Infrastructure Finance
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Lecture - 14
Analysis of Project Viability Capital Budgeting Guidelines

Hi, welcome back to this course on Infrastructure Finance. What we will do in this lecture is to continue what we were doing in the previous lecture, which is to really look at an infrastructure project. And try and do the capital budgeting analysis for that particular project.

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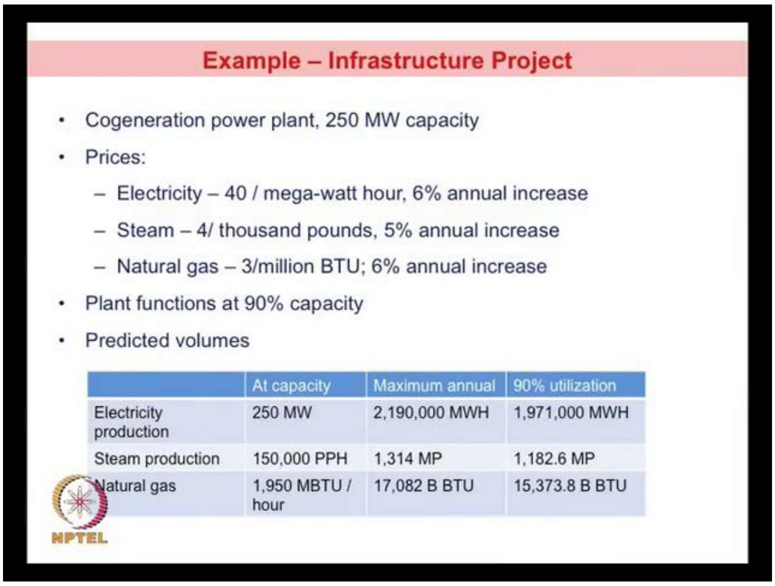

To recollect the example that we were proceeding was, we had a cogeneration power plant which actually is having an install capacity of 240 Megawatts. And the plant generates electricity as well as steam, and the plant has actually signed a purchase agreement for both electricity and steam. And the rates are specified at 40 per Megawatt hour for electricity, escalating at the rate of 6 percent every year.

And then steam at the rate of 4 per 1000 pounds, escalating at the rate of 5 percent every year, and then the plan needs natural gas as fuel. And there is a fuel supply agreement which indicates that the cost of the fuel would be 3 per million British thermal unit, and increasing at a rate of 6 percent annually. And though the plan has 250 Megawatts capacity, the plant is estimated to function only at about 90 percent capacity for a variety of reasons. For example, you may need to actually plan for shutdowns and maintenance, so that there is uninterrupted operations for the remaining part of the year.

So, if we consider all that very rarely you will find a plant operating at 100 percent capacity, so for this example we will assume that the plant will function at a 90 percent capacity. So, therefore, the electricity production every year, if we assume a 90 percent utilization will be 1.971 million Megawatt hours, the steam produced will be 1182.6 million pounds. And then the natural gas that is needed would be 15,373.8 billion British thermal unit.

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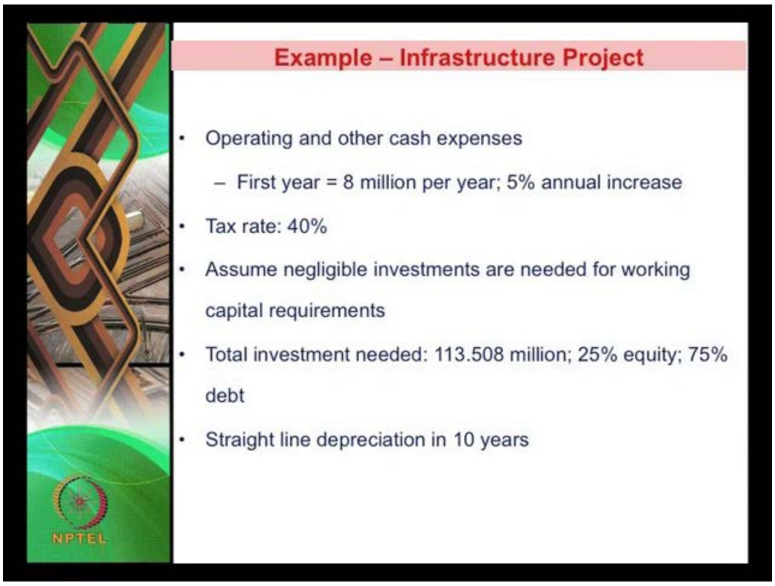

And there are also some of the other cause to that was mentioned, we talked about operating and other cash expenses, in the first year it would be 8 million per year; and subsequently the cost are expected to increased at a rate of about 5 percent and then the tax rate is 40 percent. We assumed in the working capital investments required are negligible this is a very, very simplistic assumption to make, but nevertheless we given the fact that the investments required, otherwise are fairly large.

We will assume that, the work capital investment might not constitute a very significant portion. So, therefore, we make a very is simplifying assumption like negligible working capital investments, and then the total investment needed is 113.508 million, and 25 percent of this investment is coming from equity, and remaining 75 percent from debt. We also assume that the assets are depreciated on a straight line basis in 10 years, so that means, the entire investment of 113.508 it depreciated uniformly over a 10 year period, and you will actually then have a depreciation of 11.35 every year.

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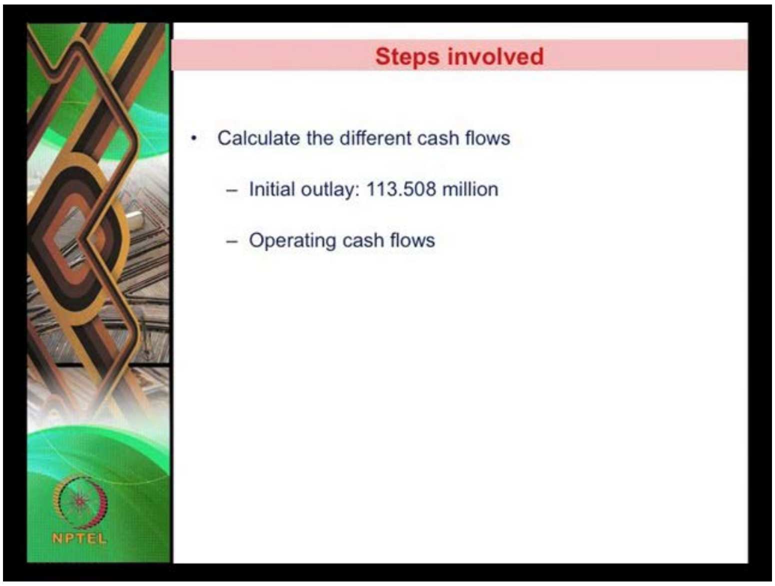

Now, what we will do is, we will try and understand the different cash flows that we need to determine for calculating the capital budgeting. The first would be your initial outlay, initial outlay is nothing but the initial investment that is needed for the project, and as we just discussed the total initial outlay is 113.508 million. So, we have determined one part of four different cash flows that is needed for a capital budgeting decision.

