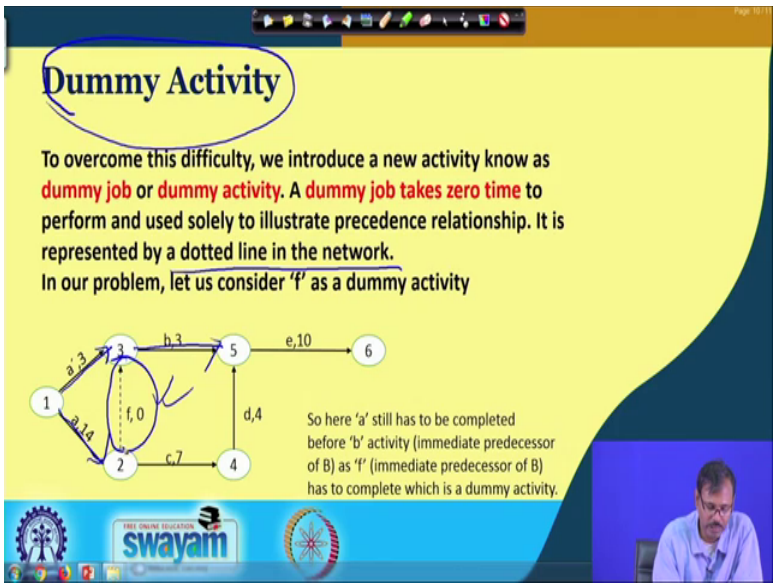

So, to avoid that criticality or to address that problem a new concept has come that is called dummy job; dummy job is nothing, but a sudo job which is added considering it

takes 0 time and 0 costing. And its purpose is to only show in the illustration of the precedence ship so that the network can be completed and that is why has, it is not physically existing, it is represented in a dotted line in the network.

So, now, in this case let us consider that f is dummy job and now you can see we are having the market survey, the forecasting of sales both are required for the job b that is for pricing and is this presidencies provided by this; provided by this dotted line which is basically showing a dummy activity f.

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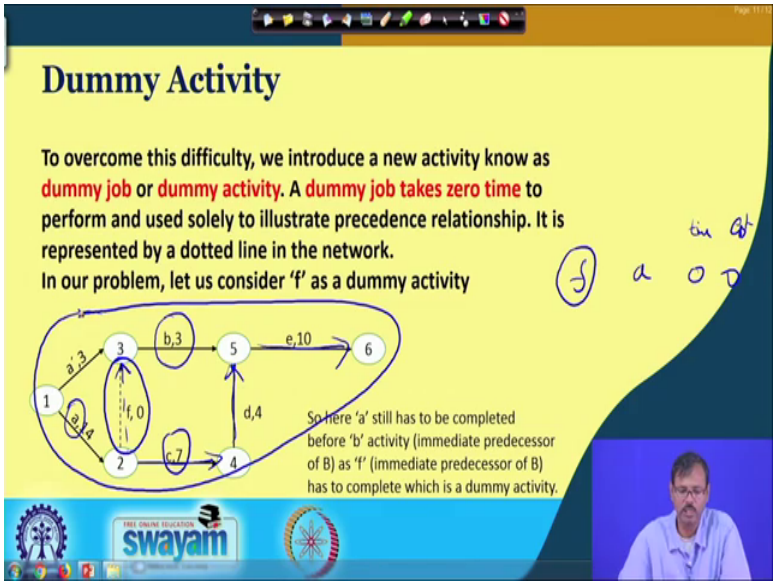

So, f is a dummy activity. So, f is a dummy activity which is having a predecessors of a, but that time duration requirement is 0, cost requirement is 0. So, this dummy activity is added in the network to show the predecessor ship of the precedence of the a to the job b. But the job c there is no problem the precedence of a can be easily shown in this, then you can put the d job here and finally, the e job which is the budgeting is presented. So, we need one additional dummy job to be added in the network for the construction of the network.

