

Introduction to Accounting and Finance for Civil Engineers

Professor. Sudhir Misra

Department of Civil Engineering, IIT Kanpur

Professor. Kumar Neeraj Jha

Department of Civil Engineering, IIT Delhi

Module No. #02

Lecture No. #07

Incremental Rate of Return (IROR)

Good morning, and Welcome to this lecture on, Introduction to Accounting and Finance for Civil Engineers. In the last week, you have been exposed to, various definitions of cash flows. Now, you are in a position to draw, different cash flow diagrams, for different situations.

You have also been told, regarding various methods of evaluation, of different alternatives such as, the present worth method of comparison, the future worth method of comparison, the annual equivalent method, and rate of return methods of analysis. If you remember, the various assumptions that we used, in analysing alternatives, using these methods, you can very clearly note, these following assumptions.

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Lecture 7

INCREMENTAL RATE OF RETURN (IROR)

In the last class, we had discussed the Future worth comparison method and Equivalent annual charge

Today, we will discuss Incremental rate of return (IROR) and its application

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Assumptions made in the evaluation so far		
<ul style="list-style-type: none"> • Cash flows are known. • Cash flows do not include effect of inflation. • The interest rate (discounting rate) is known. • Comparisons are made with before tax cash flows. • Comparisons do not include intangible considerations. • Comparisons do not include consideration of the availability of funds to implement alternatives. 		
Key point: The methods learnt so far are to be used for comparing two alternatives only and not for more than two alternatives.		
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For example, the first assumption that we made, in the analysis was that, cash flows are known. So, whatever cash flows we assume, whether in the form of inflows or outflows, we assume them to be certain. We will also see situations in which, we will try to analyse what happens, if there are uncertainties involved in the cash flows. The further assumption was, that the cash flows do not include, the effect of inflation. We will see, how to take care of inflation, in subsequent lectures.

Further, the interest rate that we assume for our analysis purpose, we assume that, it is known, and known with certainty. There is no change in the interest rate, over the entire period of the analysis. Further, one of the assumption that we made was, there is no tax implication, for our incomes. Although, all these assumptions what we are stating just now, we will find them, none of them are practical. In practice, cash flows will never be known, with certainty. In practice, you will always find, there would be effect of some inflation.

The interest rate, as you know, very frequently they are revised. And, you already know that, whether it is personal income or corporate income, they have to be given the taxes. Now, one of the assumption is that, comparisons whatever we are making, they do not include, intangible considerations. So, anything that we cannot measure in terms of money, we are not considering them for our analysis purpose. Now, two very important assumptions, are like this.

The first one is, let us say, you have N number of alternatives. In the first alternative, let us say, you are investing 100 Rupees. In the second alternative, you are investing, let us say, 150

Rupees. And, in the third alternative, let us assume, you are investing 200 Rupees. Now, through our analysis, let us assume that, we find that, the 200 Rupees investment option is coming to be, the most economical option.

In that case, you just cannot complain that, sorry, I do not have this much money. So, this analysis assumes that, we have plenty of fund. And, in case, we choose to find that the highest investment option is the most economical one, we have plenty of money to fund that. On the other hand, we also have one more assumption, in which we assume that, suppose, we are going in for 100 Rupees alternative. That means, we are going in for, least investment alternative. That means, we find that, through our analysis that, this alternative is the most economical one.

In such case, again we cannot complain that, what will I do with the money, which I am having surplus. So, the analysis assumes that, we have plenty of money to fund, even the highest investment option. And, we have number of opportunities available should be go in for, the least investment option. Now, while going through all those methods of evaluation, you might have noticed one very important point that, all these methods are to be used, only for comparing two alternatives.

So, whenever we have got more than two alternatives, none of these methods are useful. This is because, you will find that, there are certain problems associated with the methods, which we have learned so far. And, because of those problems, we will see, what are those problems. Because of those problems, if you try to use those methods, for evaluating more than two alternatives, you will find your answers are going to be wrong.

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Incremental rate of return (IROR)		
<ul style="list-style-type: none"> • When the best alternative (economically suitable) is to be selected from two or more mutually exclusive alternatives on the basis of rate of return analysis, the incremental investment analysis is used. • In this method, the alternative with larger investment is selected, provided the incremental (extra) investment over the lower investment alternative produces a rate of return that is greater than or equal to minimum attractive rate of return (MARR). • If an alternative requires a higher initial investment than the other and evaluation is of the rate of return on the increment of initial investment, the return yielded on this extra investment is called the incremental rate of return (IROR). • The incremental analysis is based on the principle that every rupee of investment is as good as the other. 		