The second part is to determine the operating cash flows, when we determine the operating cash flows, we need to look at the revenues from the project, the cost from the project, as well as other non cash expenses that are needed from the project. Now, let us look at what are the revenues from the project, the project gets revenues from two sources, one is from sale of electricity, the other is from sale of steam. So, let us try and estimate the cash flows, the revenues from these two sources as well.

So, we actually have the price, for price at which the electricity is sold and the price at which steam is sold. And based on this information given, we will be in a position to estimate the revenues by selling these two products, generated from the power plant. Let us try and calculate the revenues from power and steam.

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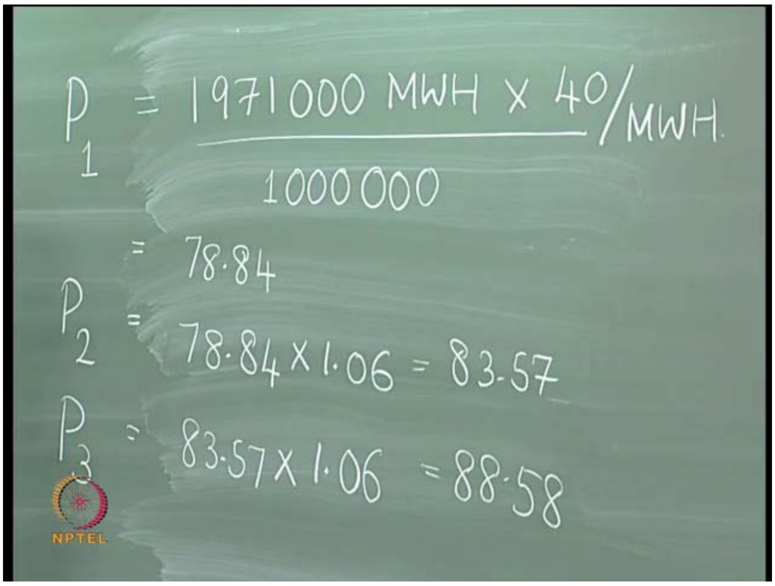

And the revenues from power in year 1, so remember we will have to do the revenue estimations every year because we are talking about increases in price at a specified rates for both steam and power. So, let us try and calculate the revenues from steam in year 1, revenues from generating power in year 1, P signifies power and 1 signifies your 1. So, we have the total power that is been generated in year 1, the total power that is generated is 1971000 Megawatt hour.

And the price at which this power is going to be sold is 40 per Megawatt, so the product of the total power that has been generated, and the price at which the power is going to be sold, will give you the total revenues from electricity. And this we divide it by 1 million to make the number look smaller, and this gives you number of noise 78.84, so in year 1, the revenues from power generation is 78.84 million. Now, how do we determine the revenues in year 2, the revenues in year 2, as we have indicated in the project parameters, the price of electricity increases 6 percent annually.

So, if we make the assumption that, the power generated does not change from year to year, and it remains constant at 1971000 Megawatt hours. Then the revenues from generation of power in the second year would be nothing but the revenues obtained from the first year multiplied by 1.06, this is to take into account the price escalation applicable for the second year. So, this will give you a number of 83.57 million in your second year, so this is a total revenues from power generation in the second year.

Similarly for revenue generation power in the third year would be a revenues obtained in the second year, and account for the 6 percent escalation factor and this will give you 88.58. So, we will have to determine the revenues from power in different years using the same method, the method is very similar for steam as well.

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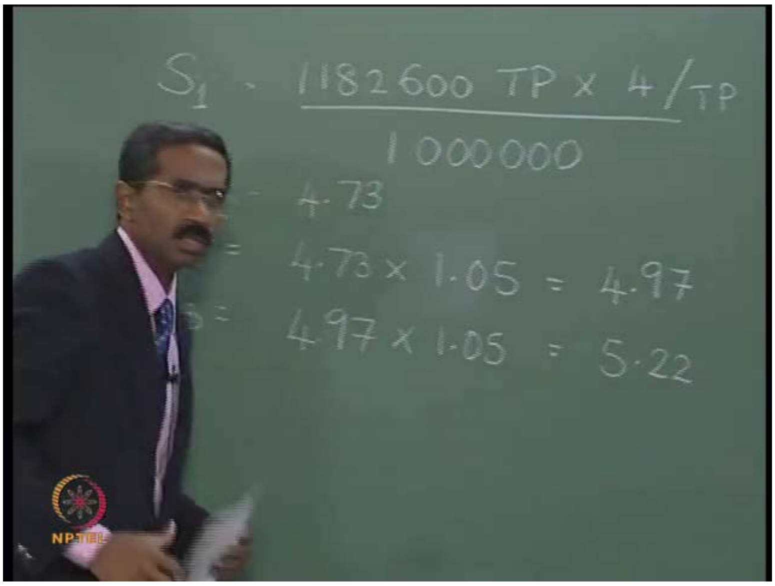

So, for steam the revenues generated from production of steam in the first year is 1182600 1000 pounds of steam that is being generated multiplied by the price of steam, which is 4 per 1000 pound, and we divide it by 1 million to get the revenues in million, so this will give you a value of 4.73. So, 4.73 is the revenues obtained from generation of steam in year 1, revenues from generation of steam in year 2 is nothing but 4.73 multiplied by the escalation factor for year 2. The escalation factor for steam is different as compared to the escalation factor for power.

The escalation factor for steam is only 5 percent, so therefore 5 percent we multiply by 1.05 and this gives you a number of 4.97. And revenues from generation of steam in year 3, very similarly 4.97 which is the revenues generated in year 2 multiplied by the escalation factor 5 percent this will give you 5.0. So, we will have to determine the revenues from steam for each of the years, now let us go back to calculating the costs.

Costs are two types, one is your natural gas the fuel that you need for generating that steam and electricity, and then there are other regular operational expenses. So, the operational expenses are assumed to not vary with respect to power generated, so first let us try and calculate the costs of natural gas.

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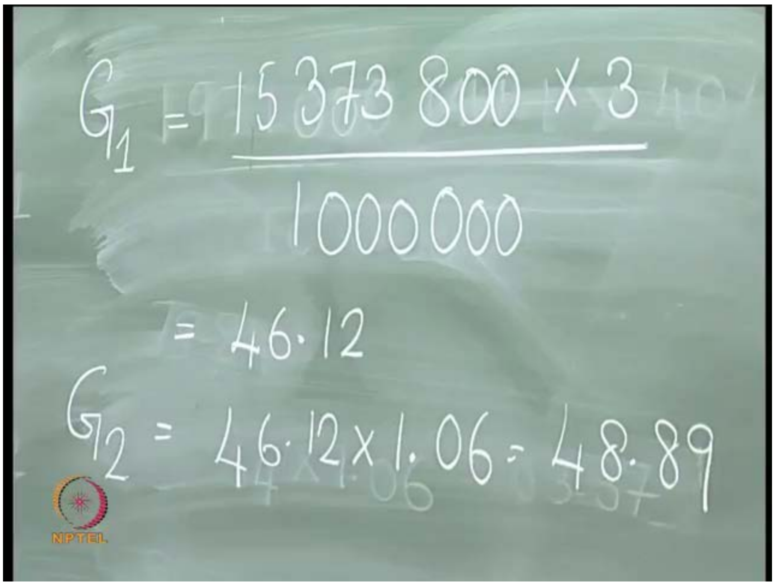

So, the cost of natural gas in year 1 is nothing but the total gas that is needed, the total gas requirement is 15373 800 million British thermal unit. And the cost would be 3 per million British thermal unit, and we divide by million to get natural gas cost in million, so this will give you a value of 46.12 million. So, the cost of natural gas in year 1 will be 46.12 million, like we did for revenues the natural gas cost will also escalate every year in year 2 this would be 46.12, and escalates by 6 percent, so this would be 48.89. So, like we did for revenues we can also calculate, the yearly cost of natural gas by applying the escalation factors, with this we are ready to find out the cash flows from the project for each and every year.

