Water Economics and Governance
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Lecture – 42
Evaluation of Water Projects:
Selection of Capital Budgeting Methods (Contd.)

Hello friends. So, we are into the 40 second lecture this is the last session for week 8 where we will continue our discussions on to the capital budgeting method. We did discussed in the previous lecture that how the capital budgeting different capital budgeting methods can be used individually from like last 2-3 lectures we did see how the different capital budgeting methods can be used individually to asses a project.

And how we can basically use for the independent projects when we have more than one projects available.

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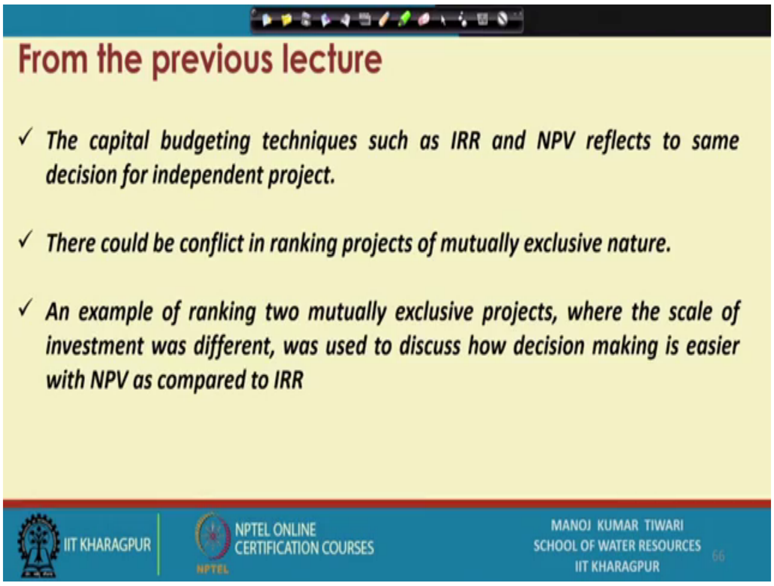

Particularly the NPV and IRR which we just discuss in the lecture; So, for independent project whether we go for any of the capital budgeting methods it is fine, they lead to same decision or they lead to similar decisions about investment investing into the project or not. While there could be conflicting decisions in ranking different projects of mutually exclusive nature.

So, if we have let us say if we are comparing two different projects out of which only one can be selected then which one is better and which one is not this kind of decision particularly with NPV and IRR may actually lead to conflict in situations. We took an example in the previous session if you recall onto two different mutually exclusive project where the scale of investment was different.

One was having 50 lakhs investment while other was having 150 lakhs investment, 3 times of the investment and we did see that the NPV and IRR criteria separately were leading to the different conclusions and eventually we discussed how the decision making is relatively easier with net present value as compared to the internal rate of return.

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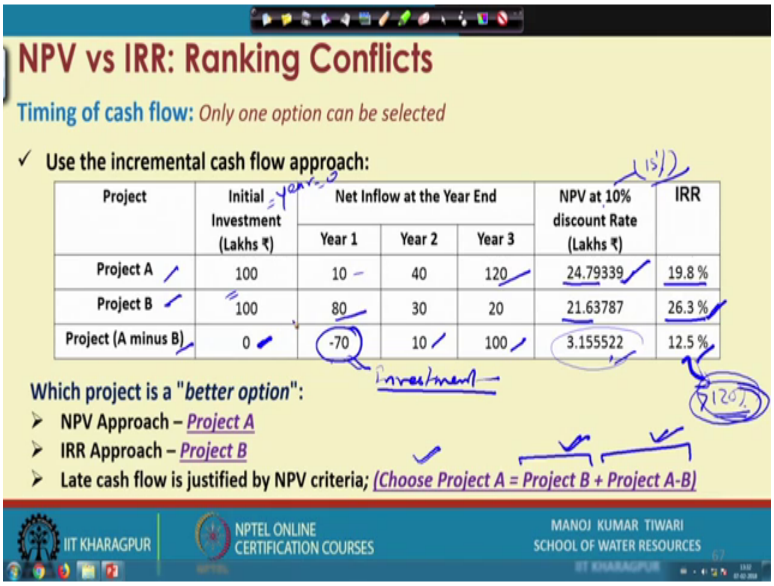

We will take couple of more examples today and see how these conflicting situations can be handled. So, let us say the earlier example we considered the two different projects with different initial investment.

