Project Planning & Control

Prof. Koshy Varghese

Department of Civil Engineering

Indian Institute of Technology, Madras

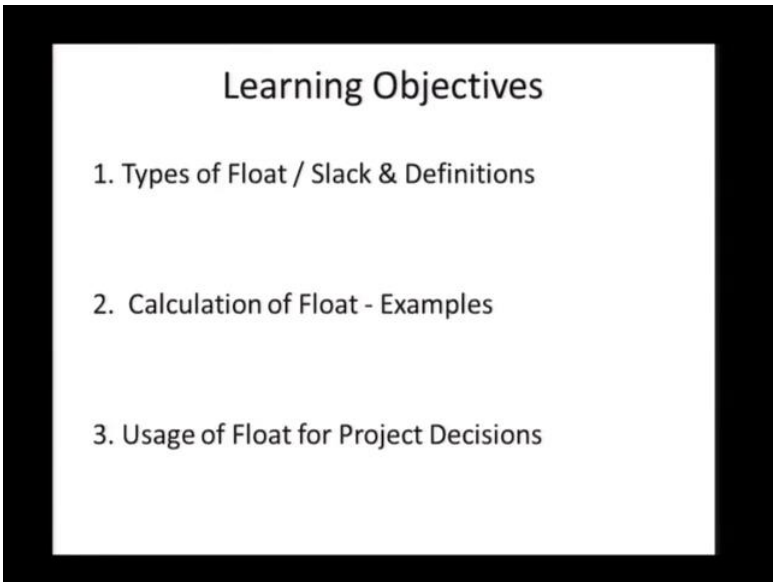
Lecture – 19

Lesson – 01

Introduction to Floats, Types of Floats and Example -1 Discussion

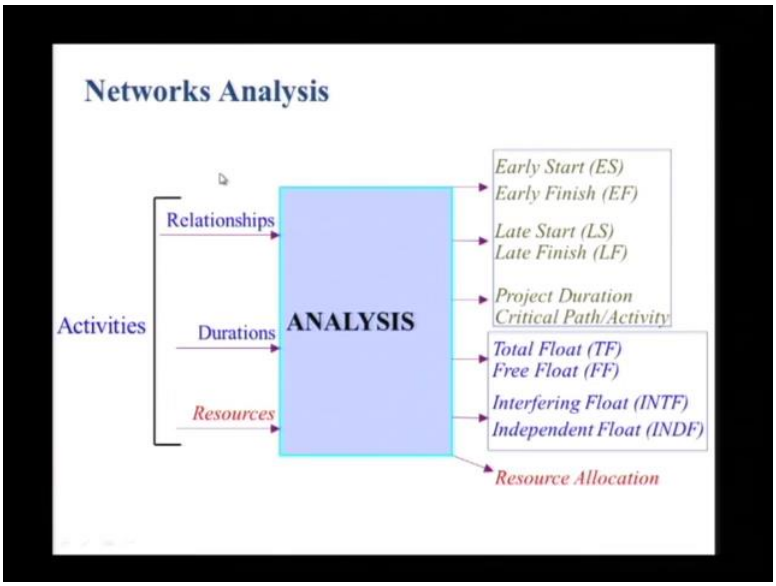
In this lecture, we are going to continue with network analysis and what we are going to cover is the concept of float and how float and slack are calculated. Now, float and slack are interchangeable terms, in many places the term float is used; we also use the term slack. You will find the software which uses project management uses the terms interchangeably, and we will continue to use the word float through rest of the lecture.

(Refer Slide Time: 00:46)



I just mentioned, our objective here is to understand the different types of float or slack, the definition, the calculation behind this and then the usage of the float for project decisions.