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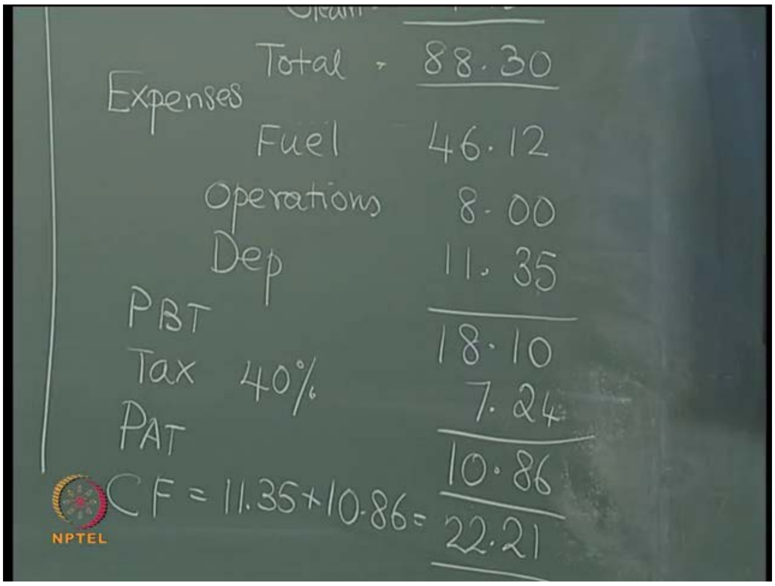

So, the cash flows from the project for each and every year is determined, so we start with revenues, so revenues from electricity would be 83.57, revenues from steam is 4.73 and the total revenues then work out to 88.3. Now, remember trying to calculate these cash flows for each and every year, so what we are trying to now do is we are trying to calculate, the cash flows in year 1. I am just showing year 1 as an example, and I will leave it to you to do the cash flows for the subsequent years.

And after arriving the total revenues we account for the expenses, so what are the different categories of expenses. So, the expenses will consist of fuel, fuel in this case is a natural gas and the expense for natural gas in year 1 is estimated at 46.12, in addition there are other expenses related to operations. So, the operational expenses has given in the projections is 8 million every year, and we also have to account for some non cash expenses.

So, depreciation is a non cash expense we will have to account for depreciation, and the depreciation is 11.35 what we said is that is going to be tenure life, and it is going to be depreciated on a straight line basis. So, every year the depreciation would be 11.35 million, and after accounting for the expenses we get a profit before tax of 18.10, and then we have tax which is 40 percent that will mean a tax of 7.24. And therefore, your profit after tax will be 10.86.

Now, the cash flow from operations would be as we have seen earlier, profit after tax plus addition of the non cash expenses. So, to get the cash flows in year 1 we will have to add profit after tax and depreciation, so the cash flow would be 11.35 plus 10.86, so this will give you 22.21 million in year 1. So, this is the cash flow in year 1 which is 22.21 million, and like we did for year 1 you will have to use the year wise revenues, year wise cost to determine the cash flows for all the years that the project is expected to operate.

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Operating cash flows

	Revenues		Cash expenses					
Year	Electricity	Steam	Natural gas	Operating	Non cash expenses	Pre-tax income	Post tax income	Cash flow from operations
1	78.84	4.73	46.12	8.00	11.35	18.10	10.86	22.21
2	83.57	4.97	48.89	8.40	11.35	19.90	11.94	23.29
3	88.58	5.22	51.82	8.82	11.35	21.81	13.08	24.43
4	93.90	5.48	54.93	9.26	11.35	23.83	14.30	25.65
5	99.53	5.75	58.23	9.72	11.35	25.98	15.59	26.94
6	105.51	6.04	61.72	10.21	11.35	28.26	16.96	28.31
7	111.84	6.34	65.42	10.72	11.35	30.68	18.41	29.76
8	118.55	6.66	69.35	11.26	11.35	33.25	19.95	31.30
9	125.66	6.99	73.51	11.82	11.35	35.97	21.58	32.93
10	133.20	7.34	77.92	12.41	11.35	38.86	23.31	34.66
11	141.19	7.71	82.60	13.03		53.27	31.96	31.96
12	149.66	8.09	87.55	13.68		56.52	33.91	33.91
13	158.64	8.50	92.81	14.37		59.96	35.98	35.98
14	168.16	8.92	98.37	15.09		63.62	38.17	38.17
15	178.25	9.37	104.28	15.84		67.50	40.50	40.50

So, I have actually done this in an excel spreadsheet which I will show it to you just know. So, invoke actually calculate the year wise operating cash flows, you will actually get a table something like this, for each of the years we calculate the revenues from electricity and the revenues from steam. And we calculate the expenses for natural gas, as well as other operating expenses for each of the years, then we have a non cash expenses. So, if you actually notice there is no depreciation from year 11 why because the assets are completely depreciated over a 10 year period.

And there is no further depreciation, and there is no further value that needs to be depreciated from year 11 onwards. And we actually calculate the pretax income, which is nothing but sum of all revenues minus the sum of all expenses, and then after deducting 40 percent tax we get the post tax income, and cash flow from operations is nothing but sum of post tax income plus your non cash expenses. So, now, we have determined the second component of the cash flows.

The next component of the cash flow is to determine the changes to working capital investment. So, for this project we assume that working capital investments are negligible, so therefore, there are no there are no values that needs to be considered for changes to working capital investment. So, as I mentioned before this is a simplistic assumption to make, in case we actually have information about changes in working capital we will have to factor that in, but as far as this example is concerned we will overlook that changes to working capital investments.

Fourth would be to calculate terminal or residual value, see remember we have actually considered when we look at the operating cash flows, we have actually considered cash flows till your 15. But, I am the plant might still have who you have economically useful life, even after a year 15, so it is not that the plant is not able to generate power of steam at the end of 15. But, we are able to project only till year 15 for the simple reason that most of the agreements that we actually have are probably only till year 15.

So, the electricity power purchase agreement has valid for 15 years, the steam purchase agreement is valid for 15 years. So, for a period of 15 years we are able to accurately project the operating cash flows, but at the same time we will also have to consider the fact that, the plant has useful operating life left at the end of 15 years. And it is expected to generate power and serve for the remainder of it is economic life, so we will have to consider that value as well, in determining your capital budgeting decisions.