Now, let us consider that we have 2 projects where the initial investment is same, we have project A, project B both is having initial investment same 100 lakh rupees. Now here what is different is that the timing of cash flow is different for the 2 projects. One is actually generating larger share of revenues in the beginning itself while other is generating larger share of the cash inflow in the later period. So, that is the basic difference, one is the cash flow is higher in the beginning less in the end while with other cash flow is very little in the beginning and subsequent cash flow is arising in the later phase of the project.

Now, if we compute the net present value for the these 2 projects what we get is 24.8 lakh rupees for project A and 21.6 lakh rupees for project B. So, this suggests that the project A is a better option than project B while if we go at IRR this NPV is calculated at 10 percent discount rate and if we compute the internal rate of return we see that project A has a little under than 20 percent while project B has a little over than 26 percent.

So; that means, by going IRR the project 2 should be selected while by going net present value the project A should be selected. So, this brings are say in another conflict that which one to choose whether to choose project A based on net present value or to choose project B based on internal rate of return approach.

So, what actually is happening, what is leading to this conflict is the timing of cash flow. Now, if we closely loop the timing of cash flow concept over here are the idea of timing of cash flow for this one so, what happens that in year one the project A is returning just 10 and project B is returning 80. Year 2 project A is returning 40 project B is returning 30, year 3 one is returning 120 while other is returning just 20.

Now, this project can be compared in a different ap thought of approach as well that let us say we have another project which is A minus B. So, earlier we see this concept when we basically had A project B minus A which is the due to additional investment. So, because project B was expensive so, then project A project A has 50 lakhs investment, project B has 150 lakhs investment.

So, this additional investment to see whether this additional 100 lakhs investment is justified or not we created an imaginary project B minus A and evaluated that that whether is it feasible to go for both A and B minus A if it is then we can go for project B. While here initial investment is also same.

So, if you cons if you develop such a project what will see that the initial investment is 0 so, we is still we develop a project of the differences. So, let us develop a project A minus B which says that the initial at year 0 it is going to be 0 this initial investment means at year 0.

Now, in year 1 the project A is generating 100 and project B is generating 80; that means, if we have another project which requires 70 lakh rupees of investment we are generally creating a imaginary project A minus B which is equivalent to 70 lakhs of investment ok. So, if we invest further 70 lakhs let us say we generated 10 here and invest further 70. So, we will reach to this value.

So, this particular additional 70 lakhs of investment in year a this is negative so, this is not the this is not a positive cash flow this is a negative cash flow. So, this should be considered as a investment. So, it is equivalent to like we are investing 70 lakhs more in year 1 and which is generating a cash flow of 10 and cash flow of 100 in year 2 and 3, additional cash flow of 10 and additional cash flow of 100.

So, while if we want to choose project A it is equivalent to choosing project if we want to choose let us say project B which is having highest internal rate of return or this revenue it is equivalent actually to choosing project B plus project A minus B ok. So, that will be basically both the project satisfy my criteria project B and A minus B; that means, we can choose project A in fact. Because this is requiring the project A minus B is as good as making a investment of 70 lakh rupees in year 1 for getting the additional return in the subsequent years.

So, by this logic if you see if you evaluate just project A minus B from this point; So, what we see that investment of 70 lakhs in year 1 as supposed to return of 10 and 100 in year 2 and 3 will give me the net rate of return as 15.5 percent and a net present value of 3.11 3.155 lakh rupees. So, this project B is also justified. So, this project sorry project A minus B is also justified.