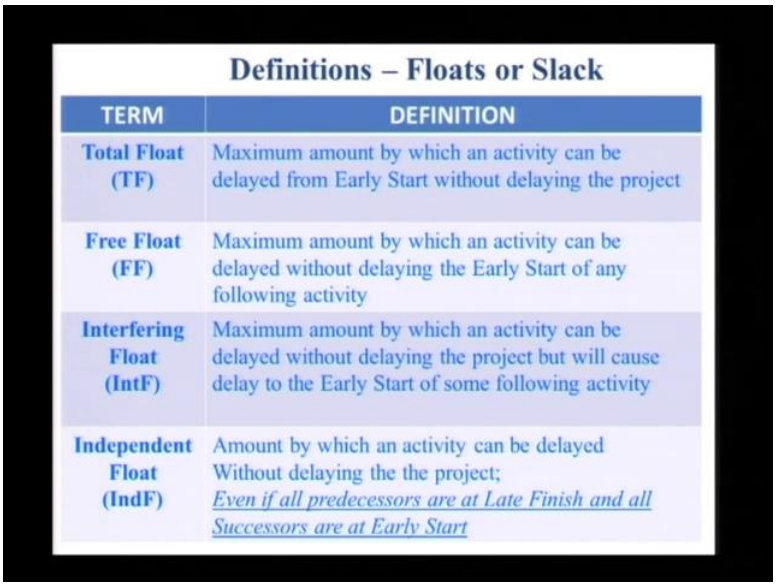
(Refer Slide Time: 01:01)



You may recall that we had covered network analysis in this manner, where we had inputs for the analysis which where relationships, durations, and resources and various outputs. So, we have covered the set of outputs which are in this box, which is the early start, early finish, late start, late finish, the project duration and we could, for the networks which we analyzed we could actually find the critical path without any calculation or any specific identification.

Today, we will cover these other parameters which are outputs of network analysis, which is a total float, free float, interfering float and independent float and there will be lots of finds a formal way to define critical path based on floats. So, this would be the exercise or the objective for today. Later on, we will take resources, resources are extremely important, and they drive the whole project and we will take, how to take resources as input and do the allocation and various operations with resources and that will be part of the resource lectures which come later in this class.

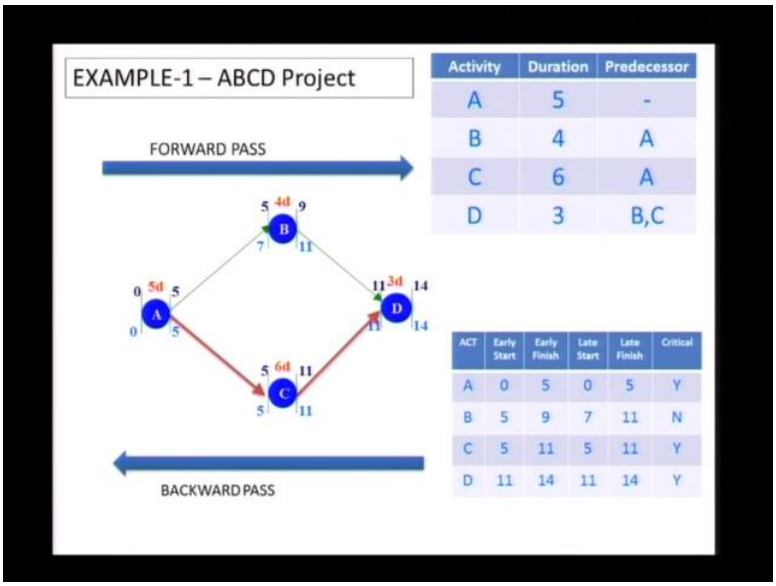
(Refer Slide Time: 02:09)



Now, what we want to do is start with these definitions, I do not expect you to understand the definitions as it is defined here. When we go through the examples, you will be able to understand these definitions, you know from the basic status, but what we will just go through the definition of these which is… So, there are four float terms as we discussed earlier, the total float is the maximum amount by which an activity can be delayed from the early start without delaying the project.

Free float is the maximum amount by which an activity can be delayed without delaying the early start of any following activity. Now, these two are fairly intuitive; interfering float is the maximum amount by which an activity can be delayed without delaying the project, but will cause delay to the early start of some following activity. We will take this up; you know through an example, and independent float is the amount by which an activity can be delayed without delaying the project and even if all the predecessors are at the late finish, and all the successors are at the early start. So, these are the four definitions and let us get into some of the details, and the best way we want to do that is through an example.