So, in this class, we are going to learn, incremental method of analysis. The principle of this incremental method of analysis, whether it is incremental rate of return method of analysis, or whether it is incremental present worth method of analysis, or it could be incremental future worth method of analysis, the underlying assumption is that, every single Rupee, is as good, or as bad, as the other Rupee. So, if we are getting a particular return, on let us say, first 100 Rupees, we must get either the same return, or even more return, for any additional investment, that we are making.

So, this is the fundamental assumption behind, incremental analysis method. So, let us say, we have got different alternatives available to us. And, each of these alternatives require, different amount of investment. In, such case, how do we evaluate various alternatives, how do we select the best alternative, out of a number of alternatives, is the subject matter of today's lecture? Now, there are very systematic ways, systematic ways to calculate, the incremental rate of return, for different alternatives.

We try to learn this, with the help of one small example. But, before that, if you recollect the last two assumptions, which I just now mentioned, those assumptions are also applicable here. So, when you arrange the alternatives in an ascending order, and you find that the highest investment option is the most preferred one, in that case, you cannot complain that, I do not have enough money. Likewise, you cannot complain that, what will I do with the surplus money, if I happen to go with the least investment option.

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Assumptions involved in IROR analysis

- The analysis makes the assumption that sufficient funds are available to finance the alternatives with the highest investment
- There are opportunities available to utilize the surplus funds at a rate higher than the MARR, should there be any excess funds after financing the alternative with the lower investment costs.

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So, these are the assumptions, which I told you just now. The analysis makes the assumption, that sufficient funds are available. And, the second assumption is, there are opportunities available, to utilise the surplus funds, in case you are finding that, the lower investment option is the most desirable one. Now, as I told you, we will try to list out the various steps. So, the problem is, you have got N number of alternatives. So, in the first step, what I do, I arrange those alternatives, in ascending order of your initial investment.

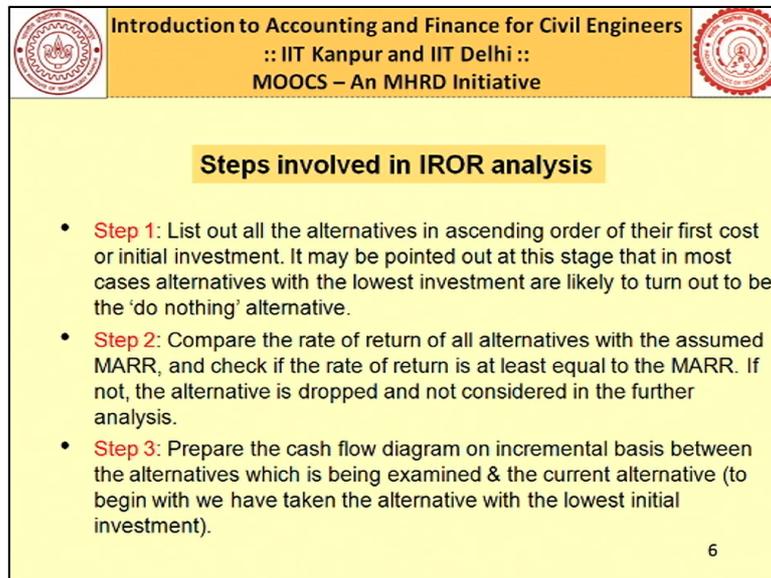
So, suppose in one case, you have 100 Rupees to invest. In another case, 150. In another case, you have 200 Rupees to invest. So, the first thing that I do is to, arrange them in an ascending order. Right. Then, if it is possible, I will calculate the Internal Rate of Return, for each of these alternatives. Now, from your past lecturers, you are now in a position to understand that, not in every situation, you will be able to find the Internal Rate of Return.

So, if your cash flow diagram is, let us say, cost dominated, or if it is revenue dominated, you would not be in a position to find, the Internal Rate of Return. So, that is why I am telling, in case, it is possible to calculate the rate of return, for the given cash flow diagram, find it out. So likewise, if it is possible, I calculate the Internal Rate of Return, for each of the alternatives, that is given to me.