So, making this additional investment in year 1 imaginary investment in year 1 is also justified so; that means, it is better to go for project A where basically it is as good as choosing project B as well as a project A minus B. So, we can basically choose both project A and project A minus B and then we can say that the late cash flow which is coming in project A is actually justified by the NPV criteria and we should choose project A in that case.

So, here also the NPV is more helpful in picking up the right project based on the written on the additional investment or analysis of the late cash flow we can see that NPV is still and it is giving at the desired discount rate, it is still giving me the positive NPV and acceptable value so, that I must choose project this project.

Of course, if we change the rate of return if we change the discount rate maybe if we change this discount rate not 10, but let us say 15 percent. So, then we never know this actually might turn negative this will turn negative because the IRR for this additional investment is 12.5. So, up till point 12.5 percent if my discount rate is up till this reason my NPV is going to be 0 so, up till this point this project can be considered.

But at any expected when my expected return exceeds this value exceeds this 12.5 percent value then ah; that means, that this late cash flow or the imaginary investment and return the receiving cash flow on to that investment is not trustworthy is not justified at return rate greater than this. So, that is how this decision can be made based on the net present value which is actually again looking more helpful in making such decisions.

So, the point here is that in NPV we can actually we can see the investment like the additional investment, what is being made will be considered at the desired we can be evaluated at a desired discount rate. While in IRR any additional investment or any sort of late cash flow or any difference in the cash flow will again be evaluated only at IRR and that is why the leading to the conflicting decision. And as we know that IRR estimation is much more difficult as compared to net present value, it is better to basically go based on the net present value.

We saw in the earlier example as well that net present value was sort of more justified in decision making that gives us instantaneously like this method should be followed. And here also that we see that the late cash flow is justified by the NPV criteria and we should choose project A which even without considering this third line we can just compare project A and B based on NPV and that is suggesting us to go for project A. So, eventually like after this further analysis also we are lending to the same this thing that NPV is the criteria that should be choose in ranking such projects. So, that is how in the NPV is more helpful.

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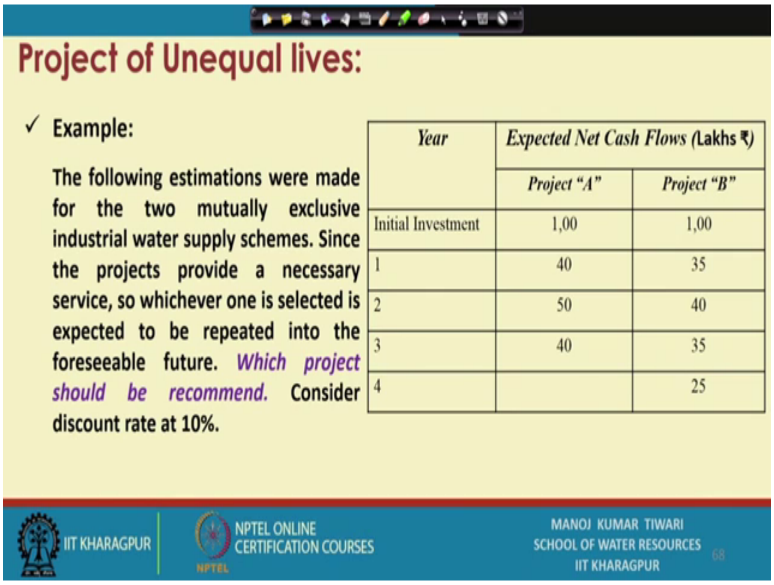

Now, let us consider another example where the projects are of unequal lives. So, we have a let us say two different projects the project A and project B and the life of the two different projects is different. The project A has a life of 3 years while project B has a life of 4 years ok.

Now, there are this example this is an example which says that there are estimation for 2 mutually exclusive industrial water supply schemes, since the project provides us a necessary service. So, whichever one is selected is expected to be repeated on to the foreseeable future which project should be recommended let us considered at 10 percent discount rate.