If you are not able to consider on the remaining part of the economic life, then we have are not accounting for a very important component of the project economics. And the decision that we might make in the absence of that value might not be correct, so we will have to make some estimates in terms of the value of the project, at the end of 15 years, because the plant is going to continue to generate power, even after the 15 year period.

So, how do we actually determine that, so usually the most simple way is to look at the cash flow from operations in the last year of the projections that we have made. So, in this case we will have to look at the year 15 the cash flow from operation, and use that as an estimate to determine your residual value. So, what we normally do is to actually consider the fact that, these cash flow from operations are expected to grow at a steady rate at the foreseeable future.

So, we assume that this is more like an annuity that is going to occur of for an indefinite period of time. And we use the annuity we use a perpetuity valuation approach to determine the residual value of the cash flow from operations at the end of year 15.

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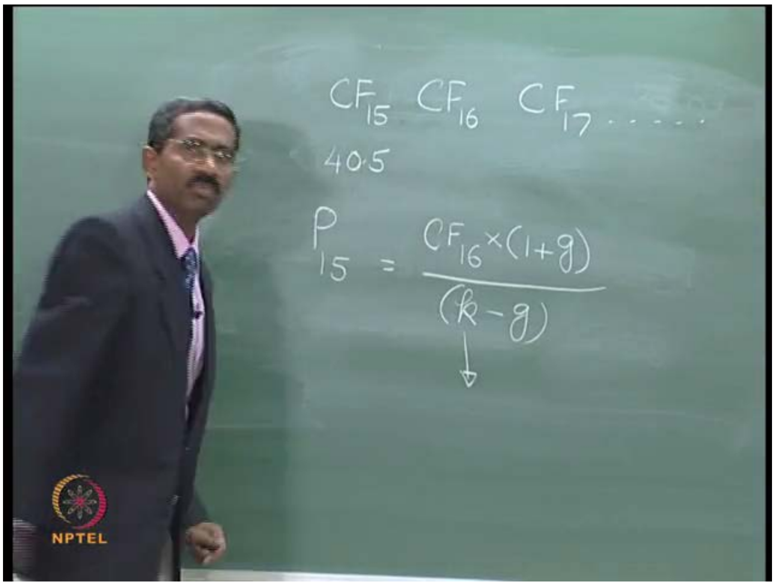

And, so what do we actually do we have cash flows from year 16 cash flows from year 17, so on. And we make an assumption that cash flows from year 16 will grow as compared to cash flow from year 15 by some growth rate, and this growth rate is expected to be steady in the foreseeable future it is a very valid assumption to make. Because, when the project is, so far when you are going to predict, so far away in the future, the rates might actually be approaching a steady state growth rate.

So, we have cash flows in year 15 which is a 40.5 noise, so cash flows in year 16 is going to grow by a percentage over cash flows near 15, cash flows in year 17 will go by a certain amount of fixed percentage as compared to year 16 and so on. So, this is what we can call is a perpetuity, cash flow stream growing at a steady growth rate.

So, now, if you want to determine the value of the perpetuity cash flow stream, at the end of your year 15, the expression that we will have to use is cash flow in year 16 and multiplied by the growth rate of this cash flows every year divided by the discount rate which is your cost of capital, and divided by a discount rate minus your growth rate.

So, this will be the value of this perpetuity cash flow stream from year 16 onwards, so the value of this perpetuity clash cash flow stream, in year 15 will be cash flows in year 16 multiplied by 1 plus growth rate divided by the cost of capital minus your growth rate. So, for calculating the terminal value, so this a sense is your terminal or residual value at the end of year 15, so for calculating this terminal or residual value, we need to actually determine your cost of capital. So, first we will determine your cost of capital and then come back to determining your terminal value. Now, let us see how do you determine the terminal or the cost of capital for the project.

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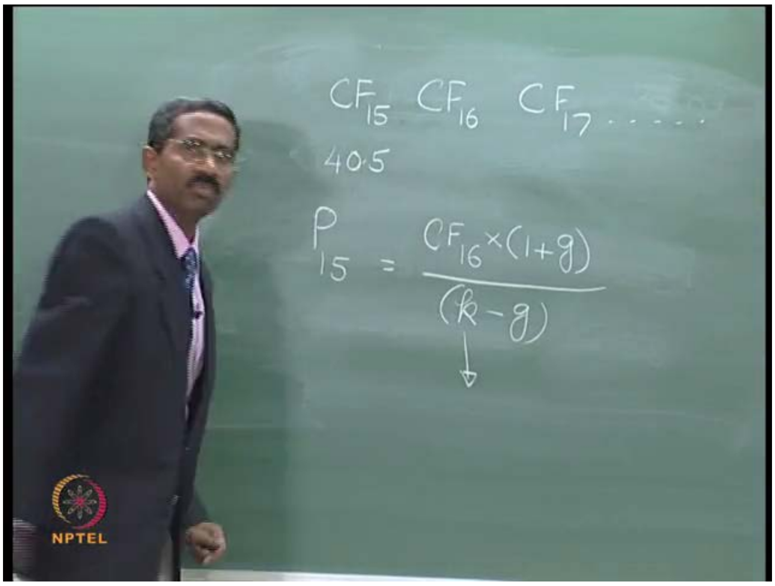

So, cost of capital is nothing but your weighted average cost of capital, and this is the weighted average of debt and equity multiplied by their respective cost, in the capital structure. So, as we have seen the project is funded 75 percent by debt capital, so 75 multiplied by the cost of debt which is nothing but the interest on the loan which is 10 percent. And remember when we always calculate, when we always use the cost of debt it has to be done on a after tax cost of debt basis.

So, we multiply it by 1 minus tax rate noise which is your 40 percent, so this represents your after tax cost of debt plus noise the cost of equity which is 25 percent of the capital structure multiplied by the cost of equity which is 28 percent. So, when you calculate the weighted average cost of capital, it will give you a figure of 12 percent. So, we then use the weighted average cost of capital of 12 percent, in determining your terminal value at the end of your 15, terminal value of the distilled value at the end of year 15.

And, so the terminal value at the end of year 15 will be 45 multiplied by the growth rate it is a growth rate is something that we need to assume. For example, we assume a very nominal growth rate and because we and the project is not expected to have very high growth rates at when it actually at the end of about 15 years and so on. Because, of various reasons, competition and it would gradually reach a steady state of growth and so on.

So, I have actually assumed a growth rate of 3 percent and so therefore, 1 plus g or 1.03 and your divided by 12 percent, which is your cost of capital minus your growth rate is your 3 percent. So, this will actually give you the terminal value, so the terminal value thus calculated works out to 490.76 million. So, what we now have is we actually have information on all the four components of cash flows that are needed to calculate the capital budgeting to make the capital budgeting decision.