So, this is the way using the dummy job we can complete a critical network in the system.

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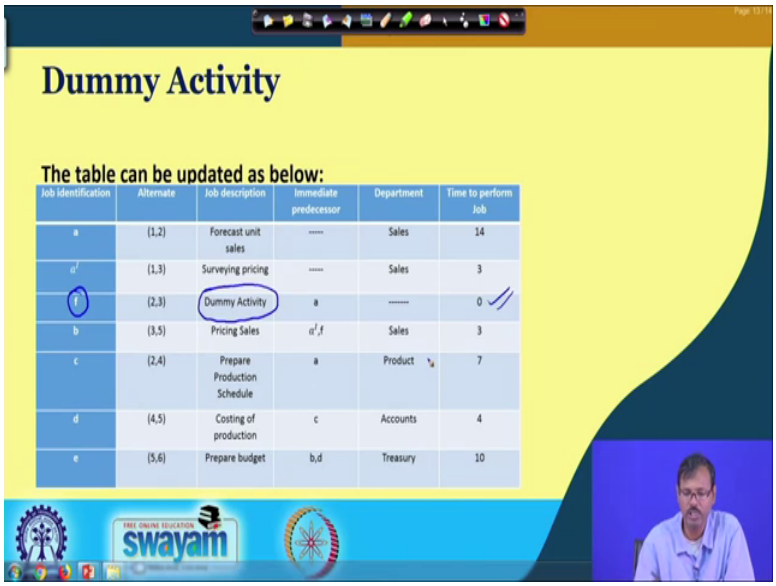

So, let us see how the table may be formed in this case. So, in this case the example you can see the job numbers are given a a dot the dummy job the dummy job f is presented here and this duration is show as 0. Alternates are given, the names are given this is dummy activity clearly mentioned and by this way we can able to complete the construction of the network.

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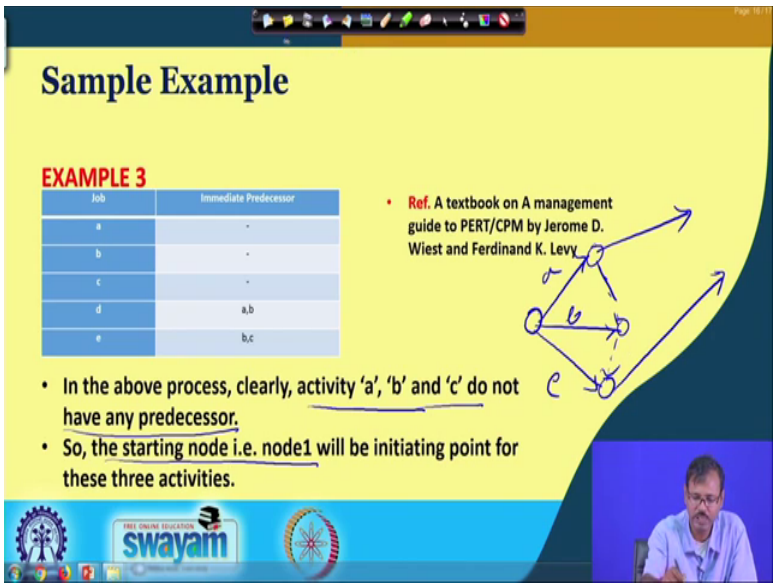

Now, let us see another example where now we are not giving the clear ideas which job is which one like in the previous way we have given a means forecasting of sales. Now

let us forget those things we will say the expert system has, experts are already defined which one which are the predecessors of which one. So, that is why we are not naming which activity it is.

So, now, let us consider a b c d e jobs are there, among which a b c all are the starting job and may be started from the starting node and d and e; d and d are having the predecessors of a and b and b and c respectively.