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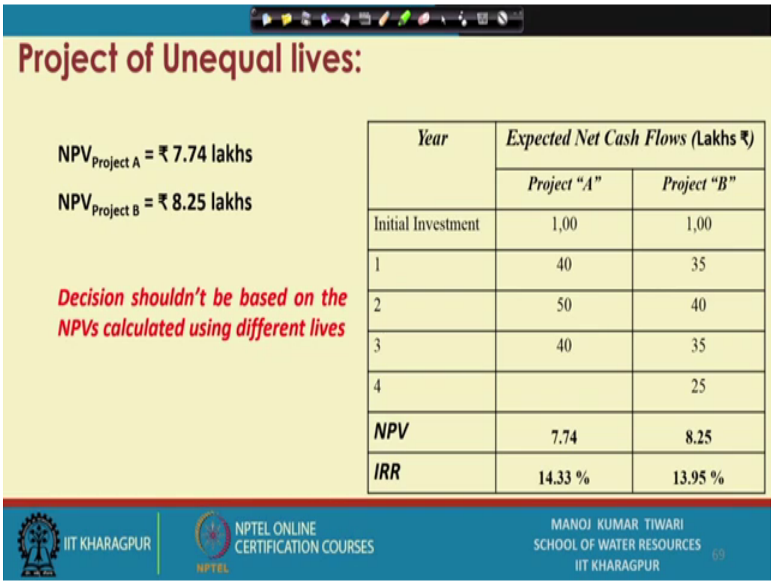

Now, if we estimate the net present value and IRR for these 2 projects we see that again the A is giving me a net present value of 7.74 lakh rupees, B is giving me a higher net present value 8.25 lakh rupees. If we see IRR A is giving me the higher rate of return while B is giving me the smaller rate of return as compared to project A ok.

Now, the point is that these values are computed across different time scales the for project A the investment is for 3 years. So, the net present value is computed for a period of 3 years, IRR is computed based on the cash and flows up to 3 years, in project B it is for 4 years. So, there is one additional time unit involved in the project B and that is leading to higher net present value although the IRR is lower.

Now, decision should be based on the net present value as we earlier see that net present value often like in the earlier different cases net present value was giving us the right ideas, but decision should not be made based on the net present values calculated using different lives. Because if we go by net present value here we see that project B is profitable, project B is having more higher net present value and from our earlier experience as these we saw that net present value is more representative.

So, of the for more representive for ranking of the project. So, we should select project B, but that is not going to be applied here because the life of the project is different and the net present value is calculated using different project lives should not ideally be compared. Then what to do in such case well.

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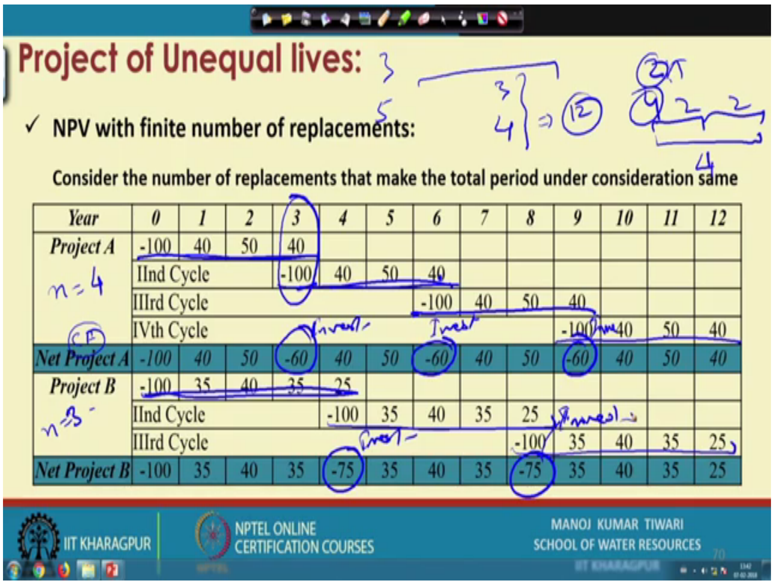

In such case will have to basically consider a NPV for the same period with finite number of replacements.

