Software Project Management
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Lecture – 13
Project Evaluation and Programme Management (Contd.)

Good afternoon to all of you. So, today we will discuss the different cost benefit evaluation techniques.

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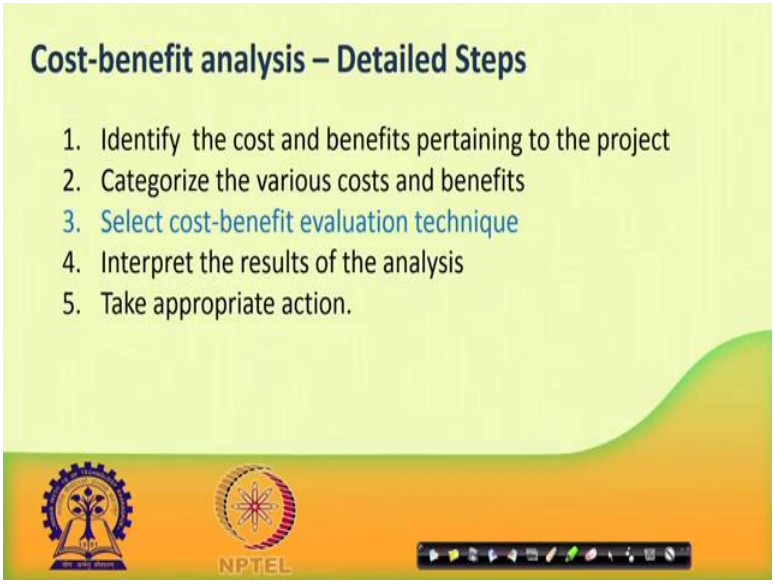

Last class we have seen these the two phases of cost benefit analysis; that means, identifying the cost and benefits, then categorizing the various cost and benefits. Today we will see the third step that is the selecting the cost benefit evaluation technique. How to select a proper a suitable cost benefit evaluation technique?

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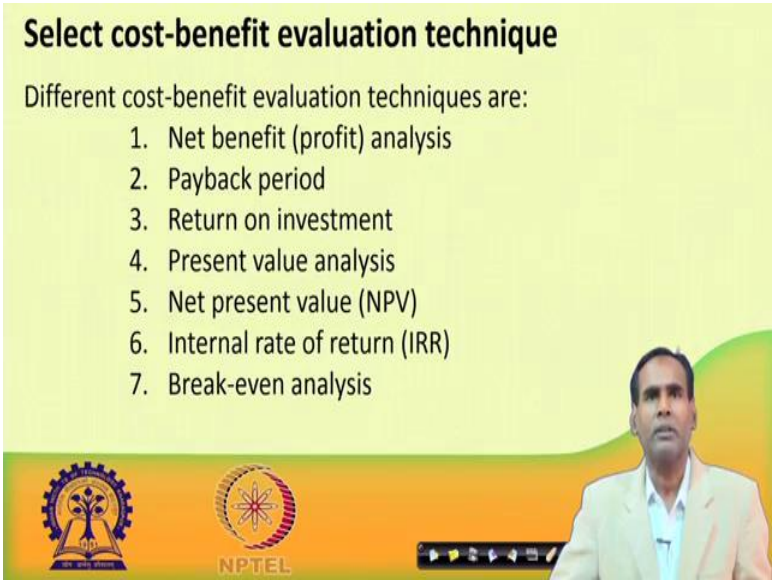

So, let us see what are the different cost benefit evaluation techniques available, there are many cost benefit evaluation techniques available these are as such net benefit or net profit analysis, payback period, Return on Investment or ROI, present value analysis, Net Present Value or NPV, Internal Rate of Return or IRR and break even analysis and a few others also exist let us discuss these cost benefit evaluation techniques one by one.

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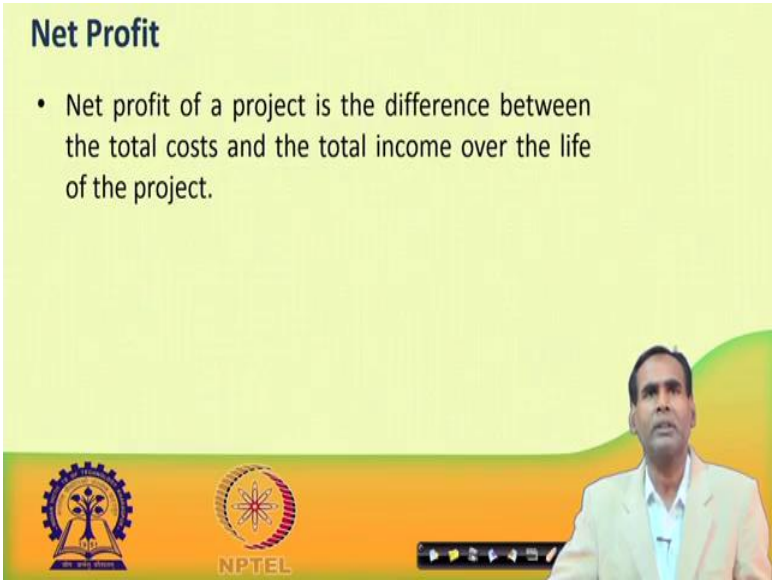

First we will discuss about the net profit. So, what do you mean by net profit? Net profit of a project is the difference between the total cost and the total income over the life of

the project. So, we have to find out the difference between the a total cost spent and the total income obtained over the life of the project.

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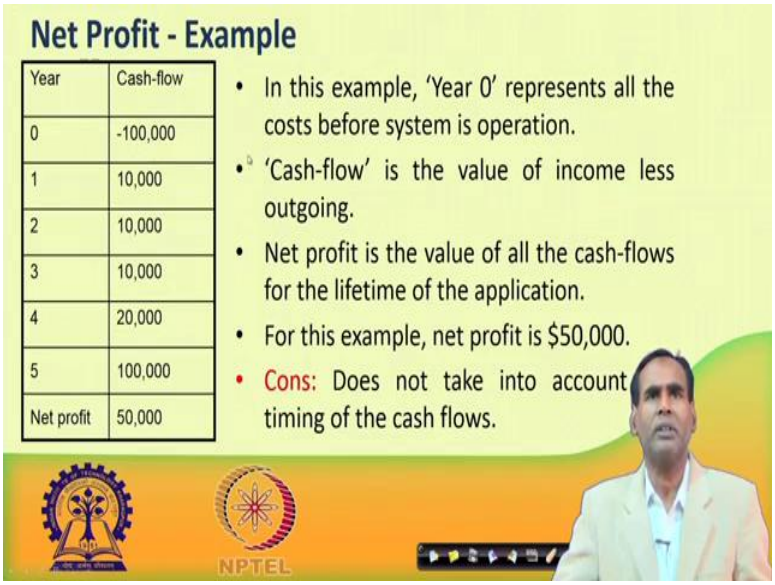

We will take a small example to illustrate this, so we have taken a small example we are the cash flows are given year wise last class we have already seen what a cash flow is. So, in this example you can say that the year 0 represent the cost before the system is operation. So, before the system is in operation that we take as year 0 and this cash flow represents the cost before the system is in operation.