Now, the first stage of analysis, what I do. I compare the Internal Rate of Return, which I opted just now, with the Minimum Attractive Rate of Return. If you remember, the Minimum Attractive Rate of Return is that rate of return, below which, no company would like to go for

business. So, the first step, what I do, for each of the alternatives, I calculate the IROR. That is, Internal Rate of Return. And, I compare it with the, Minimum Attractive Rate of Return.

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Steps involved in IROR analysis

- **Step 1:** List out all the alternatives in ascending order of their first cost or initial investment. It may be pointed out at this stage that in most cases alternatives with the lowest investment are likely to turn out to be the 'do nothing' alternative.
- **Step 2:** Compare the rate of return of all alternatives with the assumed MARR, and check if the rate of return is at least equal to the MARR. If not, the alternative is dropped and not considered in the further analysis.
- **Step 3:** Prepare the cash flow diagram on incremental basis between the alternatives which is being examined & the current alternative (to begin with we have taken the alternative with the lowest initial investment).

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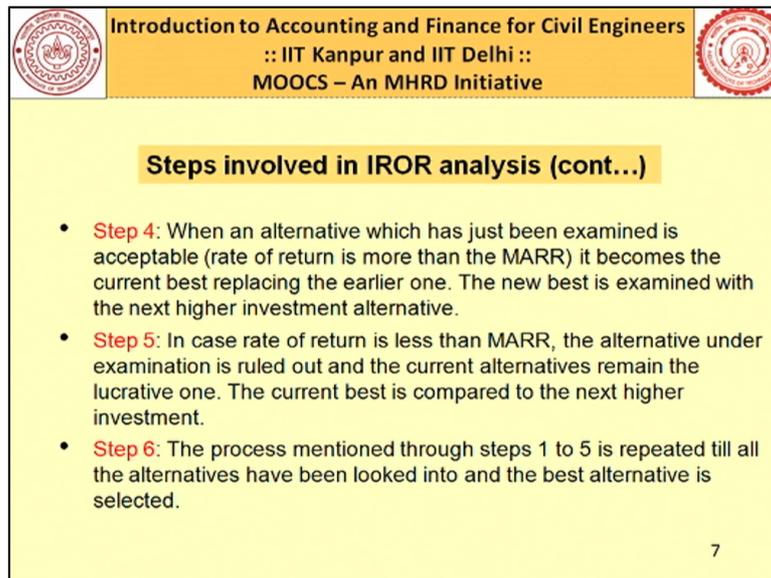
Ok. This is what, the various steps are listed here. You can see the first step, is to list out all the alternatives in ascending order, of their first cost, or initial investment. In the second step, as I told you, you have to find out the rate of return, if it is possible. If it is not possible, I will tell you, how to calculate the rate of return, through some other manipulations. Once you have compared the Internal Rate of Return, with the Minimum Attractive Rate of Return, you have to make a decision, now.

In case, you find the IROR, is greater than Minimum Attractive Rate of Return, this alternative will go into the second stage of analysis. However, if I find that, Internal Rate of Return is, less than the Minimum Attractive Rate of Return, then this alternative does not go, in the second step of our analysis. Right. Now, having done this preliminary screening, now what I do. I compare the least investment option, with the next higher investment option. And, I prepare a cash flow diagram, what we call it as a, incremental cash flow diagram.

In that I see, what is the benefit that I am getting, by investing extra sum of money, over and above the least investment option. So, if I find that, this extra investment is also yielding me a return, more than Minimum Attractive Rate of Return, it means, the additional investment is desirable. So, in that case, I go for higher investment option. On the other hand, if I find that this extra investment is not yielding me a return, more than MARR, then I drop the higher investment option.

So, what I do. I do such analysis, in a pairwise manner. So, I take the least investment option, compare it with the next higher investment option. Select out of the two, whichever is the best one, whichever is giving me, a return in excess of Minimum Attractive Rate of Return. And, this process continues, till I get, one final answer. Now, whatever steps, I told you just now, it will be more clear, if we take one small example.