So, how do we do that we have project A which is there for let see year 0, 1, 2, 3. So, that is my project A and this is my project B which is up to 4 years what I should do we should basically like repeat these projects with n for n number of cycles for finite number of cycles and bring it to a equal lifespan. So, how we can bring it to equal lifespan? One is for 3 year, one is for 4 year we should take there least common factor and we should run this project for that many years.

So, for 3 and 4 it will turn out to be 12, 3 into 4. So, we have to run this project for 12 year. So, that this is my first cycle at end of 3 year I will invest another the same amount and I will have generated revenues for next 3 years that way. So, that is my second cycle of investment and cash return second cycle of cash flow, this is my third cycle of cash flow and this is my fourth cycle of cash flow which brings me to the 12 years.

Similarly, for project B we will have second cycle of cash flow which will bring it down to 8 years and then a third cycle of cash flow which will basically make it 12 years ok. So, that way the project n a we will have 4 cycles, while project B we will have 3 cycles. So, when we run project B for 3 cycles we are running we are considering a total cash flow for 12 years when we are running project A for 4 cycles we are considering a total cash flow of 12 years. So, that has to be computed this way let us say we have 2 another project one is for 2 year another is for 4 years. So, then again we should basically find their common for common lifecycle. So, then we can say that will run this project B for 1 cycle. So, 4 year and project A for 2 difference cycles are 2 years plus 2 year will make it 4 year ok.

So, in that case one project will get a cycle of 1 year another project will get a cycle of cycle one of one project will get 1 cycle while other project will get 2 cycle. If we have let us say 2 other projects 3 and 5 year so; that means, we have to run them for 15 years ok. So, one will get 5 cycles another will get 3 cycles right if we have 4 and 6 so, then we can run again for 12 years. So, 4 year project will get 3 cycle in that case while 6 year project will get just 2 cycles. So, that way we can choose we can pick the finite number of replacement or finite number of cycles for each project to bring the total period and consideration as same right.

So, that is how one can do now if you see now let us consider this projects individually. So, project A 100 investment 40, 50 and 40 return then in at the end of year 3 again 100 replacement 40, 50 and 40 return. So, for this particular third year if you see the net cash flow being generated is 40, but for operating the second cycle of the project will have to invest 100. So, net cash flow is minus 60 means total 40 is being generated, but 100 is to be investment; that means, additional 60 lakh rupees is to be invested. So, that is why if you take the sum so, there is a need of investment of 60 lakhs. So, this is negative; that means, investment this is also negative at the beginning so; that means investment.

So, this is my investment then again there will be written on the fourth and fifth year, sixth year again 40 is returned and 100 is investments. So, again there is a investment of minus 60 and similarly again there is a investment of minus 60 in the year ninth. This is also investment while at year twelfth what is your 40 return is coming will be there.

So, we if we take the some of these we get the net cash flow for project A, this is net for a net cash flow these net cash flow for project A as this for a period of 12 years while similarly for project B it is returning 24 it is getting a cash inflow of 24 in the year 4 and there is a 100 investment. So, there is net 75 investment in the year 4 and similarly there is a 75 investment in the year your investment in the year 7 sorry year 8.

So, I this way I get the total cash flow for project A and project B for the period of 12 year a common period of 12 year including both the projects.