So, in this case activity a and b and c do not have any predecessors and can be started with the node 1. So, let us try to proceed it, now the problem is we are having this a, this is b this is c. So, we are having c and d which is being started from b and a. So that means, our d is must be like this and we need to add one dummy activity here, similarly we are having another activity proceeding from this. So, we have to add another dummy activity here.

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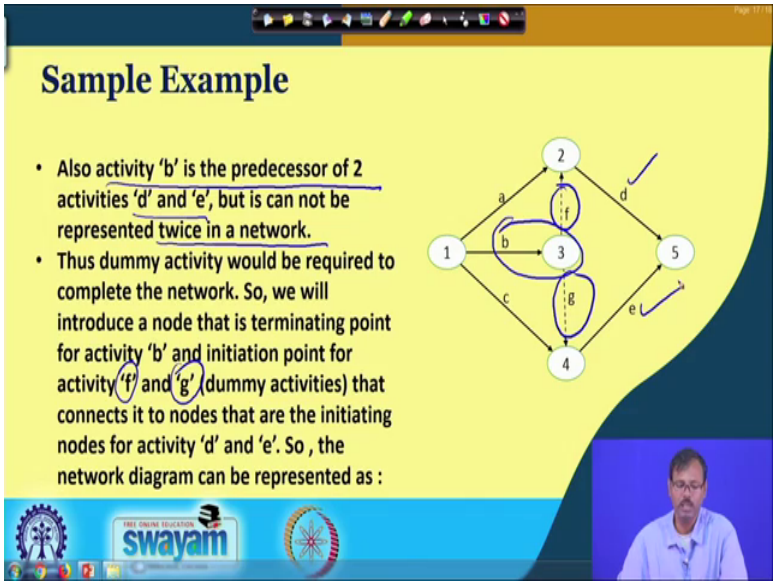

So, basically we have to look into; we have to look into the predecessor ship of this activities to find out how we can construct this.

So, activity b is a common predecessors for both d and e. So, it is represented twice in the network, thus we are placing this b activity in the middle and connect this activity with 2 sudo or dummy activity f and g so that the precedence of d and e can be represented in its best way. So, these are the examples created so that you can understand

the requirement of this dummy activity to complete the network. So, let us see how this example in terms of alternate we are showing it.

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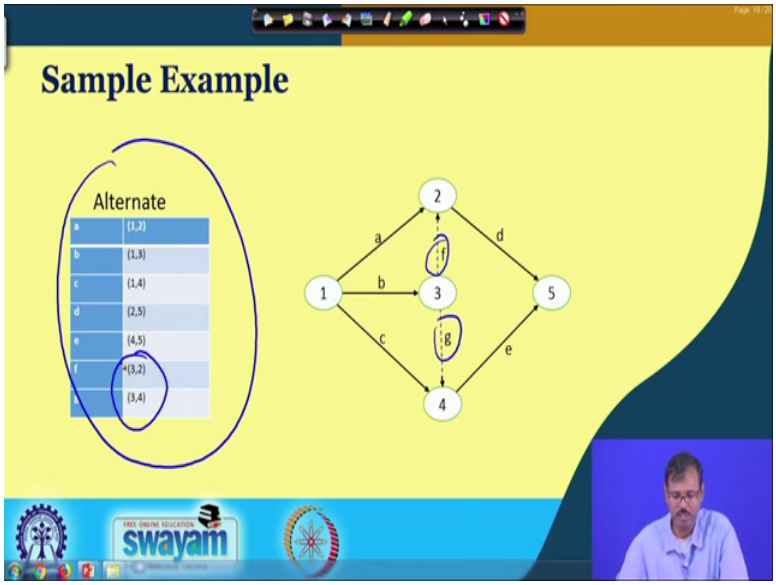

So, now you can see a is the alternate between 1 2, b is alternate between 1 3 and c can be represented with alternative at a 4 and d may be represented in the alternate 2 5; e may be represented as the alternate 4 5 and f and g are dummy activities mentioning the alternate between 3 to 2 and 4 to 3 to 4.