(Refer Slide Time: 03:22)



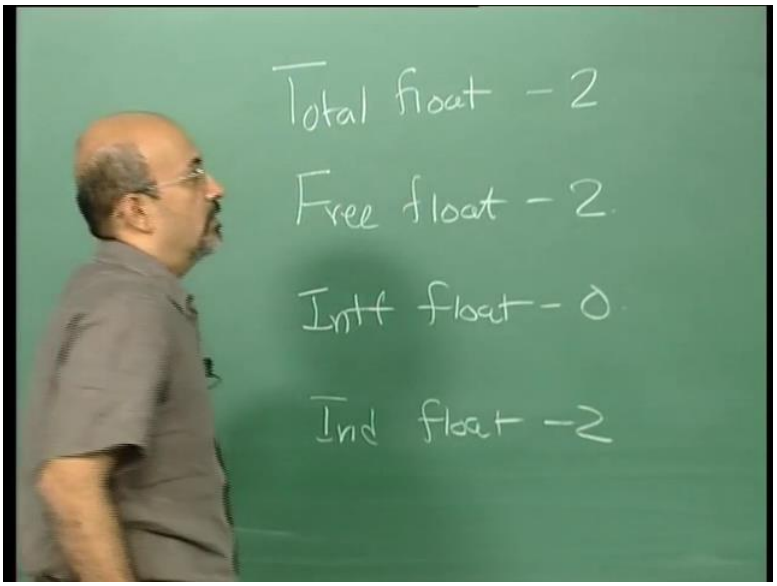
So, this is an example we solved before, we have four activities A, B, C, D. We have the durations, we have the predecessor relationship given, and I am just going through the basic analysis to refresh. I have memories, so we did the forward pass if you recall we have the durations here and we had the early times, the early start, the early finish and now we went through and then we found the project duration and when we did the backward pass, we started with the project duration fixed, worked backward through the network, calculated the late finish and the late start, you will recall the equations we had for it, and we come back to the very initial node.

So, this was the analysis of the network and we then put the various network parameters and we did the early start, the early finish, the late start, the late finish and we went ahead and defined a critical activity, because we could easily see that if there is any delay in activities A, C or D, project duration is get delayed, and we could see that, if there is the delay in B there is no problem. So, this is how we defined a critical activity in the last lecture, now let us get more formulae. So, how many days can I delay B?

Student: 2 days.

Two days, so I can delay B by two days, and it will not affect the projects. So, if we take the definitions we had.

(Refer Slide Time: 05:07)



So, we had, remember we had four terms, we had a total float which was the amount by which I can delay an activity without delaying the whole project. So, what would be the total float of B? two days, so I can delay B without delaying the whole project by two days. Now, what was free float? Any successive activities, so I can delay B again by two days without, it is a very simple example without any successive activities, without.

Now, what was interfering float?

Student: It was the maximum amount.

It was the maximum amount which activity can be delayed without delaying the project because the delay to the early start of the following activity. So, in this case, is there a delay for B? Any delay in B will…

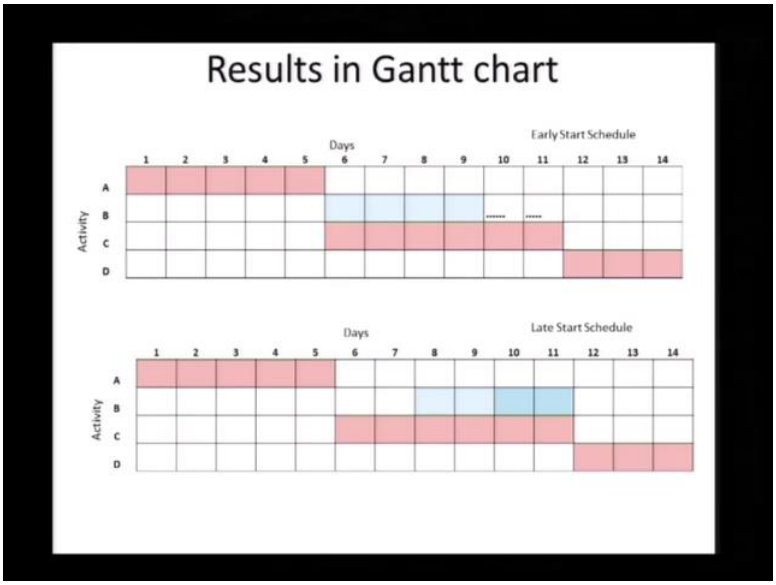
Student: Will affect the duration.