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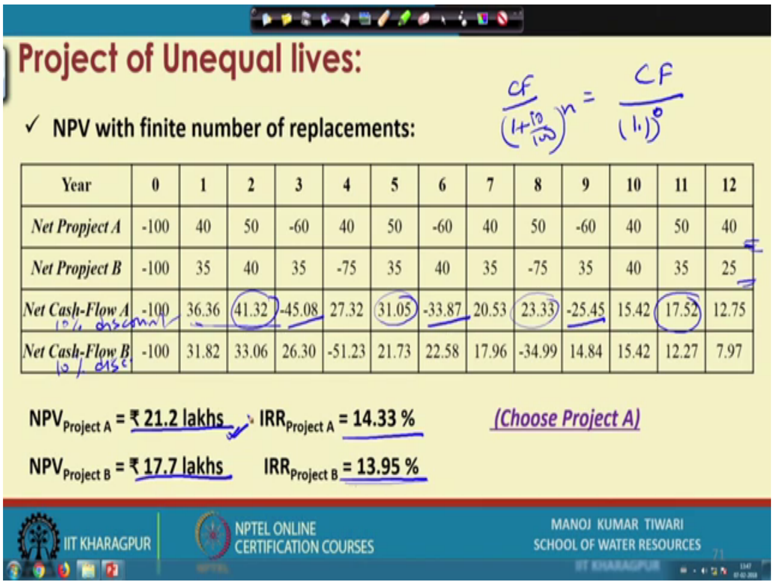

And from here onwards I can actually compare this projects.

So, we see that for project A this is the net cash flow up to year 12, for project B this is the net cash flow for up to year twelve. So, we can now get the discounted cash flow this is at the rate of 10 percent discount same way this is also at the rate of 10 percent discount. So, the discounted cash flow or net cash flow in for project A will actually be this and we can estimate the discounted cash flow for project B.

So, if you see that way this the for the investment 0 when you have let say this is anyway 0 year. So, in a discounted cash flow we have cash flow by 1 plus whatever rate of return. So, it 10 percent so, 10 by 100 to the power n where n is the year so, cash flow divided by 1.1 to the power n. Now n being 0 is basically this will become 1 so, this will remain hundred and then we have different number of n size we have done this earlier as well.

So, if you see for the same like for this thing it will be basically this and when there is a investment, when there is a negative cash flow, when there is a investment this investment is also going to be discounted. Because investing 60 lakh rupees today and investing 60 lakh rupees down the le year like after 3 or 4 year is not of equal value.

So, that investment should also be discounted by the similar factor. So, that is becoming 45 the same amount of investment in year sixth is becoming around 34 and the same amount of investment in year 9 is becoming 25. Similarly, the same amount of return let us say 50 in year 5 is 31, in year 2 is 41 and in year 11 is 17 in year 8 is 23. So, that is how basically the same amount of cash flow is actually losing the value across the time when we discount it for the cash this way. We can get the discounted cash flow for project B as well and now if we take now if we add this discounted cash flow or see the total value so, what we get that net present value of project a is 21.2 lakhs while 5 project B is 17.7 lakhs.

So, if you recall we had a net present value earlier around 7. something for project A and 8. something for project B, project B was having higher net present value while project A was having lower net present value. But when we bring them to equal lifespan time and of course, if you calculate the IRR this way because we are IRR will not change. In all such cases the you can try taking a span of 4 years means for one cycle or you take for one what is say one amount of cycles you will eventually see because it leads to the net present value 0.

So, the IRR is going to remain same so, this was the earlier IRR that we computed anyway. So, IRR was higher for project A while net present value was higher for project B when we see in the beginning, but now what is what we see when we bring them to equal lifespan.

So, we see that even net present value is also high for project A and not for project B. So, project A is having higher net present value as well as higher IRR ok. So, we can choose project A again even if we overlook IRR the net present value is giving me the right decision. When we take the project over to the equal lifespan even if the projects are unequal lives we can actually is work with their finite number of replacement, bring their total live period at the same and then compare the projects based on the net present value ok.

So, this way the net present value will actually indicates to choose which project should be chosen.