So, basically when we are carrying out this network analysis in computer system we in general represent a job or arrow by its alternate; that means, in computerized time, you probably you are calling it an array.

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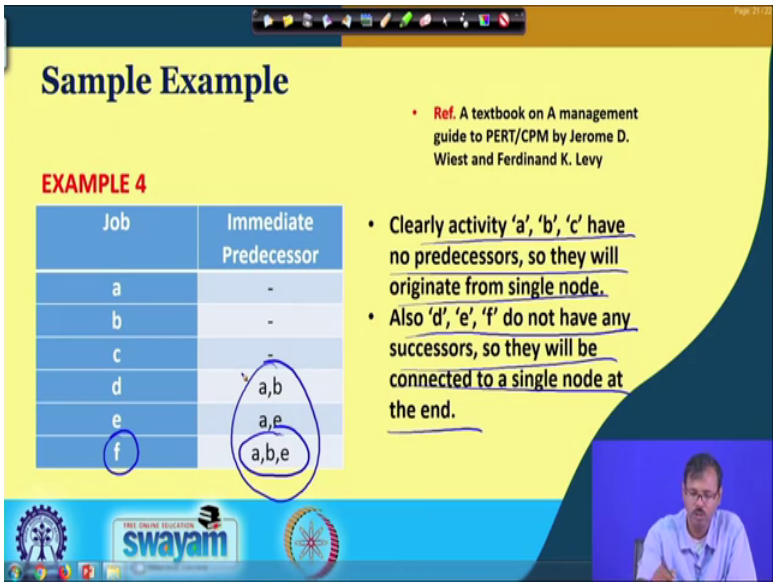

In that array you basically present the jobs or activity. So, let us see another example in which the we are just extending this one. Now we are having another job f it is not a dummy job now and these are the predecessors f is having. So, now, clearly activity a b c no predecessors, you can immediately draw this from the starting node, but d e f do not have any successors. So, there are all connected in the single node in the end so; that means, their precedence must be followed with a given dummy job presented suitably as it is represented in the in this diagram.

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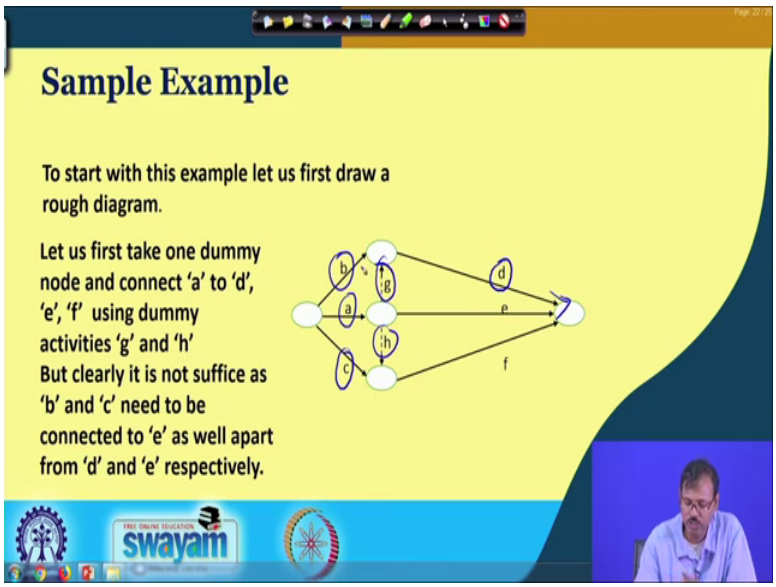

So, you can see all terminating nodes are meeting in the end and these are the starting node from which the initial jobs are started and there are connected with two dummy jobs.