Will affect the duration. So, it is anyway going to, so interfering float. What about independent? Again I will go back to the definition which I have to do it this way, if we look at the definition here ((Refer Time: 06:39)) we have amount by which an activity can be delayed without delaying the project even if all predecessors are at late finish and successors at early start. So, in this particular case as you know both the predecessor and the successor are critical, and it does not affect the way it would do, you know what is required. So, we would go into, what would it be.

Student: 2

Should be 2.

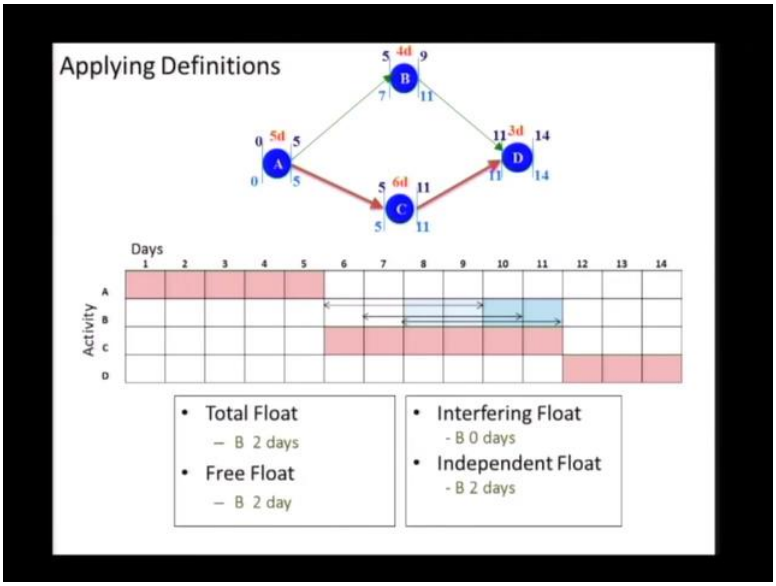
(Refer Slide Time: 07:08)



So, we can now take, so the independent is also 2. Now, you can see you put this into a bar chart here, and you can see that the B, the bar for B is here; you can see the B, you can see it in blue and you can see the two days of total float. So, there are two days of free float, because I can move it here and it does not interfere and anything else and it also happens to be an independent float.

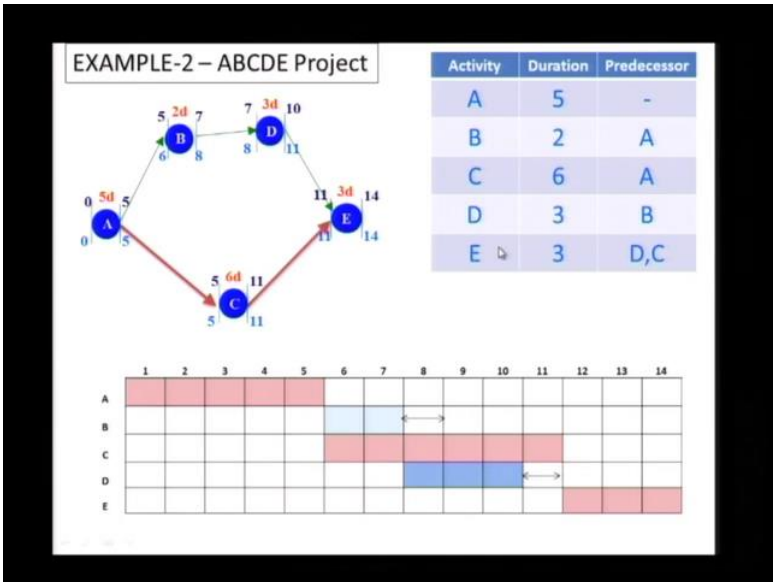
Very simple example, some other more what I would say the complex issues of float are not coming out here. So, let us take a slightly more complicated example.