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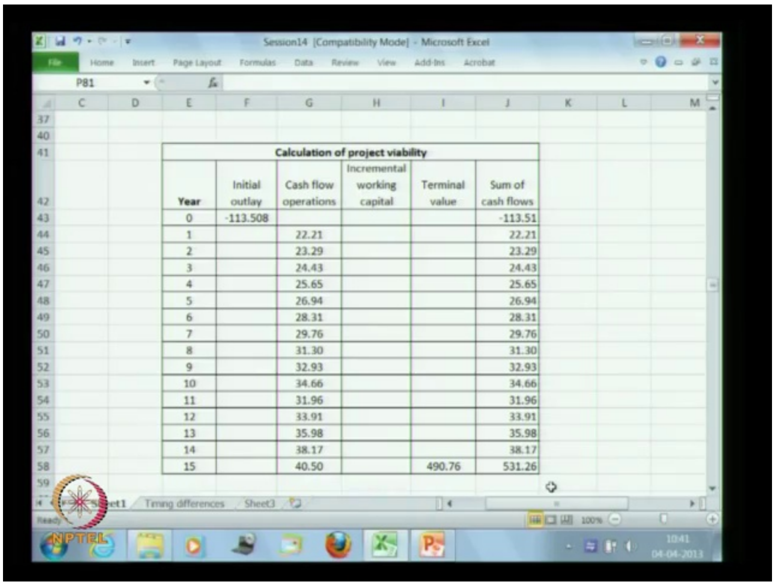

Calculation of project viability					
Year	Initial outlay	Cash flow operations	Incremental working capital	Terminal value	Sum of cash flows
0	-113.508				-113.51
1		22.21			22.21
2		23.29			23.29
3		24.43			24.43
4		25.65			25.65
5		26.94			26.94
6		28.31			28.31
7		29.76			29.76
8		31.30			31.30
9		32.93			32.93
10		34.66			34.66
11		31.96			31.96
12		33.91			33.91
13		35.98			35.98
14		38.17			38.17
15		40.50		490.76	531.26

So, I have actually put everything in a excel spreadsheet as follows, so for each of the years starting from year 0 to year 15, in year 0 there is an initial outlay of 113.508 million. And then subsequently the cash flow from operations is what we have discussed initially that we calculate, from the year wise revenues and costs and then we assume there is no working capital or negligible working capital investments that are needed. So, the entire column is blank just indicate that there are no any major working capital investments.

And finally, we discuss the terminal value, so the terminal value is nothing but the value of cash flows that accrues to the project from year 16 onwards. So, the value of this terminal cash flows in the end of year 15 is 490.76, so these are the four cash flow components that we needed, initial outlay cash flow from operations, incremental working capital and terminal value to determine your capital budgeting decision. So, what I have now done is, I have now calculated a sum of all the cash flows for each of the years.

So, this column is nothing but summation of all the cash flows for each of the years all the components of the cash flow is for each of the years. So, we can actually use this information we can use this information to calculate your net present value, so let us now try and calculate the net present value for this project. So, I am going to use a net present value function available in Microsoft excel, NPV and then the rate at which we need to discount it is your weighted average cost of capital, which is 12 percent.

And then we take all the cash flows of the project right from year 0, so we consider all the cash flows from the project from year 0, and this actually gives a net present value of 150.32. So, this means that the project actually has a positive value, and the project is a worthwhile investment because the net present value is positive, we can also use the same method to actually calculate the IRR. So, IRR we actually use the IRR function in excel, and then we include all the cash flows that we have calculated from the project and this gives an IRR of 26 percent.

So, the IRR of 26 percent is higher than the weighted average cost of capital of 12 percent, so the recommendation would therefore, be to accept the project. So, this is a an example of reasonably comprehensive infrastructure project, and this is how we actually calculate the net present value or the IRR to arrive at a good investment decision, that is should we actually go ahead and make the investment in the project or not. The next aspect that is involved is what is known as your coverage ratios that is we actually seen the project viability.

But, lenders to the project are also interested in finding other ways of evaluating the project for example, an important measure that they look at is the coverage ratio that is this is a project generating adequate cash flows, for each of the periods. So, that we are able to service the principal as well as interest payments, and it is not adequate that the project is able to provide a overall profits. But, the profits or the cash flows should be there for each and every period, to ensure that the interest and loan repayments are made on time.

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So, let us look at how do we calculate the coverage ratios, the total principal loan amount for this project is 85.131 million, the loan is for a period of 10 years, and the interest rate is 10 percent. And the principal is paid not uniformly, but it varies from year to year, in years 1 to 3 the principal repayment is 5 percent of the total principal, and years 4 to 7 is 10 percent of the loan amount it was borrowed, and years 8 to 10, 15 percent of the total loan amount it was initially borrowed. So, total we will repay 100 percent of the loan by year 10, but the rate at which we repay varies from year to year. So, now, let us use this information to calculate your coverage ratio, how do we actually determine or what is the coverage and how do we calculate it is what we are trying to learn at this part.

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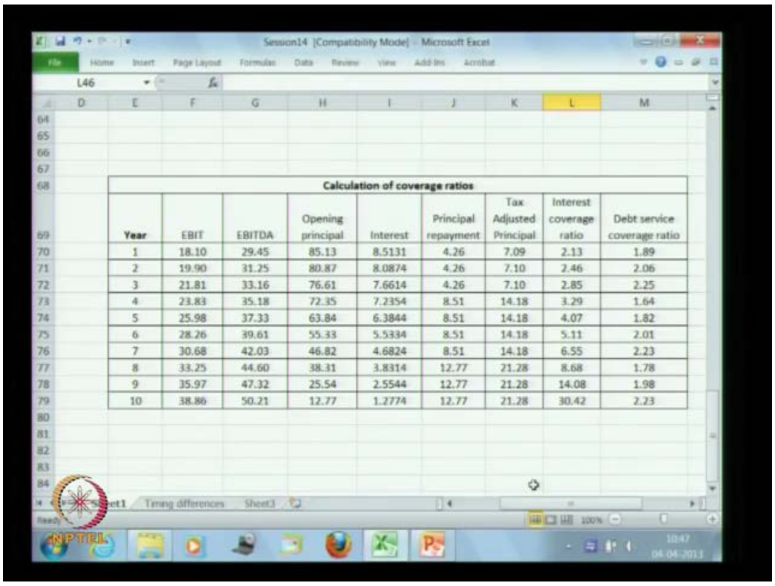

Calculation of coverage ratios

Year	EBIT	EBITDA	Opening principal	Interest	Principal repayment	Tax Adjusted Principal	Interest coverage ratio	Debt service coverage ratio
1	18.10	29.45	85.13	8.5131	4.26	7.09	2.13	1.89
2	19.90	31.25	80.87	8.0874	4.26	7.10	2.46	2.06
3	21.81	33.16	76.61	7.6614	4.26	7.10	2.85	2.25
4	23.83	35.18	72.35	7.2354	8.51	14.18	3.29	1.64
5	25.98	37.33	63.84	6.3844	8.51	14.18	4.07	1.82
6	28.26	39.61	55.33	5.5334	8.51	14.18	5.11	2.01
7	30.68	42.03	46.82	4.6824	8.51	14.18	6.55	2.23
8	33.25	44.60	38.31	3.8314	12.77	21.28	8.68	1.78
9	35.97	47.32	25.54	2.5544	12.77	21.28	14.08	1.98
10	38.86	50.21	12.77	1.2774	12.77	21.28	30.42	2.23

This table here gives you an indication of how do we actually calculate your coverage ratio, I have actually captured the earnings before interest tax for the first 10 years of the plant operation. This is an information that we actually obtained from the operating cash flows calculation, we calculated the operating cash flows for different years, and we have the pretax operating income. So, this earnings before interest tax is essentially taken from taken from that calculation.