Cash flow already we have discussed yes yesterday it is the value of income less outgoing I mean the value of the difference between the income and the expenditure, so income minus outgoing will represents the cash flow. Net profit is defined as the value of all the cause cash flows for the life of the lifetime of the application. So, in an application for the whole life how much what cash flows occur?

So, we have to find out the total value of the cash flows for the whole lifetime of the application in this example you see the application or the project is expected to continue for 5 years and in 0 years we have spent how much 1,00,000. So, this is spent for what establishing the project. So, here we have not got any revenue, then year 1 onwards it gives revenue and you can see that or the first year it gives a 10,000 total or and like this are the end of 5th year it gives 1,00,000 return 1,00,000 benefit. So, or 1,00,000 we can say the income it gives in the 5th year.

So, the net profit it has to be all these cash flows for 0 to 5 years they have to be added and you will get it. So, here you can say easily that the net profit for this example of project for 5 years is coming to be 50000 dollar. So, for this example in a profit is 50,000.

Now, let us see what is the drawback of this technique in the drawback is the does not taking the count the timing of the cash flows. So, what is the time value of the money? It does not take into account the timing of the cash flows that is one of the drawback in some of the classes we will see how this draw back can be overcome by which technique.

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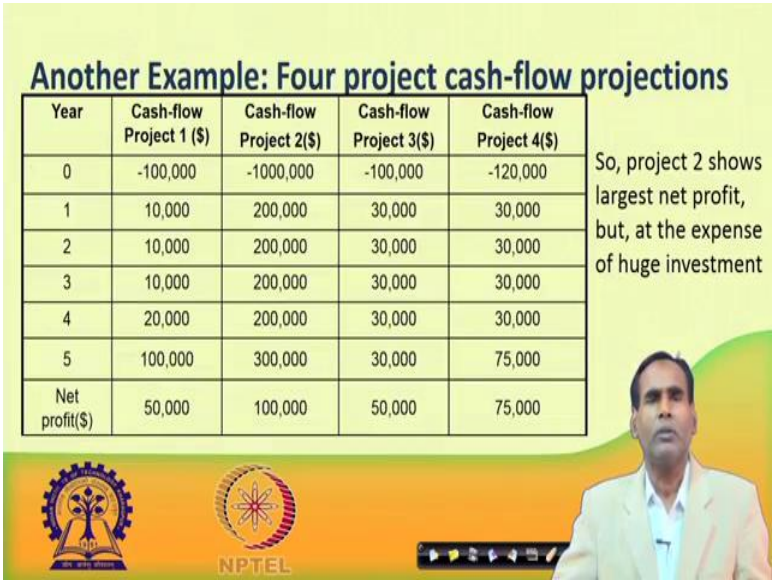

So, we will take quickly another one example here you can see that there are four projects have been shown, the cash flows for each of the projects have been shown and year wise the year wise cash flows for every project has been shown. And finally, at the last row we have discussed about this what we have discussed the various, the net profits for each of the projects and you can see here that already for project 1 I have shown in the previous slide.

So, the net profit is coming to be a 50,000, for project 2 again you will got of the all the cash flows you will get the total the net profit this is like say 1,00,000. And similarly for the net profit for cash, for project 3 its 50,000 and the net profit for project 4 is coming to be 75,000.

You can easily say that here project 2 gives the maximum net profit. So, that is why this will be the what beneficial one here, but you see even if it gives the maximum net profit, but at the expense of huge investment initially see how much every year you are just spending here the project 1 and project 2 1,00,000, project 4 it is 1,20,000 about here we spent about how much it 10,00,00. So, the initial investment is of 10,00,000. So, that is why even if it gives maximum net profit, but at the expense of huge investments, so that has to be considered.

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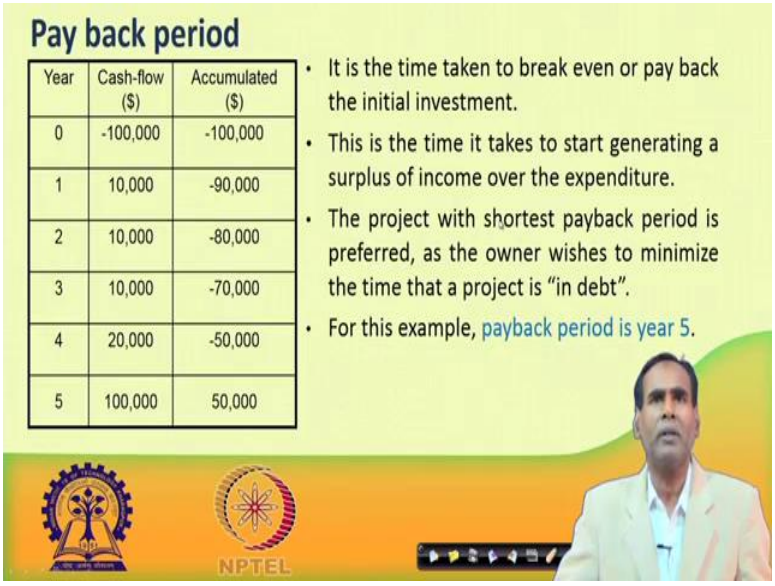

The next one is payback period, so payback payback period it depend the time taken to break even or pay back the initial investment how much you have initially spent, when you are starting when you are in which year you are getting that amount to back, so that is the payback period.

This is the time that it takes to start generating surplus of income over the expenditure how much you have spent, in which year you are getting you are recovering you are getting back that amount plus you gets you get more on the amount more benefits. So, that year is known as the what payback period.

The project what is the desirable? The project with shortest payback period is desirable it is preferred because the owner wishes to minimise the time that a project is in debt. So, you will try to minimize that period because he might have brought this initial funding from some loan or from some bank.

So, in this example if you will see first here in invested how much say 1,00,000 and you see 1st year he is getting 10,00,00, then 2nd year 10,00,00, 3rd year 10,00,00, 4th year 20,000. So, this is how much; that means, up to 4th year he is getting 50,000. So, next in 5th year he is getting 1,00,000, so; that means, the initial 1,00,000 here invested he is getting only at the only during 5th year. So, for this example the payback period is year 5.