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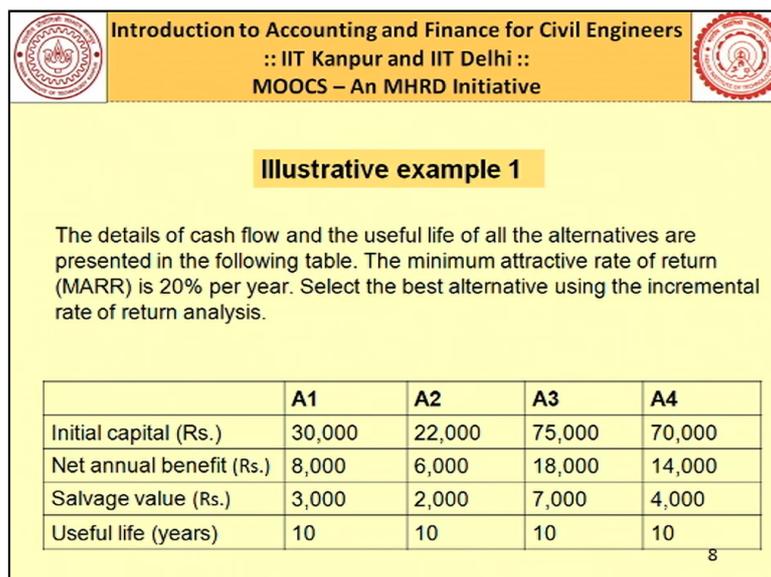
Steps involved in IROR analysis (cont...)

- **Step 4:** When an alternative which has just been examined is acceptable (rate of return is more than the MARR) it becomes the current best replacing the earlier one. The new best is examined with the next higher investment alternative.
- **Step 5:** In case rate of return is less than MARR, the alternative under examination is ruled out and the current alternatives remain the lucrative one. The current best is compared to the next higher investment.
- **Step 6:** The process mentioned through steps 1 to 5 is repeated till all the alternatives have been looked into and the best alternative is selected.

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In this example, we are given four alternatives, A1, A2, A3, and A4.

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Illustrative example 1

The details of cash flow and the useful life of all the alternatives are presented in the following table. The minimum attractive rate of return (MARR) is 20% per year. Select the best alternative using the incremental rate of return analysis.

	A1	A2	A3	A4
Initial capital (Rs.)	30,000	22,000	75,000	70,000
Net annual benefit (Rs.)	8,000	6,000	18,000	14,000
Salvage value (Rs.)	3,000	2,000	7,000	4,000
Useful life (years)	10	10	10	10

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For each of the alternatives, we are given the initial investment. For example, in A1, we require 30,000 Rupees. And, corresponding to this investment, we are getting a return of 8,000 annually, for next 10 years. The salvage value, for this particular alternative, is given to

be 3,000. Likewise, we are given the details for alternatives A2, A3, and A4. Now, as I told you, in the first step, we organise each of these alternatives, in their ascending order of initial investment. So, that way if you see, these alternatives can be written like this.

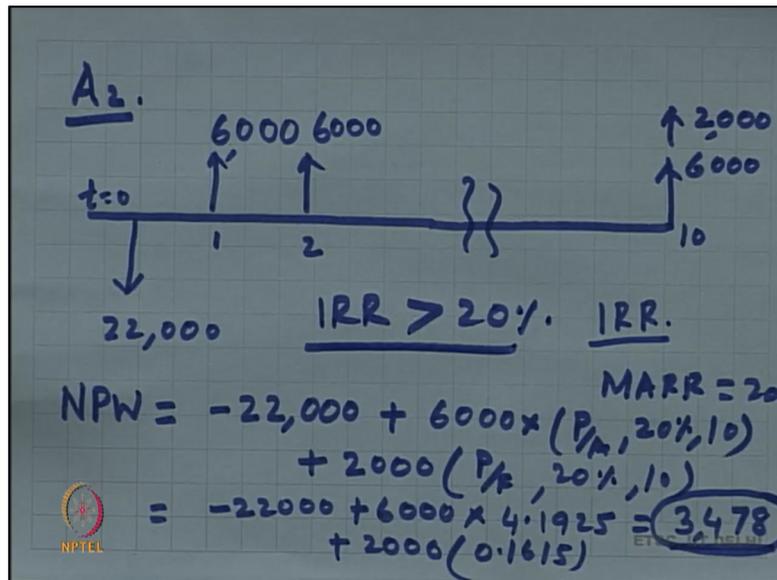
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A ₁	30,000	A ₂	- 22,000
A ₂	22,000	A ₁	- 30,000
A ₃	75,000	A ₄	- 70,000
A ₄	70,000	A ₃	- 75,000

A 1 requires 30,000. A2 requires 22,000. A3 requires 75,000. A4 requires 70,000. So, these are the initial investment given to us. Now, what I do in step one, I arrange them in ascending order of investment. So, the least investment option with us is A2, which requires 22,000 Rupees. It is followed by A1, which requires 30,000. Then, you have A4, which requires 70,000. And, finally you have A3, which requires 75,000

So, as far as step one is concerned, we are done with this. We have organised these alternatives, in the ascending order of the investment. Now, what I do, for each of these alternatives, I draw the cash flow diagram, and I try to find out the Internal Rate of Return. Then subsequently, we will compare this Internal Rate of Return, with the Minimum Attractive Rate of Return of 20%, which is given in this problem. So, let us try to do with the least investment option, first.