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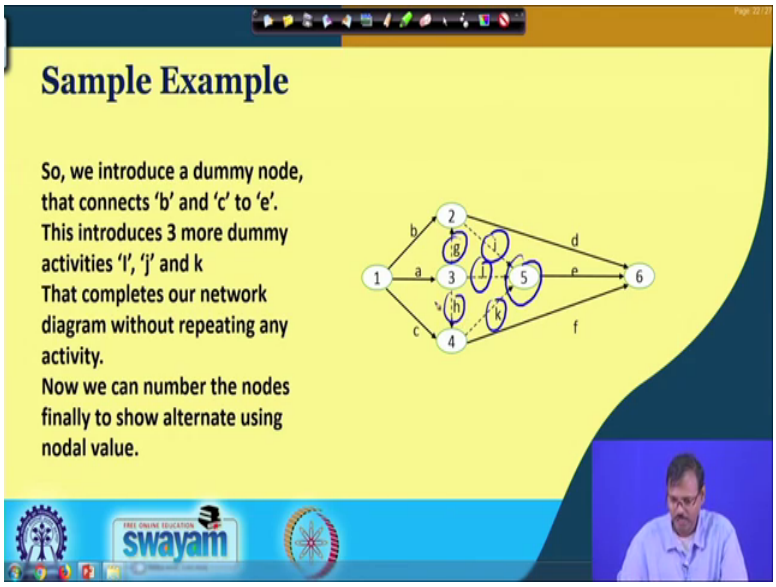

So, that their precedence, their precedence there are rendered here. So, that their precedence are well accepted using this fifth node at this position.

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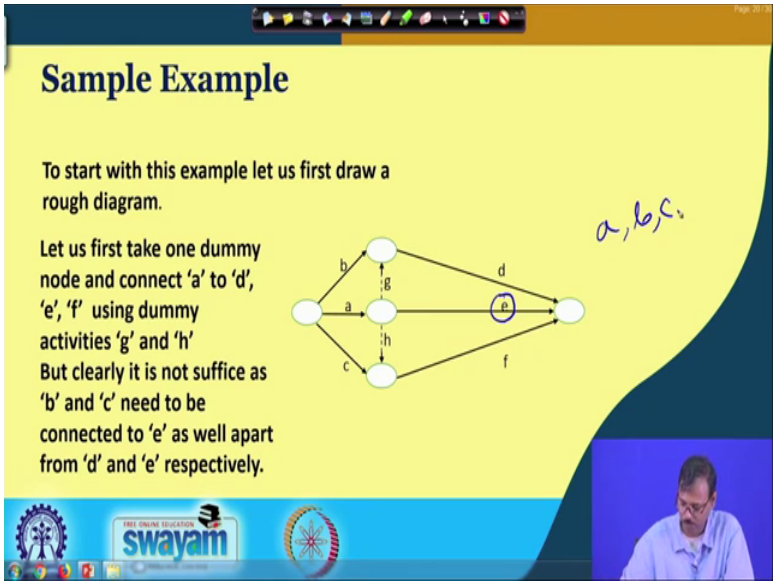

So, let us. So, if you draw this, if you draw this activity like this way then what will happen, you can see in t he previous one our e activity e activity which is added here had

both a, b and c probably let me check once again. So, actually e having both b c and a all 3 are a f is having both a b c; a b c all three are basically the predecessors of f.

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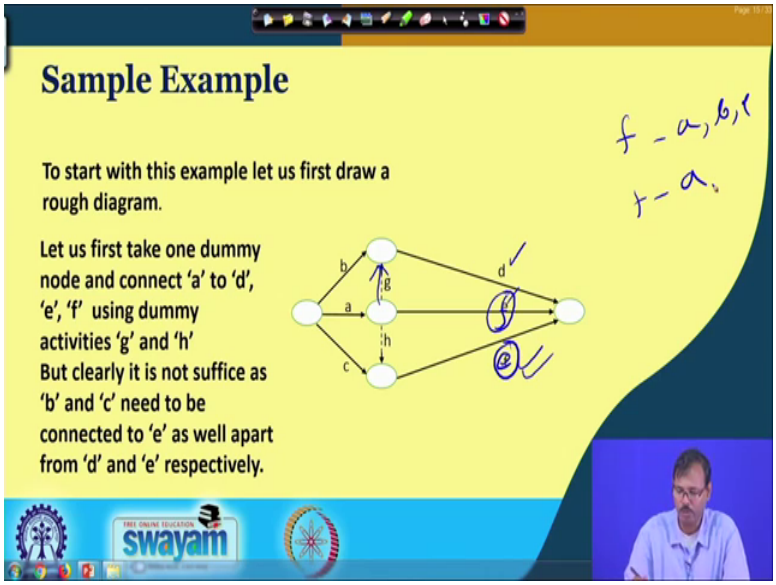