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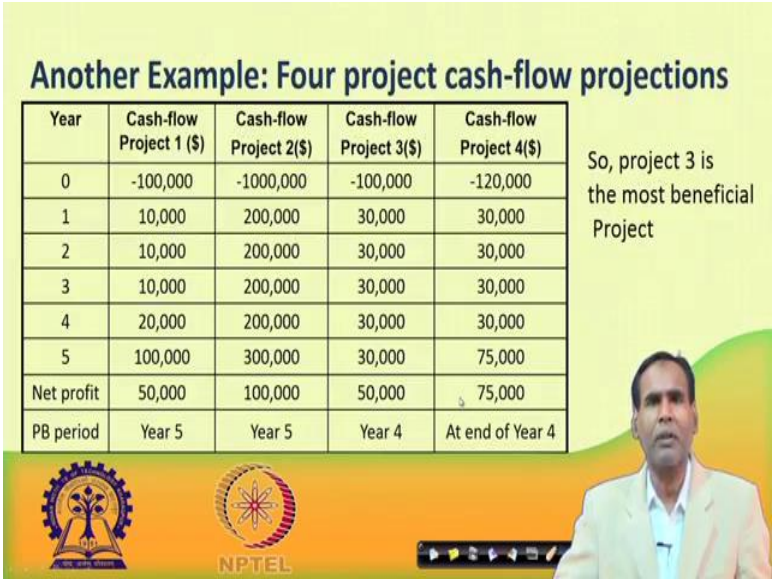

So, similarly for our earlier what example where four projects are there, you can compute the payback periods, you can say that for project 1 I have already shown you the payback period is 5. And similarity for project 2 you can see initially as sends 10,00,000 this is also you are it is getting recovered and the what year 5 and a for project 3 you are getting that in the initial he has spent 1,00,000. So, it is getting 30 plus 30 60, 30 90 and the 4rth year he is getting this initial amount that he has spent that is 1,00,000.

So, for project 3 year 4 is the payback period and in case of project 4 you can see that initially he has spent or the project the organisation has spent 1,20,000 he is getting that value when 1st year it will be in 30, then another 30,000 and then another 30,000. So, at the end of when 4th year is completed then only he gets back or the organization get back gets back the initial amount that is 1,20,000. So, at the end of the year 4 the project will get back the initial expenditure the initial expenses.

So, here you can see that project 3 where the organisation receives the original or the initial funding it is during year 4. So, you year a project 3 may be treated as the most beneficial project if we will considered the payback period.

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So, you can see that the advantages of this technique pay back payback period is that it is simple to calculate no not particularly sensitive to small forecasting errors, but it has some draw backs like it ignores the overall profitability of the project what is the overall profitability project we will does not take into account. Also it ignores any income or any expenditure once the project has broken even; once the project has reached as the procurement point whatever the income expenditure of that it does not take into account. You can see that that project 2 and 4 overall there more profitable than project 3, but this is ignore you please see here project 2 and 4.

So, according to payback period we have seen that project 3 is the beneficial one because during year 4th year he is recovering he is getting his initial amount, but you see the profit is more in where, the profit the net profit is more in case of what highest is in project 2 and then it is what a 75.

So, if you will take into account in net profit actually project 2 should be the best one, but since it is not considering; since it is not considering the overall profitability of the project, so that is why either project 2 or project 4 even if they are overall more

profitable they are ignored by using the payback period. So, this is one of the drawback of the payback period.

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So, now let us see the next metric the next measure or the next technique that is ROI which stands for Return on Investment, this measure provides a way of comparing the net profitable to the investment period, it will compare the net profitability to the investment period of for an organization. It provides a simple and easy to calculate measure of return on capital now. So, this technique provides a very simple and easy to calculate measure of the return on the spent capital amount.

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The mathematically we can define ROI as like this.

$$ROI = \frac{\text{Average annual profit}}{\text{Total investment}} \times 100$$

So, now, ROI is expressed in terms of percentage. So, if you will take our the a previous project that is project 1 here you can see the net profit is coming to be 50,000 along the how many years along 5 years.

So, average profit is coming to be how much? Average profit will be coming to be 50,000 divided by 5 because it is occurring in 5 years. So, average profit coming to 10,000. So, ROI it can be computed as 10,000 by the total investment you have seen initially the farmers spent 1,00,000. So, 10,00,00 by 1,00,000 into 100 coming to be 10 percent.

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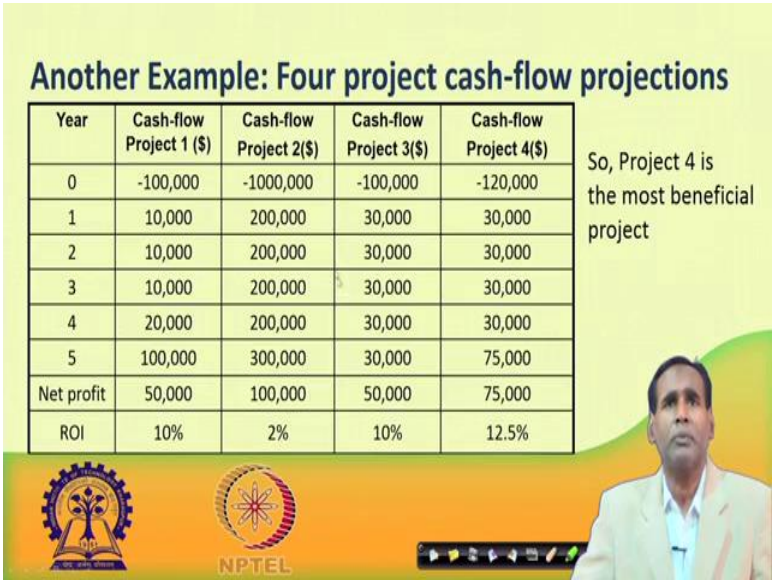

So, for project 1 ROI coming is coming to be 10 percent. So, similarly you can compute the ROI for the other projects where for project 2 it is coming 2 percentage, for project 3 it is 10 percent and project 4 it is 12.5 percentage and the objective is which one will be preferred the project having the highest ROI must be preferred. So, project 4 in this case have is having the highest ROI, so project 4 is the most beneficial project in this example.

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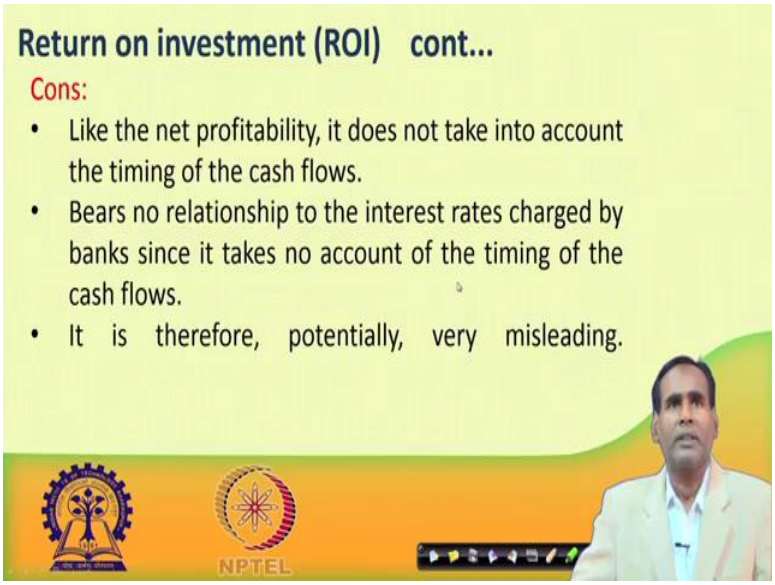

Next see let us see what are the drawbacks of this ROI like the profitable net profitability, it also does not take into account the timing of the cash flows. We have already seen net profit profitability method or net benefit method the problem with that it does not take into the timing value of the cash flows. Similarly, ROI also does not take into account when the timing value of the cash flows, it also bears no relationship to the interest rates charged by the bank. So, different banks may charge different interest rates.