And then you have EBITDA, EBITDA is nothing but EBIT plus your depreciation we add back our depreciation. So, this is your earnings before interest tax plus your depreciation, and then we have what is called as the opening principal that is the total amount that is borrowed, which was 85.13 million. And since the interest on the loan is 10 percent, the interest that is paid in year 1 is 10 percent of the principal that is 8.1531 million. We repay 5 percent of the opening principal in year 1, so the total principal that is repaid is 4.26.

And then there is something called as your tax adjusted principal, what is this tax adjusted principal. Remember, when you actually repay interest you get some tax shields you get tax benefits, but when you actually repay a principal there are no tax benefits, so essentially you repay principal from the cash flows that are available to the company, after payment of the tax. So, if you need to actually pay a principal of 4.26 million, then you should actually have a cash flow that is higher than 4.226.

Because, certain amount of tax would be deducted from these cash flows, and the relevant cash flows available after tax is what is can be used for payment of principal. So, let us consider that tax rate of 40 percent.

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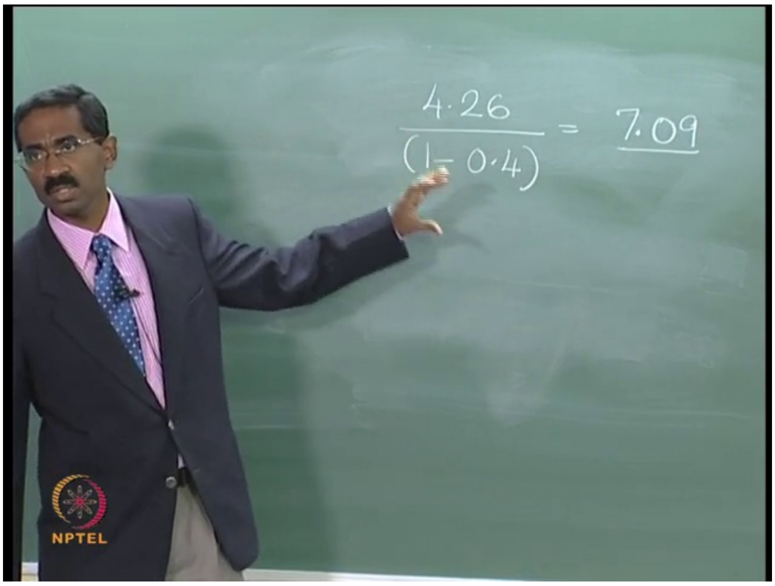

So, for repayment of 4.26 in terms of principal the firm would have generated 1 minus 40 percent tax, which equals 7.09. So, only if the firm is able to generate cash flows of 7.09, it would be able to repay a principal of 4.26 because it has to pay 40 percent tax and the profit that it generates, so that it is able to repay the principal back. So, this is a tax adjusted principal 7.09.

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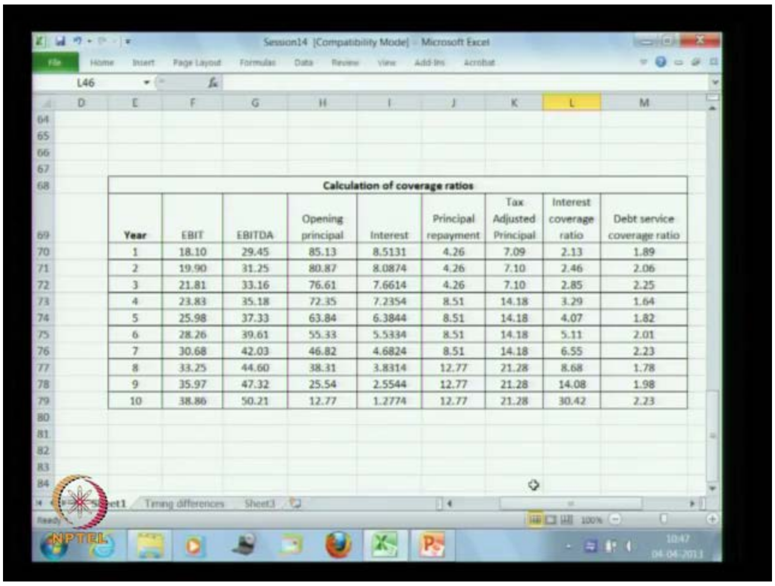

Calculation of coverage ratios

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1	18.10	29.45	85.13	8.5131	4.26	7.09	2.13	1.89
2	19.90	31.25	80.87	8.0874	4.26	7.10	2.46	2.06
3	21.81	33.16	76.61	7.6614	4.26	7.10	2.85	2.25
4	23.83	35.18	72.35	7.2354	8.51	14.18	3.29	1.64
5	25.98	37.33	63.84	6.3844	8.51	14.18	4.07	1.82
6	28.26	39.61	55.33	5.5334	8.51	14.18	5.11	2.01
7	30.68	42.03	46.82	4.6824	8.51	14.18	6.55	2.23
8	33.25	44.60	38.31	3.8314	12.77	21.28	8.68	1.78
9	35.97	47.32	25.54	2.5544	12.77	21.28	14.08	1.98
10	38.86	50.21	12.77	1.2774	12.77	21.28	30.42	2.23

And then we have the coverage ratios, we have that coverage ratios, we have the interest coverage ratio, and then we have the debt coverage ratio. How do we actually calculate the interest coverage ratio.

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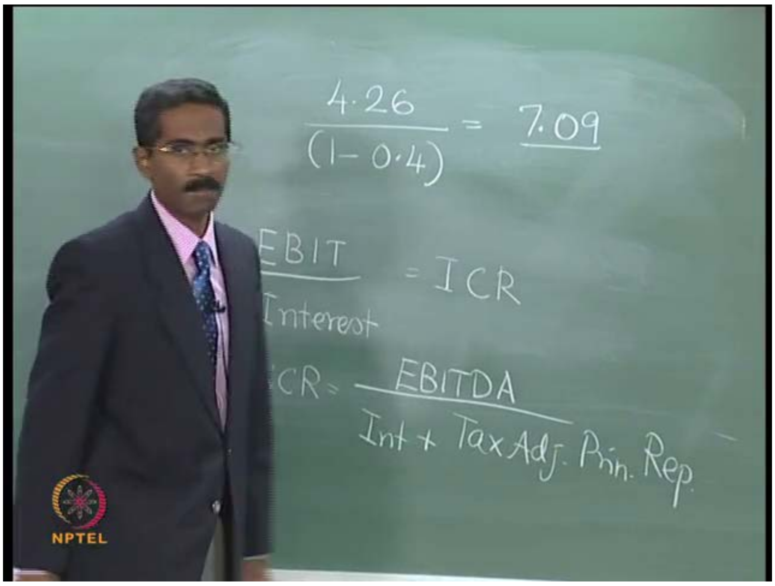

Interest coverage ratio is nothing but earnings before interest tax divided by your interest. So, this is your interest coverage ratio, I will denoted it as ICR standing for Interest Coverage Ratio, so in the excel spreadsheet we can actually calculate interest coverage ratio, this equal's earnings before interest tax divided by your interest for this particular year, and this will be 2.13. Similarly, you have the debt service coverage ratio, we define debt service coverage ratio, with the following expression this would be EBITDA divided by your interest payment plus your tax adjusted principal repayment.