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So, it is A2, as you know, it requires 22,000, initial investments. So, at time T is equal to 0, we have 22,000. And, then every year, it is giving me a benefit of 6,000, for next 10 years. So, this is, at time T is equal to 0. This is year one. This is year 2. This is 6,000, again. And, then finally, at the end of year 10, we have got 6,000. And, you are also given that, the salvage value is 2,000. So, this also, I keep it here, at the end of year 10.

So, having drawn this cash flow diagram, now I am in a position to find out, the Internal Rate of Return, that will be the first method. In the second method, what we do is, instead of finding the exact IROR, listen to me very carefully, instead of finding the exact IROR, I will simply find out, whether the return that we are getting out of this project, is more than MARR of 20% or not. MARR is given to be 20%. So, for that, what I do. I calculate the NPW, for this particular alternative. As you know, NPW, we can calculate it like this.

So, this is - 22,000 + 6,000, multiplied by P given A, for 20% interest rate for 10 years, + the salvage value which is 2,000, P given F 20%, 10. So, this is coming to be - 22,000 + 6,000, multiplied by this factor is, 4.1925 + 2,000, multiplied by 0.1615. So, you will calculate this value, and you will obtain a positive value of 3,478.

Now, this NPW of positive 3,478 represents that, we are getting an Internal Rate of Return, more than 20%. So, this is what, we require. We simply want, whether the Internal Rate of Return for our alternative, is more than MARR, or less than MARR. We are not bothered, at this point of time, what is the exact value of IROR. Our purpose is solved, the moment we

know, that the IROR is more than MARR, or less than MARR. So, in this case, since we are getting a net present worth of + 3,478, it indicates that, IROR is greater than 20%. Okay.

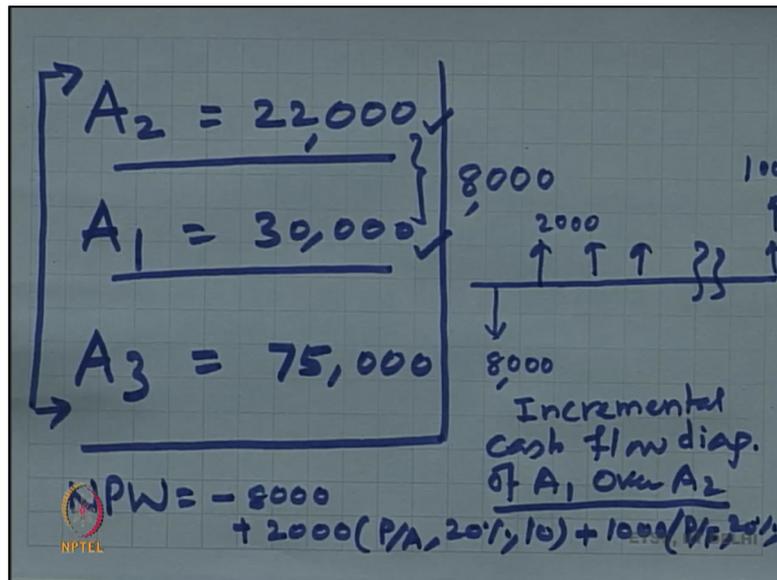
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Illustrative example 1 (cont...)				
$(P/A, 20\%, 10) = 4.1925; (P/F, 20\%, 10) = 0.1615$				
	A2	A1	A4	A3
Initial capital investment (Rs.)	-22,000	-30,000	-70,000	-75,000
Net annual benefit (Rs.)	+6,000	+8,000	+14,000	+18,000
Salvage value (Rs.)	+2,000	+3,000	+4,000	+7,000
Useful life (years)	10	10	10	10
NPW at $i=20\%$	-22,000+6000 (P/A, 20%, 10) +2000(P/F, 20%, 10)=3478 Accept	4024.5 Accept	-10659.0 Reject	1595.5 Accept

So likewise, what I do, what I do, I find the IROR value for each one of these alternatives. And, depending on, whether IROR is more than MARR, or less than MARR, I can take a decision. For example, if you look at alternative A2, we find that, we are getting positive value. So, we take it for, the next stage of analysis. Then, I do it for A1. A1 also in the same manner, if you calculate, you will find, you are getting a net present worth of 4024.50. So, here again, it is positive. So, it means that, we are having an IROR of more than 20%.