So, it does not bear any relationship to the interest rates which are charged by banks, since it does not take into account the timing of the cash flows. So, that is why; so this method potentially or may what may be very misleading.

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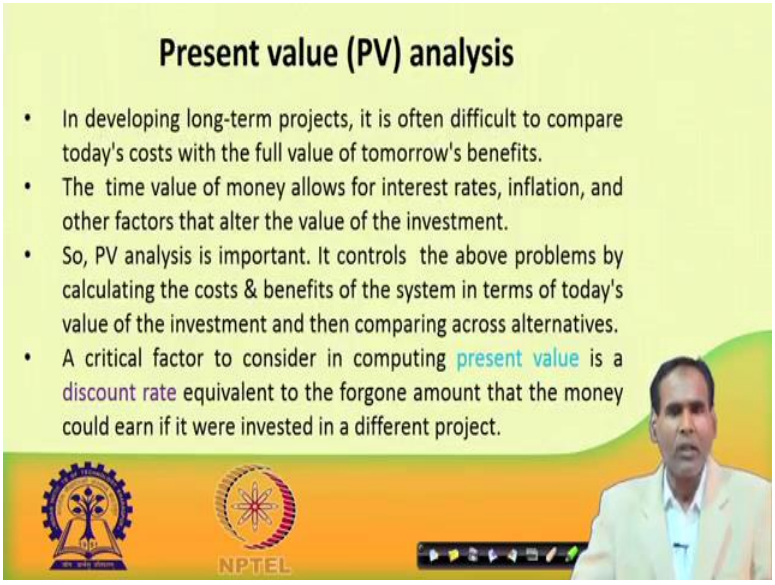

Now, we will see one of the important method that is known as a present value analysis So, what do you mean by present value analysis? In the developing in developing long term projects it is very much difficult to compare what is the today's cost with the full value of tomorrows benefits; that means, what cost we are investing today and what is the value we will get tomorrow at a benefit it is very much difficult to compare this.

Also the time value of money it allows for interest rates, inflation and other factors that might alter the value of the investment. So, that is why we must know the present value. So, we must carry out present value analysis for the what investment that we are making or the benefit that we will get. So, present value analysis is very much important.

So, this present value analysis it controls these above problems; that means, how to compare the today's cost with the full value of tomorrows benefits or, how to consider; how to take into account the interest rates inflation and other factors that might alter the value of the investments. So, this it will carry out PV analysis present value analysis. It will control the above problems how by calculating the cost and benefits of the system in terms of today's value; in terms of today's money value of the investment and then by comparing across different alternatives.

A critical factor to consider in computing present value is a discount rate. So, while we will compute the present value another important factor we have to know that is known as discount rate and this discount. So, see for present value we have to computer a factor called as discount factor. So, this discount factor it based on the discount rate.

So, a critical factor to consider in computing the present value is a discount rate which is equivalent to the forgone amount that the money could earn if it were invested in a different project. If that money could have been invested in a different project, then what could be the forgone amount? So, discount rate is equivalent to that forgone amount which the money could earn if it were invested in a different project.

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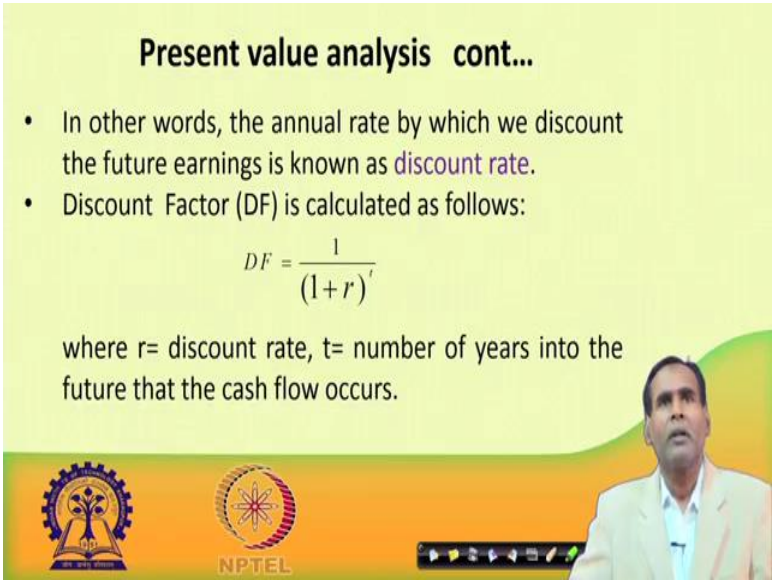

In other words we can say that discount rate is defined as the annual rate by which the discount we by which we discount the future earnings. Mathematically discount factor is calculated as follows,

$$DF = \frac{1}{(1+r)^t}$$

where r is equal to discount rate and t is equal to the number of years into the future that the cash flow occurs. So, in the this is the simple formula by using which we can use this discount factor.

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So, now let us see we will find out the discount factor for some percentage of the discount rates and for different years. If we will take the discount rate as 10 to 10 percent or the interest rate at 10 percent and 1 year per for 1 year period, then the discount factor is equal to 1 by 1 plus this much 0.10 to the power 1. So, this becomes 0.9091 and similarly in case of 10 percent return 2 years discount factor becomes 1 by 1.10 and I think there is a small mistake in the its the in this formula 1 plus r to the power t. So, here this should be 1 by 1 plus 0.10 to the power 2.

So, there is a slight mistake here it must be 1 by 1 plus 0.10 to the power 2, so which will be equal to 0.8294. So, similarly discount factor can be computed for any given year and discount rate. So, we have given you a table which help you for a computing the present values. So, the discount values we have a given, there is a table here yes.

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So, you can see that the discount values or the discount factors for different years and taking different discount rates like 5 percent, 6 percent 8 percent, 10 percent, 12 percent, 15 percent and a different what years like 1 to 10 up to 15, 20, 25 what could be the discount factor with different discount rates and different years and the number of years it is shown. This will help you for solving or for finding out the present values on the net present values.