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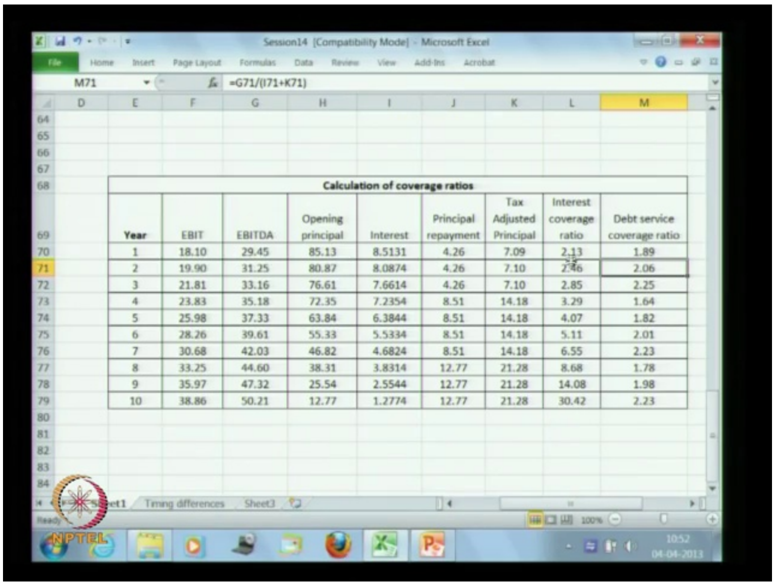

M71 =G71/(I71+K71)

Calculation of coverage ratios

Year	EBIT	EBITDA	Opening principal	Interest	Principal repayment	Tax Adjusted Principal	Interest coverage ratio	Debt service coverage ratio
1	18.10	29.45	85.13	8.5131	4.26	7.09	2.13	1.89
2	19.90	31.25	80.87	8.0874	4.26	7.10	2.46	2.06
3	21.81	33.16	76.61	7.6614	4.26	7.10	2.85	2.25
4	23.83	35.18	72.35	7.2354	8.51	14.18	3.29	1.64
5	25.98	37.33	63.84	6.3844	8.51	14.18	4.07	1.82
6	28.26	39.61	55.33	5.5334	8.51	14.18	5.11	2.01
7	30.68	42.03	46.82	4.6824	8.51	14.18	6.55	2.23
8	33.25	44.60	38.31	3.8314	12.77	21.28	8.68	1.78
9	35.97	47.32	25.54	2.5544	12.77	21.28	14.08	1.98
10	38.86	50.21	12.77	1.2774	12.77	21.28	30.42	2.23

So, in the excel spreadsheet if you look at it will be your EBITDA divided by interest plus your tax adjusted principal repayment, and this will give you a debt service coverage ratio of 1.89. So, we calculate the interest coverage ratio and the debt service coverage ratio for each of the years, when the loan is outstanding by year 10 the loan is been completely repaid. And therefore, there is no need to calculate the interest coverage ratio and the debt service coverage ratio, because it would not exist, when the interest that is paid is 0 the value will not exist.

So, therefore, whenever the loan is completely repaid, the interest coverage ratio and the debt service coverage ratio would not exist. But, for the period when the loan is in force we need to calculate whether the interest coverage ratio on the debt service coverage ratio are meeting, the conditions that the lenders have set forth. It is not enough if the interest coverage ratio the average value of interest coverage ratio for the entire loan life meets the conditions.

But, each of the year should be able to meet the parameters put forward by the lenders. So, we will have to calculate the interest coverage ratio for each of the years and ensure that it is met as per the loan covenants, so this completes the discussion on the capital budgeting in that we have been looking at for the last two sections, and we actually you know put forth the thought question to discuss. And let us now spend some time to look at that question that we put forward.

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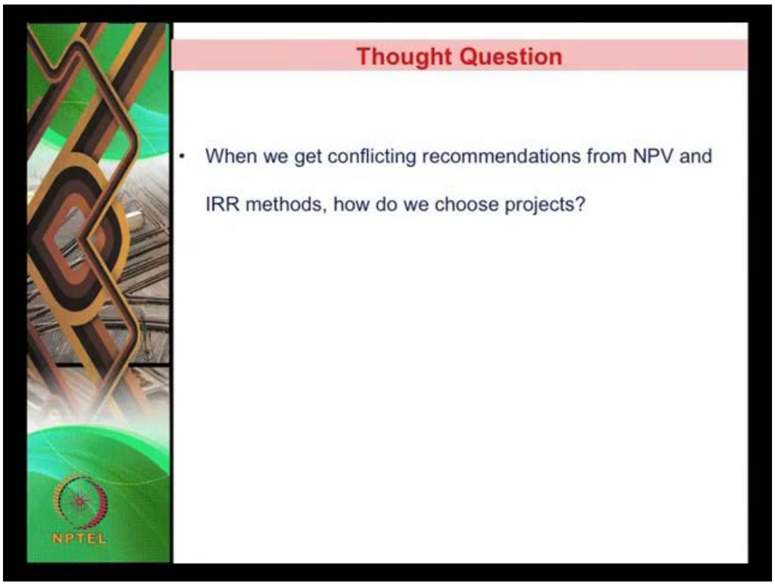

So, the question that they had was when we actually get conflicting recommendations from net present value and IRR methods, how do we choose the projects. So, far our discussion has been that when you actually have a project with a positive net present value or an IRR that is more than your cost of capital, then you go ahead and choose the project. But, when you get conflicting recommendations, when do we actually have to safeguard when recommendations are conflicting.

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So, an important situation that in reality that would exist is a mutually exclusive projects. So, when you implement project A by default we cannot implement project B or when you go head and select project B you cannot implement project A. So, this projects are mutually exclusive, you can implement any one of the project both of them having positive net present values, then all you will have to implement only one of the projects. Simply, because implementing one project will automatically disqualify the other project from implementation. So, the conflicting recommendations could occur because of size differences that is the project sizes are different or the cash flow timings are different.