So, this will also be taken to the next stage. But, when it comes to alternative A4, if you see, you find that, we are getting a negative net present worth, which is equal to 10,659 in negative. So, we say that, this alternative is not to be taken, in the next stage of analysis. Likewise, if you do it for A3, there we are getting net present worth of positive. So, we can say that, this A3 also can be taken to the next stage. So, out of A1, A2, A3, and A4, for the next stage of analysis, we take it only 3 alternatives.

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Those three alternatives, which are going for the next stage are, in the order of ascending investment A2, we are taking it to the next stage. Then, A1 also, we are taking it to the next stage. And, finally A3, we are taking it to the next stage. So, out of four alternatives, A4 is not going to the next stage. Because, the return that we are getting is, less than MARR. Now, A2 if you remember, we are investing 22,000. A1, if you remember, we are investing 30,000. And, A3 if you remember, we are investing 75,000.

Now, in the second stage, what we have to do is, we have to carry out, pairwise comparison. So, if you see the lowest one is 22,000, and next higher one is 30,000 investments. So, what we have to see here is, what is the benefit that we are getting, if we are investing 8,000 Rupees extra here. So, here you can see, 20,000 we are investing here, here we are investing 30,000. So, the extra investment needed is 8,000.

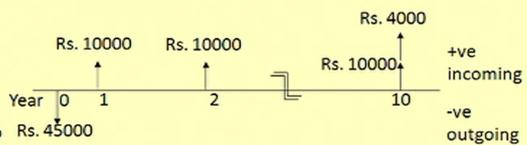
So, we say that, in A1, we are investing 8,000 extra. So, what is the benefit we are getting, out of that. So, that we need to capture it, in the terms of a cash flow diagram. So 8,000, I am putting extra here. And, what is the benefit that I am getting, between A2 and A1. If you see in A1, we were getting 8,000 benefit. And, in A2, we were getting 6,000 benefit. So, the extra that we are getting is, 2,000.

So, you will find that, 2,000 additional benefit we are getting. And, in terms of salvage value if you see, in one alternative we were getting 3,000, and in another alternative we were getting 2,000. So, we are getting this as, 1,000. So, this is the cash flow diagram. And, we say, this the incremental cash flow diagram, of A1 over A2.


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Illustrative example 1 (cont...)

Case 2: A3 over A1



Assume $i = 20\%$
 The net present worth = $-45,000 + 10,000/(P/A, 20\%, 10) + 4,000/(P/F, 20\%, 10) = -2429$

Since, at 20% (same as MARR) the value is negative, additional investment is not desirable, hence **prefer A1 over A3**.

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So, if you look at the comparison between A1 and A3, this is how it looks. So, you find that, between A1 and A3, you are investing 45,000 Rupees extra, at time T is equal to 0. And, what is the return, that you are getting? You are getting annual benefit of 10,000, for next 10 years. And, you are also getting, increase of Rupees 4,000, in terms of salvage value.

So, here again, I calculate the NPW, at I is equal to 20%. And, you find that, I am getting a negative value. It is - 2,429. What does this indicate. This means that, the Internal Rate of Return for this additional investment of 45,000, is less than 20%. So, that means, it is not wise to invest this additional 45,000.

So, the conclusion is, we stick to A1, and we do not go for A3. So, out of the four alternatives, A1, A2, A3, and A4, we saw that, the first stage screening itself, A4 was rejected. And, then finally, when the second stage of analysis was carried out, we found that, A1 is the best choice, out of the remaining three. So, this is how, we carry out the incremental analysis, in a step-by-step manner.