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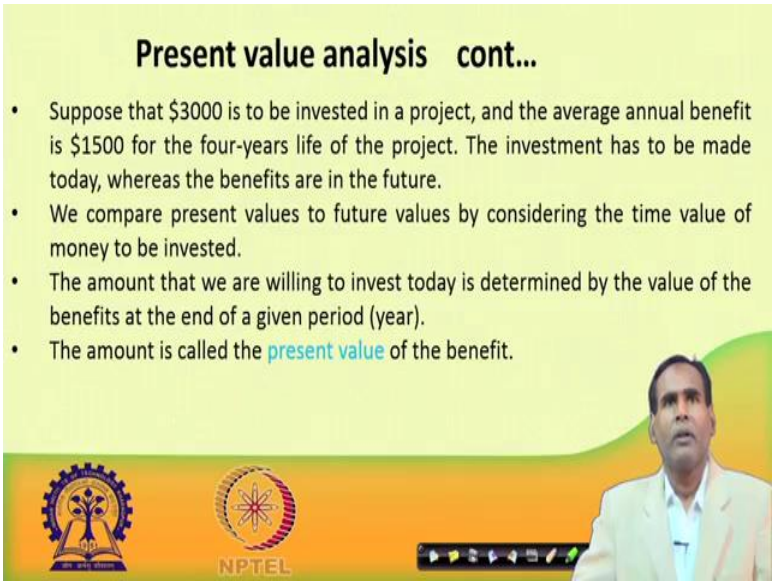

So, let us quickly take a small example, here suppose that dollar 3,000 has to invested in the project and the average annual benefit is expected to be 1500 dollar for four years life of the project. The investment has to be made today please see the investment will make today, where as the benefits are expected to come in the future. So, we compare the present values to the future values how much we have spent today and how much we are expecting in future. We compare the present values to the future values by considering the time value of the money that we have invested.

So, this time value of the money has not considering has not been considered in net profit and the ROI, so that those are the problem. So, those problems are over come by in this present value analysis. The amount that you are willing to what investment today is determined by the value of the benefits at the end of the given period, please see how define present value.

The amount that we are wanting to invest today, how it can be determined? This is determined by the value of the benefits which may be obtained at the end of a given period or the given year. So, this amount that we are willing to invest today for which we are expecting that some benefit will occur might be after n years or n number of years. So, this amount is call the present value of the benefit.

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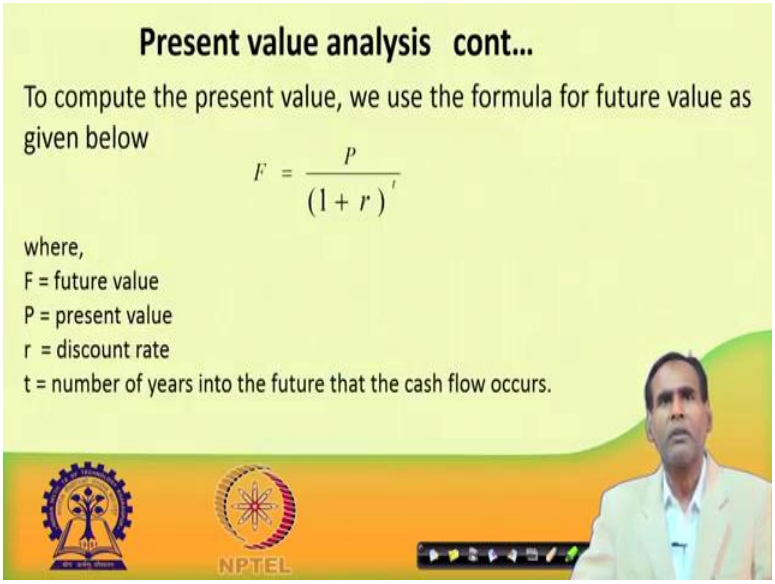

So, how you can compute the present value? We can compute the present value by using formula for the future value. The future value or the benefit can be expressed as

$$F = \frac{P}{(1+r)^t}$$

that P the future value; that means, if the future value, P is the present value of the money or the present value of the investment, r is the discount rate and t is the number of years into the future that the cash flow occurs.

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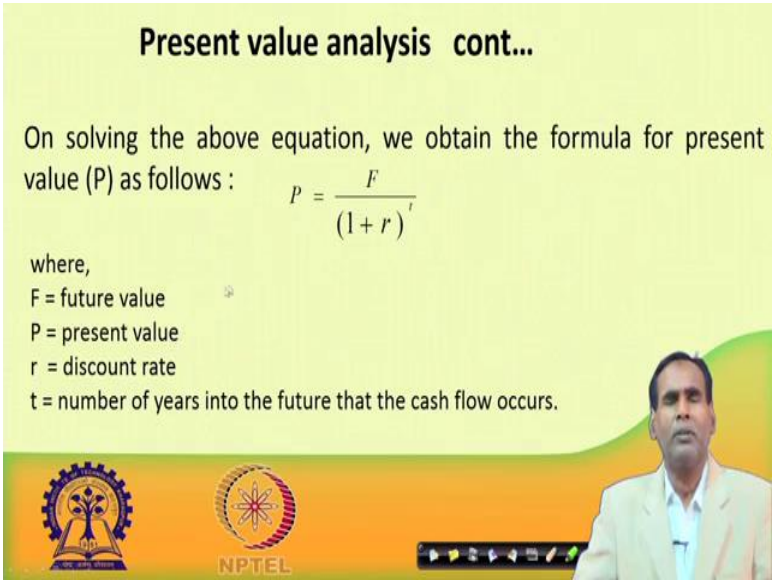

On solving the above equation you can get the value of a P which is equal to P is equal to F by 1 plus r to the power t,

$$P = \frac{F}{(1+r)^t}$$

where the terms have usual meanings.

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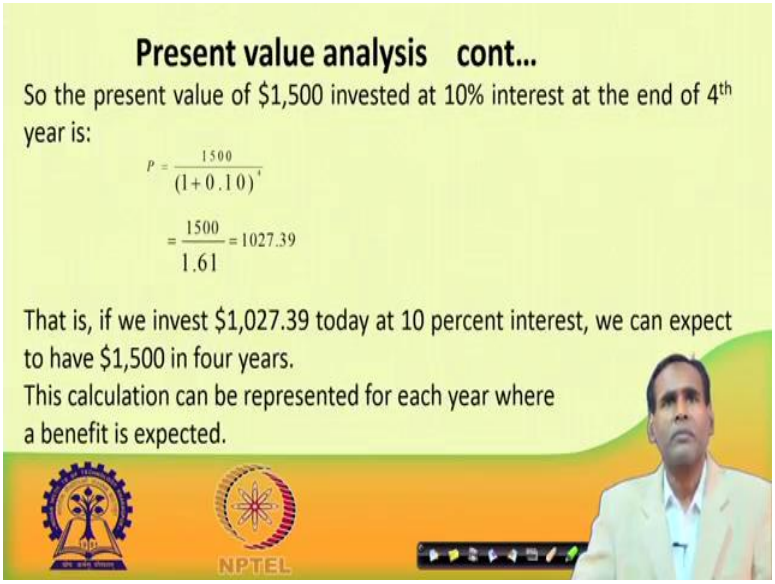

We will take a small example for that previous example that we are saying that suppose we want to what invest 3000 rupees and the average annual benefit is coming to be 15000 sorry 1500 for the four years life of the project now we want to compute its what a present value, you can see the present value can be computed like this. So, the present value of dollar 1500; 1500 invested at 10 percent in interested at the end of 4th year.