(Refer Slide Time: 07:59)



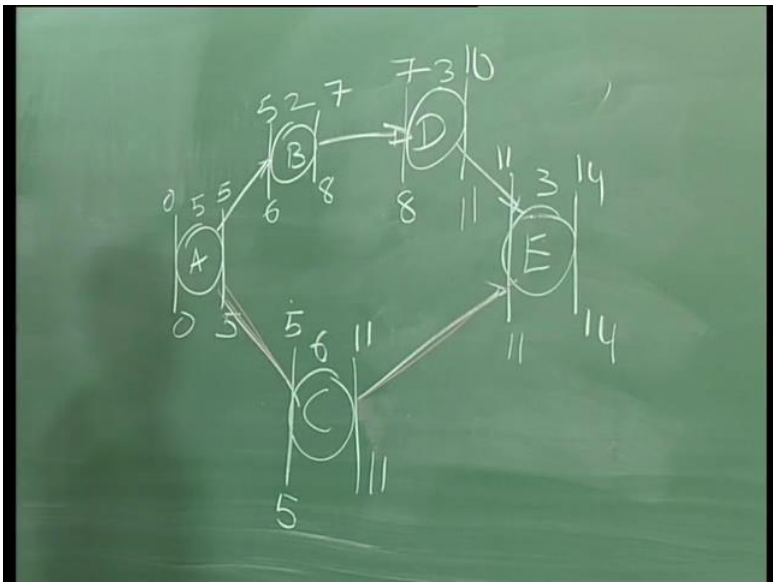
So, we would see this is the results which we have just discussed. So, whatever we; however, we move it, this is the end we can move. So, we have two days of total float, two days of free float, no interfering float and two days of independent float.

(Refer Slide Time: 08:16)



Let us take a little more, let us change the example now. I am just extending it, and we have a, we have this network now.

(Refer Slide Time: 08:30)



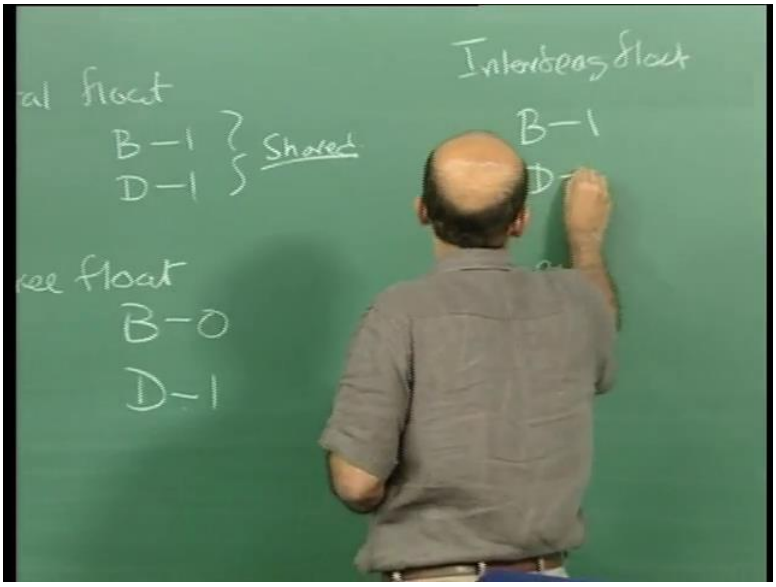
We have A; I am just added another activity, and you can see the network; that is, the analysis there. So, we have 5; we have B is… B have 2-day duration, D have three days, E is again 3 and C are 6, the quick analysis is 5. I should have calculated B, but I, because I know

the way it goes into, go that is why I have. So, we did the forward pass backward pass, what is the critical path?.

Student: A C E.

We can see that A C E, now we just ((Refer Time: 09:50)), we only had the added D now, that is all we did compare to the earlier network. We have B and D, and we can see that certainly, the critical activities have no total float or any float for that matter. Now, let see what kind of float B and D have. So, you can see, let us use total float first.

(Refer Slide Time: 10:15)



Does B or D have a total float?

Student: Yes.

How much?

Student: 1

Is it one each? We will come back to that. What about free float?

Student: B is 0, D is 1.