So, that is y for d and e it is not for d and e it is able to satisfy, but for f it is unable to satisfy because the dummy job is unidirectional and it basically showing instead of f which is having a predecessors of a b c. Instead it is showing f is having predecessors of a only. So, that is why we have to do some more add some more dummy jobs here so that it can be presented in such a way that that actually probably here we made some mistake, this is the f this is the e.

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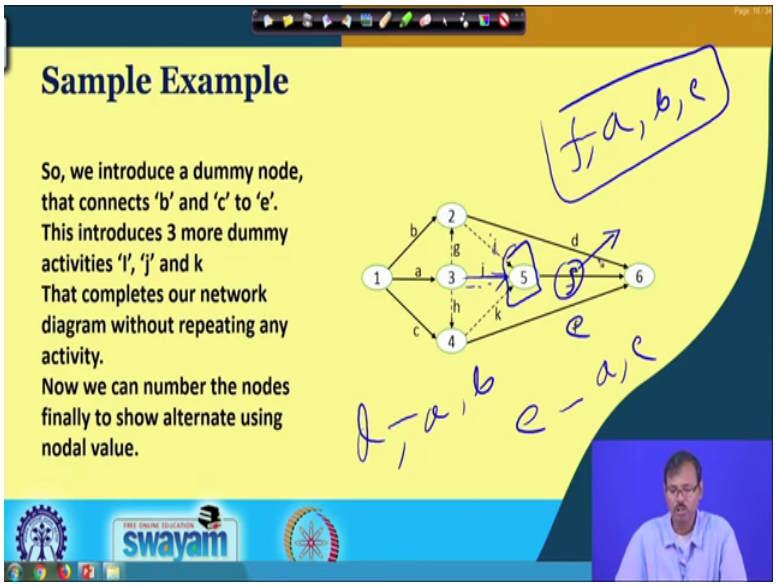

So, in this job the f job is having a is also the predecessors f because j is the dummy job, i is also the dummy job shows the b is the predecessors of this one, k is also shown here c is the predecessors of this one.

So, f is basically showing the both all the a, b, c are the predecessors of f, while for e the predecessors are a and c and for d the predecessors a and b. So, basically providing this additional node at this position and adding the dummy activity i j k to that node we are placing an option for f so that all the a b c can be the predecessors of the f.

So, basically this is adding this dummy jobs are giving us the opportunity to construct, completely construct a very very critical network critical network also where n number of activities can be added as predecessors for a for a activity though there are having other dependences also. In fact, in real cases the dependences are very high and that is why n number of jobs are acting as the predecessors of a job and there are predecessors, distance predecessors also there in consideration of that a network has to be completed prior to analyze the network for its optimization.

So, let us stop this lecture at this position. So, in a nut shell what we carried out in this lecture we able to understood that how we can construct a network and if the given activities are given we are able to define them which are the predecessors of one activity, which are the successors of that activity and after defining the predecessors and successors we will be able to draw the network in terms of arrow diagram. And we have

seen that in the arrow diagram if for the addressing the critical problems of the precedence precedences and the successorship we have to add add some dummy jobs so that which are basically sudo job, but the requirement they are they are required to complete the network in a simpler form.

Thank you.