So, the present value you can see that 15,000 is what? 15,000 is annual average annual benefit we were expecting that the average annual benefit will be 1500 when for the 4 years life of the project. So, now, we can see what will the present value of the 1500 what rupees that we will get after 4 years at the rate of 10 point 10 percent interest is calculated as P is equal to 1500 by 1 plus 0.10 to the power four. So, this is coming to be 1027.39.

So, literally what is its meaning? Its meaning is that, if we invest 1027.39 dollar today at 10 percent interest then we can expect to get 1500 dollar in four years; that means, what is the meaning of present value. This calculation can be represented for each year where a benefit expected that you can calculate yourself.

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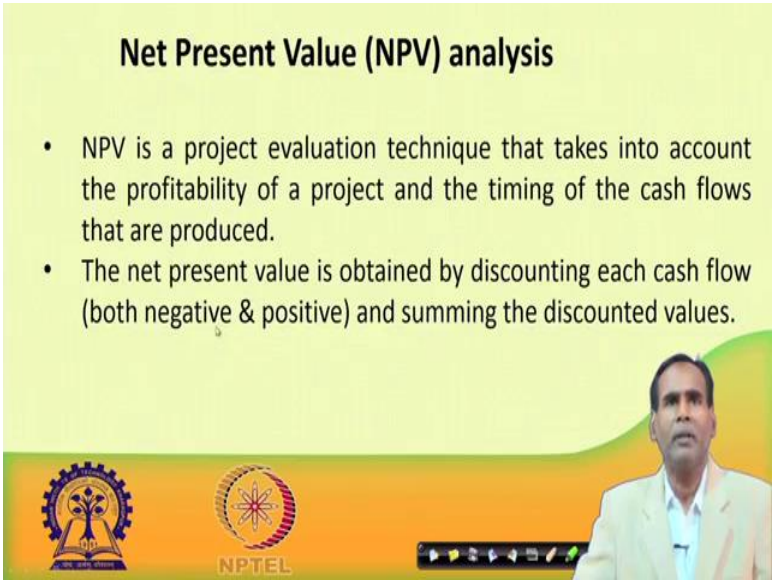

Now, based on the present value another important concept that you will see that is known as Net Present Value NPV its short form is NPV; NPV stands for this Net Present Value.

So, NPV how will define or what do you what this NVP, what does it represent? NPV is a project evaluation technique that takes into account the profitability of a project and the timing of the cash flows that are produced. So, we have already seen the earlier techniques such as net profits and this ROI they do not take into account the timing value, but here this NPV it is a evaluation technique that takes into account the profitability of a project as well as the timing of a cash flows that are produced.

The net present value is obtained how? The net present value can be obtained by discounting each cash flow both whether it is negative or positive because you know the initial expenses that we represented as negative value and then the profit we represent in terms of the positive or the income that we represent as a positive what values. The net present value it is obtained by discounting each cash flow and summing the discounted values.

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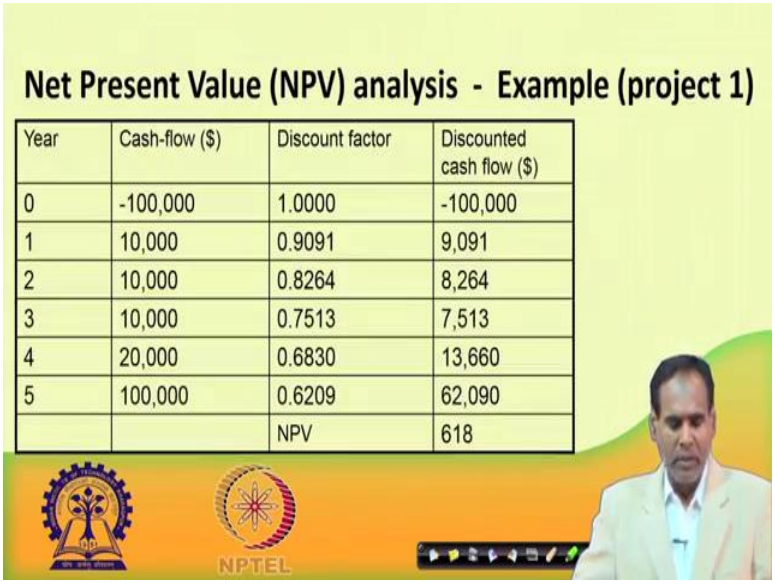

We will take a small example here. So, again the for the project one I am calculating the NPV. So, year wise the cash flow value is have been given in dollars, then the discount factor is obtained using the table I had shown here. The table we have already seen that the discount factors we have already seen for year for the rate of 5 percent at the year 1 this is the what discounted factor.

Similarly for 10 you can see for year 1 for 10 these discount factor is 0.9091, for 10 percent rate for 2nd year this discounted factor is 0.8264. So, this values you can use directly here to compute the NPV values that we have done here.

So, discount factor for see it is assume that discount factor for 0 th here is 1, then we have use that formula to compute the discount factor for 1st year it is 0.9091, for 2nd factor for 2nd year it is 0.8264 unlike that and then we multiply this discount factor with the cash flow, then we get the discounted cash flow. So, we have to find out the discounted cash flow by multiplying the discount factor with the cash flow for every year we can find out the discounted cash flow and finally, we have to add the discounted cash flows for all the periods that will give you the NPV.

So, after adding the discounted cash flows for all the your years we get NPV is equal to 618 dollar 618 dollar for this example with discount rate 10 percent and for the period of 5 year the NPV comes to 618 dollars.

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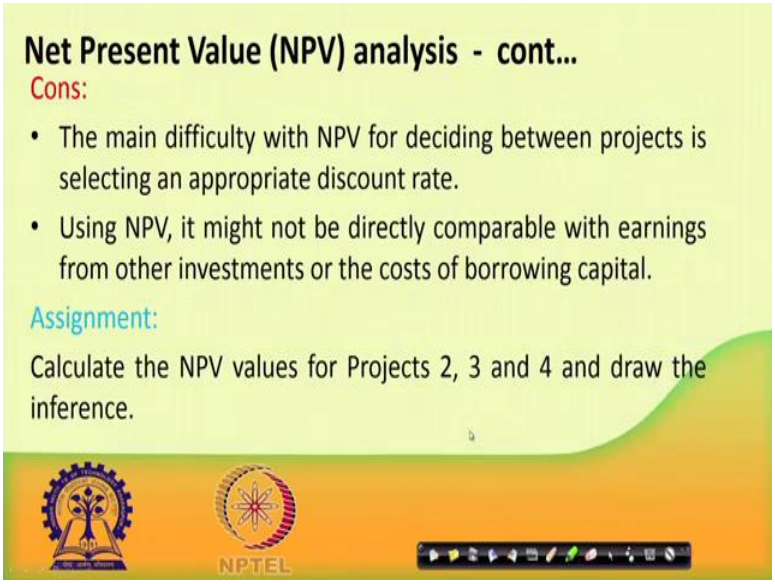

So, similarly what you do you can calculate the NPV values for the projects at for the 2nd, 3rd and 4th project and you can draw the inference find out which project with the most preferred one which project will be the most beneficial one please find out this one this is an assignment for you.