B 0, because the minute I start moving B, it will start changing the early start of D. So, B has no free float, you can see D is moving into, it is successor is E, and there is a one day difference. So, even if it delay D by one day it is not going to affect anything in the network, so D has one day of free float. Now, let's just discuss of these two floats, these are the most commonly used floats in project management and it is kind, let us spend a little more time discussing these two.

When we say B has one day and D has one day of float, so what we do on a project. So, typically if a project has multiple activities, we will subcontract activities to various subcontractors. So, here is a project, I have you know all of these subcontractors, I now convey communicate information to them and said, tells subcontractor D; you only need to start on the 7th day, you need to come to my site on to 7th day, mobilize on the 7th day, and you need to be there for 3 days based on your decision, because B will be completely and hand over to you by 7.

I need to tell subcontractor C that you need to come in on to the fifth day because A will be completing by 5. So, all these early start times gives me a way to break the project and give responsibility to the various participants. Now, how will I use the float information?

Student: ((Refer Time: 12:25)).

So, can I tell? So, basically B has one day float, and D has one day; that means, even if I change, is it B as one day and D has one day.

Student: No.

No, so B can, that is a very important thing. So, with B and D, this total float is actually shared. So, there used to be a time when, I mean when CPM is new, B would look at his float and say I can take three days, it is okay if I finish on day 8. D will take a look at it is basic information and say, I have also got one day of float, might be I should take four days, what will happen.

Student: ((Refer Time: 13:15)).

Yes, the whole project gets delayed by one day, because that float is shared. The minute one of them uses it, it goes off the network, so we have to be aware of the shared float. What about free float? Is it shared or is it what or what does B has no free float and D has a free float. So, if you are giving if you are allowing B or D to give, use that one day of float who would you give it to.

Student: D

It depends on, but if I give it to D, then there is less coordination between B and D required. If I give it to B; of course, D loses that float, but it means that D has to now mobilize on one day later, so the way I use float matters. Now, you have another way of the importance of float and criticality. So, we have now certainly depended the critical path has critical activity as an activity which has no float, we know that and if I am, if let said the foreman who is

doing activity B and the foreman who is doing activity C came and asked me for the same resource and I have only had one of those resources, who would I give it to, C because he is on critical.

So, decision making like this becomes what you say, easier to justify when you have an idea of what the float or slack is. Now, if we start looking at the remaining float, so we have interfering and independent. Obviously, A C E has nothing, what about B. So, we can look at it on the bar chart here ((Refer Time: 15:24)). So, how much can I move B by? So, here we have B on 6 and 7, can I move it by, I can move it by one day. What happens when I move it by one day?

Student: The early start of B is one day.

I am interfering with the early start of B. How much can I interfere with the early start of D?

Student: By one day.

By one day so that you can see in the bar diagram, it is you know that overlap; that is let say the 8th day will be an interfering day, D will because of the predecessor relationship B will be forced to move start on the next day and move on. So, that is one day of interfering float; D has none. What about independent? Do any of these have an independent float?

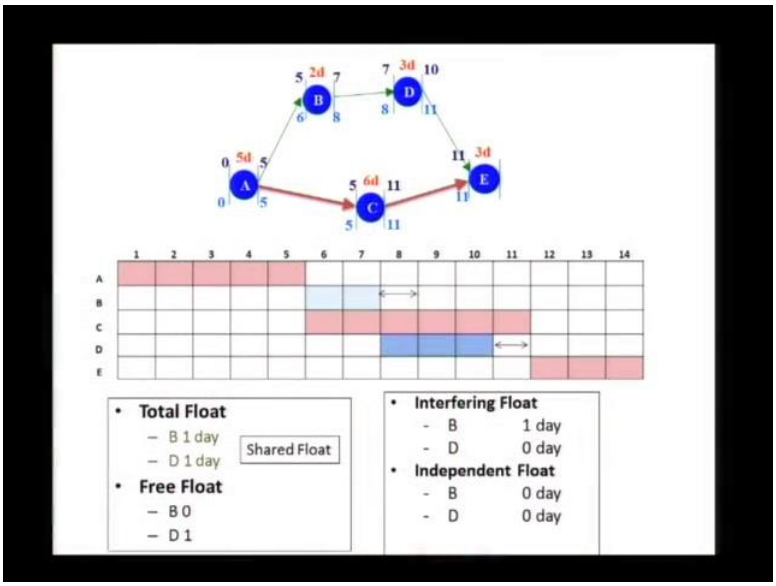
Student: D will have 1 day ((Refer Time: 16:24))

D will have basically right now you can see that D is influenced by the start of B. If I delay B, D gets delay; that means it is not independent of B. There is no independent float, so both B and D have no independent float. Now, if I wanted to… Now… Are there any questions on this?