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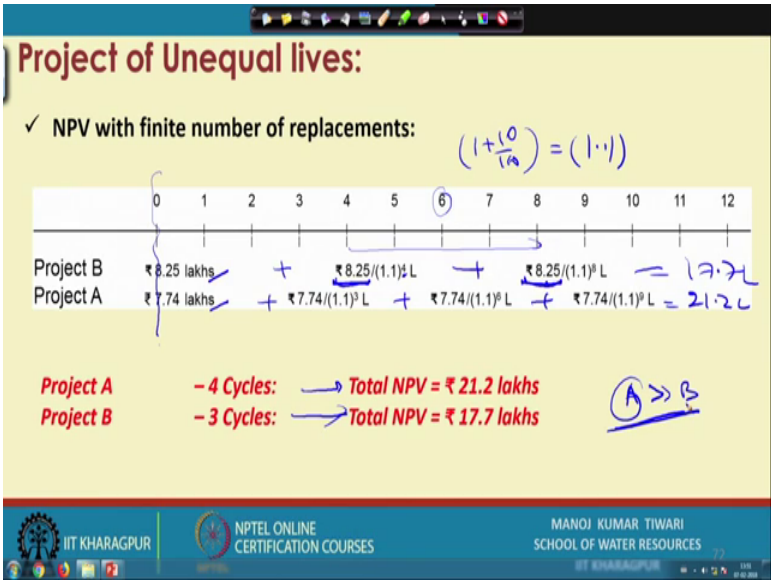

Now, this is for the same data if you see for the first cycle of the project how we discounted all this thing in a different approach and eventually lead to the number net present value for the 2 projects that actually what is happening over here you can see it in you can basically do that analysis in this way as well. For project B we had a net present value of 8.2 to 5 lakhs initially for the for the 4 year duration ideal their basic project B. While project A which was for 3 year duration we had a net present value of 7.74 lakhs.

So, in project B in the second cycle again because we added in year 0 so, this was for 4 years. So, again for the next 4 year we can have see that this is going to generate net present value of 8.25 lakh in year 4 again and 8.25 lakhs rupees net present value of the further investment in that will be there in year 8.

However for the total net present value if one if you want to cal calculate today's at this rate so, you have 8.25 at year 0, then 8.25 is being generated at year 4. So, you discount this net present value also ok. So, this net present value will be discounted 8.25 divided by if 10 percent is the rate of return so, 1 plus 10 upon 100 is we saw earlier is equal to 1.1. So, 1.1 it is actually estimated because this is the point of investment. So, the net present values for the year here which is actually fourth year in the larger reference. So, you see that to the power n. So, you make it divided by 1.1 to the power 4 and similarly in the 8 year 1.1 to the power 8.

Now, if we take the sum of these 3 numbers we get to the same value 17.7 lacks. Similarly for project A 7.74 in year 0, 7.74 in year third. So, 7.74 divided by 1.1 to the power 3, 7.74 divided by 1.1 to the power 6 because it is in the sixth year of investment. And in the ninth year it will be 1.1 to the power 9 it will be divided by 1.1 to the power 9 and if we take sum of these we get the net present value as 21.2 lakhs the same numbers ok. So, that is how the net present value for project A and project B for project in 4 cycles is turning out to be 21.2 lakhs and for project B in 3 cycles is turning out to be 17.7 lakhs and based on higher net present value project A is preferred over project B.

So, that is how we can basically have this decision making based on the net present value which is we saw some different typical cases and try to analyze IRR and net present value. So, net present value always generally gives us the better idea about making investment decisions when we have a predefined discount rate or when we have like when we know that what is the expected rate of return needed for my investment; If that return if we have an idea of that return or that discount rate the net present value is the proper capital budgeting techniques to go for making larger investment decisions ok. it is widely used in variety of sectors including water sector as well and as we have seen with the quite a few problems or quite a few examples from the water sector.

So, with this we will end this week's lecture over here. So, through this entire week we did discuss about the basics of capital budgeting technique and their applications, how they are applied which were discussed through various examples. So, we will close this week's session here and in the next week we will be now talking about the basic governance aspects of water.

Thank you.