So, let us see what are the limitations of net present value analysis. The main difficulty with NPV for deciding between projects is selecting an appropriate in discount rate, how you will select whether you will take the discount rate at 5 percent, 8 percent, 10 percent or 12 percent. So, deciding choosing an appropriate discount rate it was that is one of the main difficulty. Similarly using NPV it might not be directly comparable with earnings from other investment or the cost of borrowing capital, it is very difficult to directly compare the with the earnings from other investments or the costs of borrowing capital these are the some of the limitations of NPV method.

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Next we will see the other measure that is called is IRR which stands for Internal Rate of Return. IRR provides a profitability measures as a percentage return that is directly comparable with interest rates. IRR it provides a profitability measure and it expressed as a percentage return that is directly comparable with the interest rates.

So, suppose a project that shows an error of 10 percent, it would be worth if the capital could we borrowed for less than 10 percent or the capital it could not be invested in elsewhere for a return greater than 10 percent, then we say that project will be worth. IRR is IRR may be considered as the discount rate that would produce an NPV of 0 for the project, this IRR can be used to compare different investment opportunities.

It can be calculated using a spread sheet and also Microsoft or Microsoft Excel will be provide some functions. So, also Microsoft Excel provides some functions such as IRR which takes two arguments a value and an initial guess and initial in an initial seed value as input and finally, it returns the IRR it returns an IRR at the output. So, this is the internal rate of return which is another very good measure.

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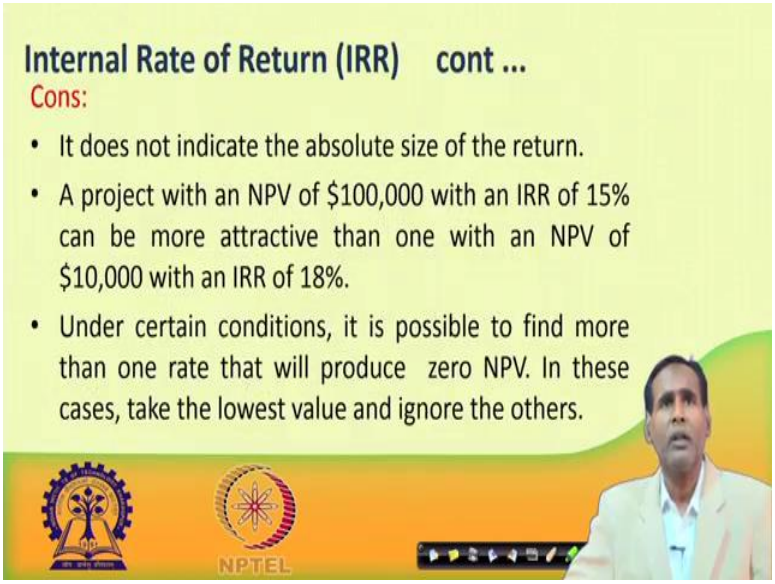

The limitations of IRR are like follows. It does not indicate the absolute size of the return it normally it does not indicate the absolute size of the return. Similarly it might happen the case that a project which an NPV of 1,00,000 with an IRR 15 percent it may be more attractive than one project with an NPV of 10,000 only with an IRR of 18 percent that might happen what IRR what is unable to what predict this thing is unable to handle this thing.

Under certain conditions it is possible to find more than one rate that will produce zero NPV, it can be possible. There can be what two rates that will produce the same 0 NPV. In these cases we have to take the lowest value and ignore the other values I mean the other rates.

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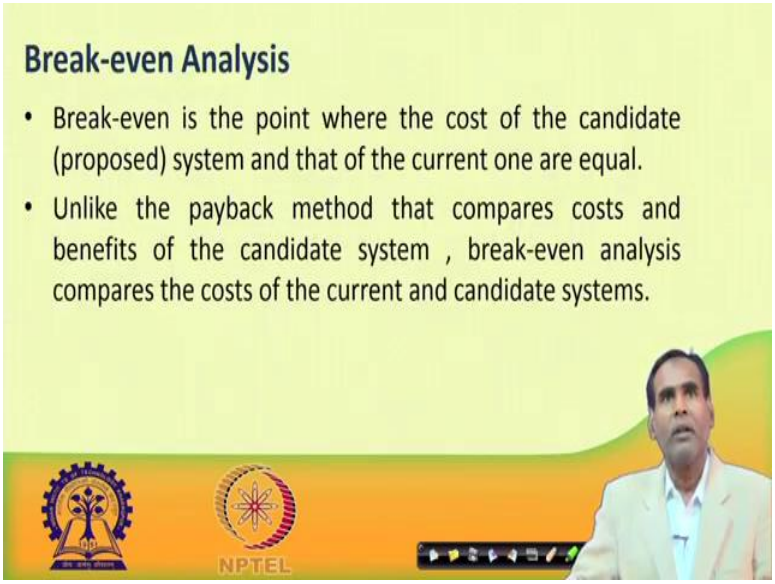

Now, we see the last technique that is the break even analysis break even analysis or first let us see break even analysis based on a point called as breakeven point. Break even is defined at the point where the cost of the candidate or the propose system and that of the current one are equal.

So, one current system say manual system is running, the propose system is an automated system, so break up suppose, then break even is the point where the existing system and the where the cost of the existing system and the cost of the point of propose system they are equal.

So, unlike the payback method which compares the cost and benefits of the candidate system I mean the propose system, but break even analysis it compares what the cost of the propose system or the candidate system and the current system.

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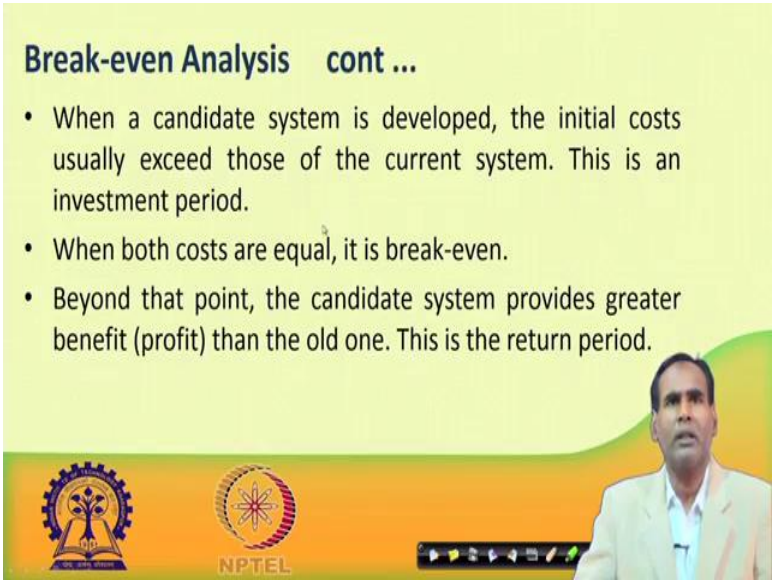

So, when a candidate system is developed the initial cost are use a normally usually exceed those of the return say current system this is an investment period. Obvious, so when a propose system is developed you have to spend more money. So, the initial cost normally it will exceed that and that of the that the cost of the current system.