Student: ((Refer Time: 16:59)) successive activity should not be delayed instead of doing interfere.

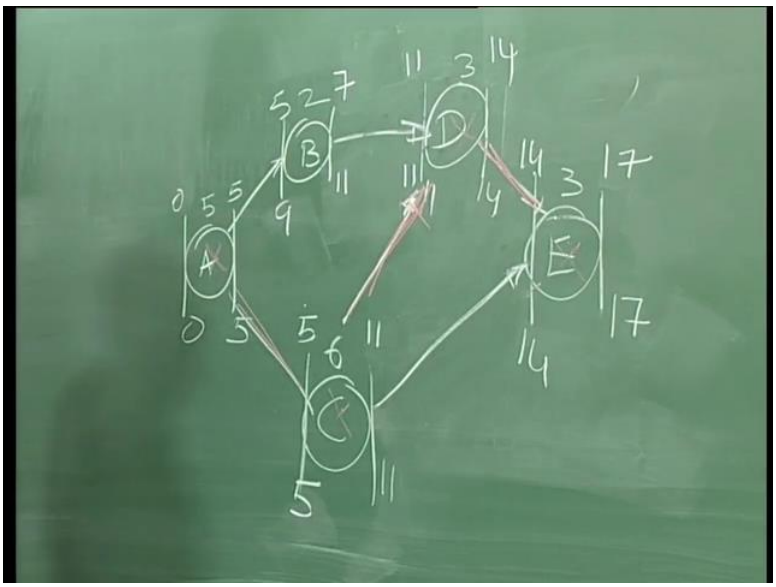
No, no; it is the amount I interfere by, the amount I; that is why it is interfering. The amount I interfere into the successor of succeeding activities. So, here I can interfere with a one day, not more.

(Refer Slide Time: 17:26)



So, if we go to the results in the power point, this is the same as what we have got on the board. Now, let us try to illustrate the concept of independent float. So, I have actually making the, changing the diagram a bit; what I am doing now is I am adding a relationship between C and D.

(Refer Slide Time: 17:47)



I am just going to change this diagram, I am adding a relationship between C and D. I am changing the duration of D to 3, this is I would have 5, I have B is 2, C is 6, D is 3.

Student: then it will become 11.

11, yes. So, now, I have, this is the this is where it is. So, now; obviously, because of the

relationship this changes. So, I will rework my times, so five 5's. So, now, 5 to 6, this goes to 11; now I have here 11 going to, so here I have 7, let me take out all my… So, this goes to 14, here I have 14 and 11, so I go 14 plus three goes to 17; 17, 14, 14, 11 actually this should go to 14.

Student: 11

11, 5, so this the critical path now changes. Where does it go through now? A, C, D, and E. So, because I change the predecessor relationship here, now my critical path goes through this. Now, let us see it is the same example, slightly different relationships, and waits, I did not finish this, so this goes back to 11 here, so now, this goes to 11, 9. So, again no floats on these because they are critical, and we now go back and see, take B, so B has…

So, we will have. Certainly, it is B which has the float. What is the kind of float B has?

Student: Total float

Total float. What about free float?

Student: B 4.

Interfering it cannot, because B; if B starts interfering with D what will happen.

Student: Project gets a delay.

The project gets delayed. So, in our definition, remember you cannot delay the project. You have, how much can you interfere with any succeeding activity without delaying the project, so it has 0. So, what about independent float? Can I delay A? I cannot delay A, so B is independent of any movement of A. Now, B can move without delaying D by 4. So, there is space for B to move so that you can see it in the bar chart, the space for B to move from, in this whole region without influencing anything else, nothing else gets influenced for that. So, you have an independent of 4 days.