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Example 2 – Incremental method of analysis		
<p>A supplier of prefabricated railway sleepers procures each piece of sleeper for Rs. 4,000. The demand for sleepers is 350 units, and it is estimated that a similar demand would prevail for another three years. Equipment to manufacture sleepers is available for Rs. 18 lakh. The annual operating cost for producing 350 sleepers is estimated to cost Rs. 7 lakh for year 1, with 10 per cent increase every year for years 2 and 3. If the equipment has no salvage value at the end of three years, should the supplier continue to outsource it or should he buy the equipment and start producing the sleepers on his own? The minimum attractive rate of return is 15 %.</p>		
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Now, to reinforce your understanding, I am giving you, one more example. In this example, you can see that, there are two options. We can just first read this example. It says that, a supplier of prefabricated railway sleepers, procures each piece of sleeper for Rupees 4,000. So, sleepers are being purchased for 4,000 Rupees. And, the demand for sleepers is, 350 units every year.

And, it is estimated that, a similar demand would prevail, for another 3 years. So, that means, there is no change in the demand, for the next 3 years. Now, there is another option in which, it is given that, the equipment to manufacture sleepers, is available for Rupees 18 Lakhs. So, that means, if you want to manufacture, or fabricate the sleepers on your own, then it is going to cost you an equipment, worth Rupees 18 Lakhs.

The annual operating costs for producing these 350 sleepers, is estimated to cost Rupees 7 Lakhs, for the first year. And, every year, you find that, there is a 10% increase, for years 2 and 3. Now, if the equipment does not have any salvage value, at the end of 3 years, the question is, should the supplier continue to outsource it, or should he buy the equipment, and start producing the sleepers on his own.

The Minimum Attractive Rate of Return here is, 15%. So, you find, this is the classic example of making a choice between, producing something on your own, versus, getting it

through some other agency. We call that as, outsourcing. So, the two options are identified, outsourcing, versus, producing on our own. Now, the cash flow diagram, for each of these two options, we can produce.

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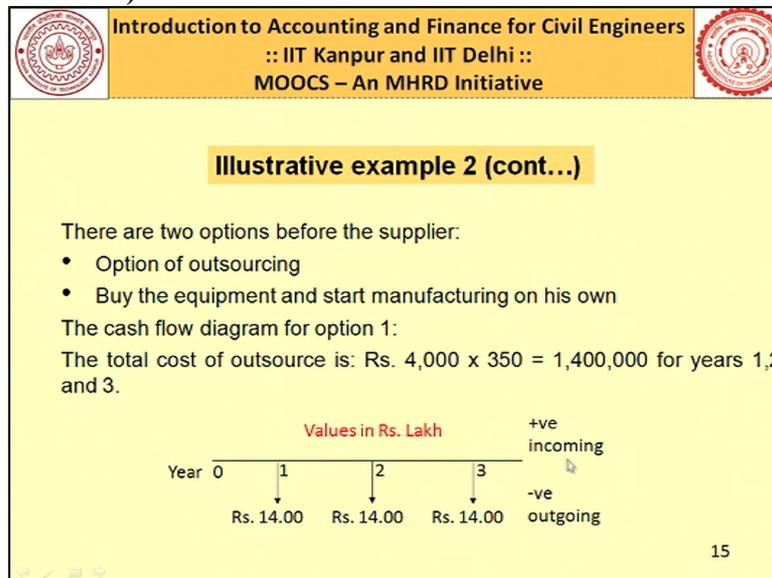
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Cash flow of all the alternatives:		
	Outsourcing	Own production
Initial capital investment (Rs.)	0	18 Lakhs
Annual operating and maintenance cost (Rs.)	350 x 4000=14 Lakhs for year 1, 2, and 3	7 Lakhs for Year 1 7.70 Lakhs for year 2 8.40 Lakhs for year 3
Salvage value (Rs.)	0	0 at the end of 3 years
Useful life (years)	3	3

(P/F, 15%, 1) = 0.8696; (P/F, 15%, 2) = 0.7561; (P/F, 15%, 3) = 0.6575

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And, you will find that, this look something like this.