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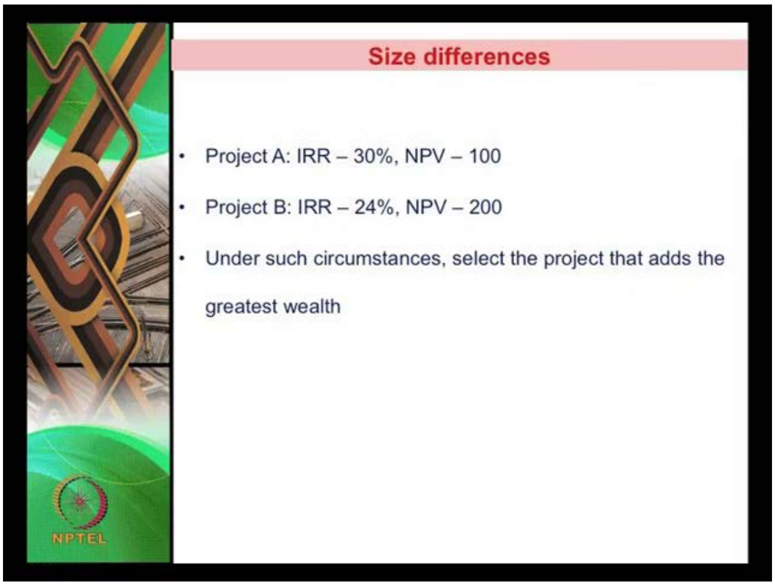

So, let me give you an example in each of those, so if you look at size difference, let us consider there are two projects, project A has an IRR of 30 percent and it gives A net present value of 100. And project B has an IRR of 24 percent, and net present value of 200, so this projects are mutually exclusive so; that means, if you implement project A you cannot implement project B. If you choose project B you cannot select, you cannot implement project A.

If you look at the outcome from both IRR and net present value there is a conflict, the IRR is higher for project A whereas, for project B the net present value is higher. So, which of these project will you choose, if these are mutually exclusive, if you actually choose the IRR criterion then you should use project A. Because, project A is the highest IRR, but if you use the net present value is the criterion, you will have to choose project B because it as the higher net present value.

So, the important thing to realize under these circumstances, which one of them should be used should we use the IRR or should we use the net present value. So, it is always preferred that we use the net present value criterion because net present value indicates the amount of wealth that the project creates. So, we should always go head and choose that project, which actually creates the largest wealth.

So, from that prospective if we see project B generates the largest wealth and therefore, we will have to choose project B. If we choose IRR sometimes we may end up selecting smaller projects, and invariably we find the IRR is larger for smaller projects as compared to bigger projects. Smaller projects need not necessarily generate the largest amount of wealth, and it is always preferred that we use a criterion of a project depending on how much wealth they actually create.

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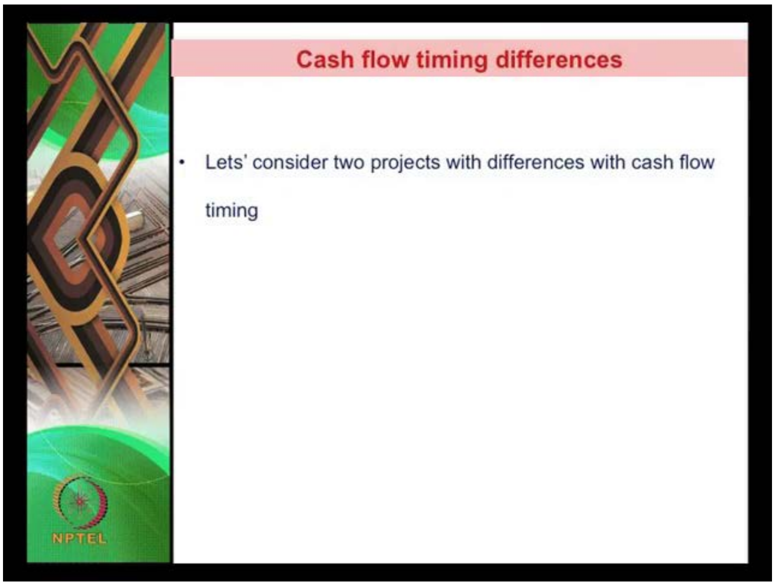

Next, we look at an example that considers the cash flow timing differences, so let us say there are two projects with different cash flow timings.

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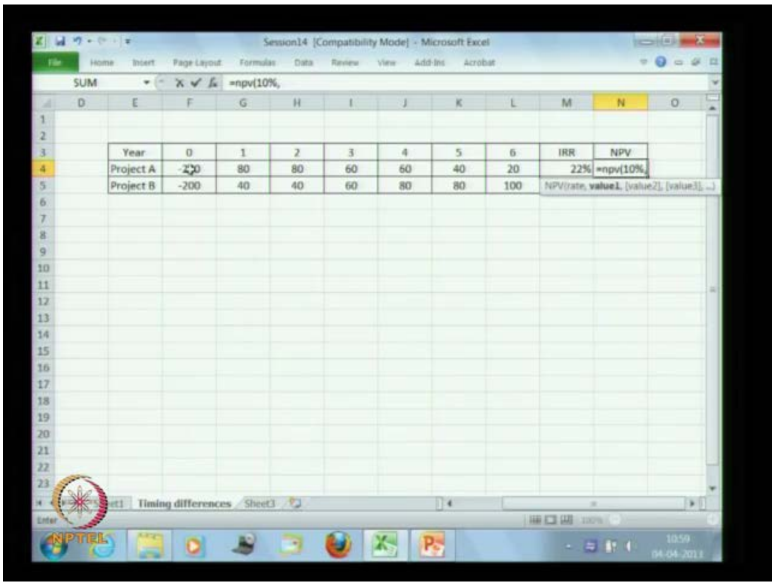

Let us see this example noise, so there are two projects, project A and project B both of them have the same investment, the initial outlay if you look at the initial outlet in here 0 it is same for both the projects, project A and project B. But, if you look at the year wise cash flows you actually find in project A majority of the cash flows are occurring in the initial years of the project. Whereas, in project B the majority of the cash flows is occurring in the later years of the project.

So, there is a timing difference, timing in terms of when do the majority of the cash flows occur. Let us now calculate the IRR and net present value for both these projects, so if you calculate the IRR for project A, I am using the IRR function that exists in excel, it gives an IRR value of 22 percent. And we calculate IRR for project B, we actually get a figure of 20 percent, so therefore, from an IRR prospective project A is preferable because it has the highest IRR.

If you look at net present value, we assume a discount rate of 10 percent, and we calculate the net present value of the project. And the net present value of project A is 55.48, and if you calculate the net present value of project B it is 68.42, so what do we do, we actually have a situation where an NPV criterion says project B is better, but the IRR criterion says project A is better. So, even under the circumstances when there is timing differences, we will actually have to choose a project that we actually preferred by the net present value method.

The net present value method for project B is preferable, so we should always go for project B because of the assumption that underlies the IRR and the net present value method. The IRR method implies that all the intermediate cash flows are reinvested at the IRR rate of return. So, that means, the cash flows from project A the intermediate cash flow from project A are reinvested at the rate of 22 percent, which in reality might not be possible to achieve.

But, if we use the net present value criterion, the assumption in the net present value criterion is that all the intermediate cash flows are reinvested at the rate of cost of capital. So, which is a more plausible thing to achieve, so when you invest you are at least expect to get return that meets your cost of capital, so net present value assumes that the intermediate cash flows are reinvested at a rate that equal to the cost of capital. Whereas, IRR assumes that intermediate cash flows are reinvested, at a rate that equals to the IRR.

And IRR in many cases is fairly large, which may not be possible to achieve in reality and therefore, we actually choose that project that is preferred by the net present value method. So, to sum up whenever we actually have conflicting recommendations under different guidelines, under the different techniques of capital budgeting and if the projects are mutually exclusive, it is always preferred that the projects that are recommended by the net present value be chosen as compared to the other methods.