So, these like, we discuss the usage of total float and free float. Typically, interfering float and independent float, you will find that lot of software packages today do not even calculate, they do not give you an option, or they do not give you a field. So, in practice, the usage is not that much because people rely a lot on software, but it really gives you specially independent float gives you a certain idea of real independence the activity has to the rest of the network and how much of really you know float.

So, this float of B is, you know there is a lot of subcontractors can do that four days without

interfering with any other part of the network. So, that kind of information also become quite relevant, any questions. So, just to wrap up this discussion on the float, we discussed how the priority to critical activities versus non-critical activities could be assigned based on the calculating float, and you know and identifying critical.

The second point is very important; we talked about the criticality of a chain of activities. So, here what is it, what is the float for B.

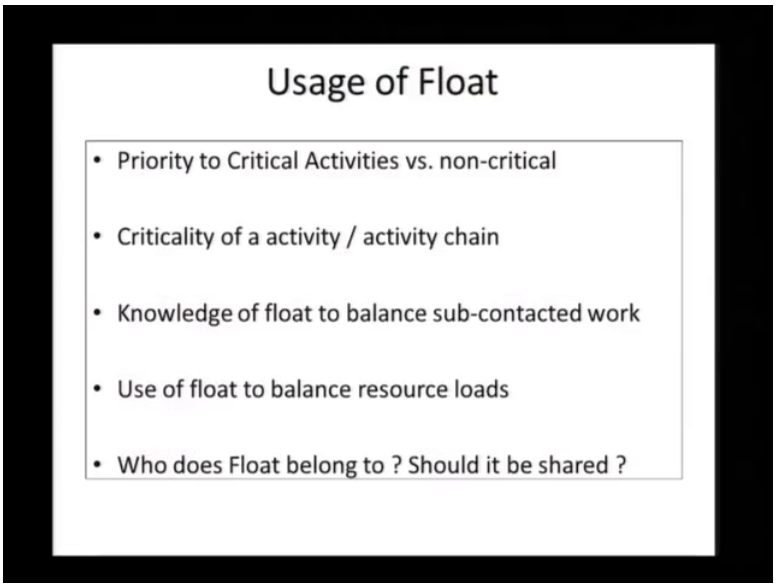
Student: 4 days.

Four days, earlier what was the float in the last network.

Student: 1

1, so one day of float, are we saying the activities are not critical. What is the uncertainty in the project? You will find that the durations we are talking about here are deterministic, but if you had some kind of a probabilistic duration, that one day is very well within the range of change. So, lot of times you will not define the critical path, where the total float is 0, you will say total float is in range. Within five days of total float, it is critical, because… So, the critical activity is not a binary decision it is a subjective decision; it can be a range of total float. So, that way criticality becomes important, so it is not critical, but criticality.

(Refer Slide Time: 23:37)



We talked about how knowledge of float can be used to balance subcontracted work. When should a person mobilized, when should demobilize; all of these can be structured and subcontractor out properly, how much extra time could a person be given. Later on, we will

be using float to balance resource loads; this is one of the most important applications of float, and we will be getting into that in great detail.

Now, the last question is also quite important, which is really I mean in an international context, this is why float has become very much part of a computation of a CPM from a legal standpoint. Because ((Refer Time: 24:23)) on this network it is not as illustrative because the only B has a float. In our earlier network, remove your B and D were sharing the float. Now, can I give it, is there a contractual term of which, who should I give the float to, both had one day, why would I want to use the float?

Student: The problem of getting resources.

So, they are all under clauses to say, there is a delay and they are doing something that they will be, they might be liable to pay some damages or what actually. They will want to use that one day, or they will want to increase the duration of the project of their sub activity because increasing duration will be requiring them to mobilize less resources. So, they might decide, you know I want to stretch because I will mobilize less resources I do not have to pay for additional resources on that, I can finish it on that time and be done.

So, this issue of how float shared is, you know it is still an issue of a lot of litigation in places and today when you take a contract document in an international contract, there will be specific classes on, who will the float belongs to and it always belongs to the owner today and how the float should be a portioned in case of some need for requiring the float. So, because the subcontractors or the people doing each of these activities cannot assume that, they having the float for themselves. So, management of float becomes a very key issue.