So, this period we call as the investment period, then when both the cost of the propose system and the cost of the existing system they become that point is known as the break even and after the breakeven point what will happen the propose system or the candidate system it will be provide better will get a profit than the older one or the existing one and this period is known as the return period we will show it through an example I will through a graph.

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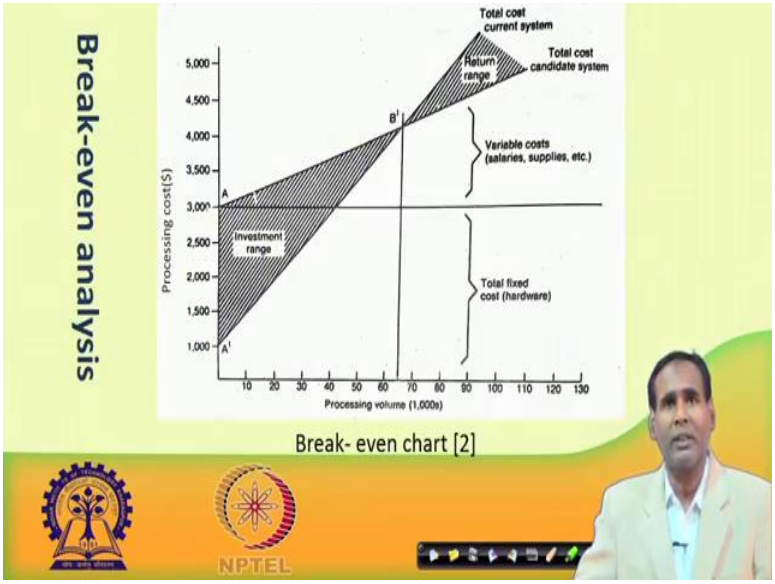

You can see that in x axis we have taken the processing volume y axis the processing cost and you can see that this line what is the total you can see that; see you can see that in this graph here this line represents the current system and this line represents the what the total the existing system the candidate system, as I have already told you initially the propose system will take more cost.

And the existing system will take the what they because it is running, so it will take less cost, but some point we will come here see at point of B prime both the cost of the existing system and the what this propose system become sequence. So, B prime becomes the what the breakeven point near about 65000 processing volume both the cost equal after this though this breakeven point.

After this then you see that the what the propose system takes less cost and the current system it takes more cost that mean the propose system starts giving, but return starts giving profit. So, that is why since here the propose system takes more cost this area is known as the investment range and after the breakeven point here the current system takes the what more cost whereas, the propose system takes less cost it starts giving return it starts giving profit.

So, that is why this area known as the return range. You can see that this area represent this point represents a fixed cost whereas, this portion represents the variable cost, this is what is meant by the break even chart; this I have already explained here.

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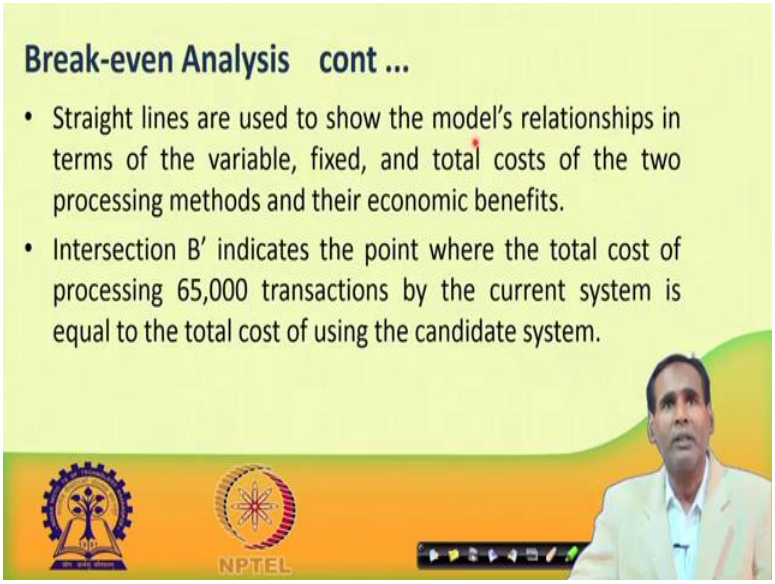

Now, the shaded area the investment period that we have already shown you this is the investment period or investment range where as this is the return range and B prime is the break even period, so breakeven point. So, breakeven point is also very helpful to decide that which project will be beneficial for us.

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So, in this lecture we have discussed the different cost benefit evaluation techniques with suitable examples also we have described the advantages and disadvantages of each technique also we have presented which technique will be best suitable in which

circumstances that also we have seen. So, in the next class we will see the remaining two steps of cost benefit analysis that is what interpreting the results as well as taking the appropriate action. These are the references and in the next class we will see the remaining two steps.

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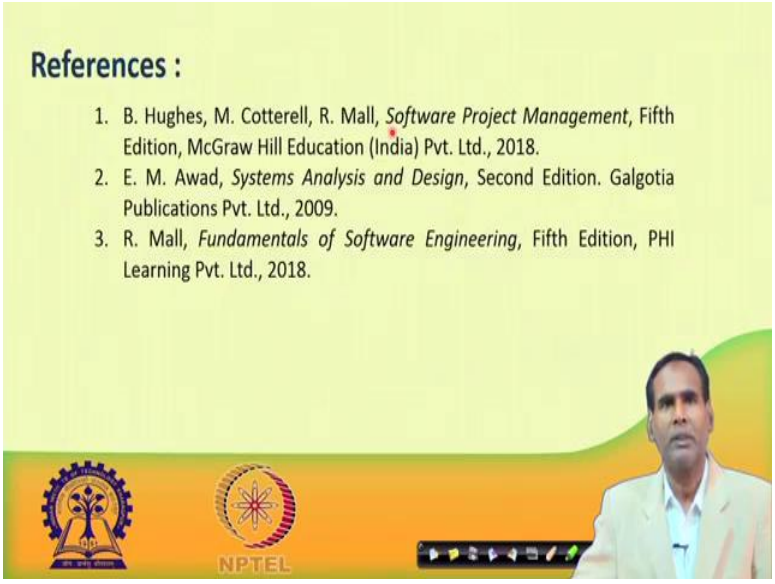

Thank you very much.