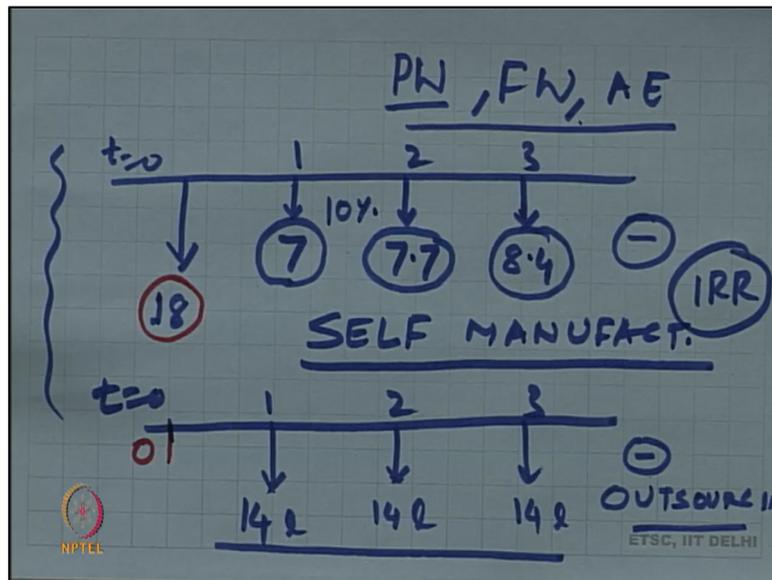
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For the first option, if you see, wherein, you want to procure it through, other agencies. So, the demand is for 350. And, the rate at which, you are procuring is 4,000. So, every year, you have a commitment of 14 Lakhs. So, you can see, at the time 0, there is nothing. But, at the end of year 1, we are paying 14 Lakhs, at the end of year 2, we are paying 14 Lakhs, and at the end of year 3, we are paying 14 Lakhs.

So, this is, as far as, the cash flow diagram for outsourcing is concerned. On the other hand, if you look at the equipment option, wherein, we want to manufacture on our own, so the cash flow diagram is slightly different. You remember, the 18 Lakhs is the cost of equipment. So, at time T is equal to 0 itself, we are going to invest 18 Lakhs.

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This is how, it looks. 18 Lakhs here, at time T is equal to 0. And then, when it comes to year 1 end, 7 Lakhs. And then, it is increasing by 10%, every year, so 7.7. And, then finally, it is going to be 8.4. So, this is cash flow diagram, corresponding to self-manufacturing. And then, we also have the cash flow diagram, against outsourcing, which is common, 14 Lakhs every year, for next 3 years.

So, these are the two cash flow diagrams. This is, at year 1, 2, and 3. This is, year 1, 2, and 3. So, you have to make a choice between, self-manufacturing, versus, outsourcing. This is outsourcing example. So, this is, T is equal to 0. You do not have to do anything. Every year, you are procuring, sleepers worth 14 Lakhs. On the other hand, if you want to manufacture on your own, 18 Lakhs you have to invest, at time T is equal to 0 itself.

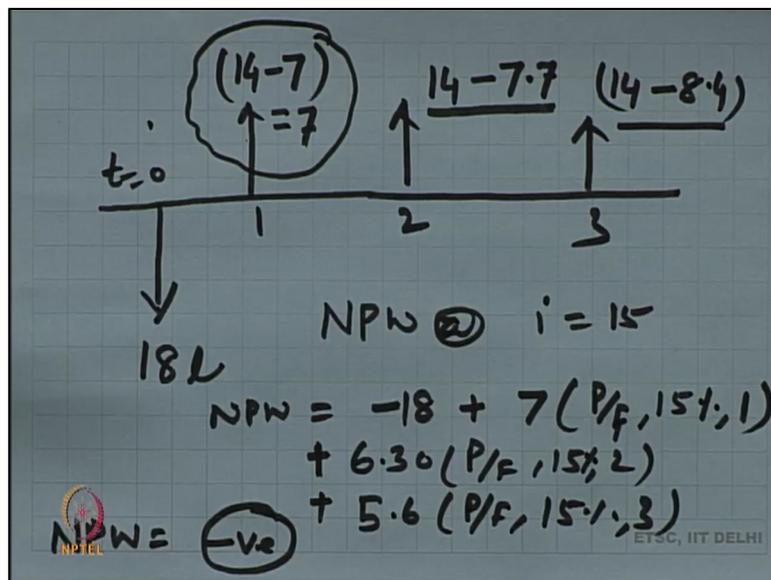
Then, the first year, the operational costs would be, 7. Then, the next year, it is 7.7. Because, it is increasing by 10%, every year. And, the next year, it is going to be 8.4. So, since these are the only two alternatives here, we can solve this problem, using the concepts of, either the Present Worth Method, or Future Worth, or even Annual Equivalent Method. But suppose, if

we have to solve this particular problem, using Incremental Method of Analysis, how do we do it.

Now, in earlier lectures, you have already been told that, it is not possible to find out the Internal Rate of Return, for a cash flow diagram, which is only cost dominated. For example, if you look at these two cash flow diagrams, you can very clearly find that, they are all costs dominated. What does this mean? There are entries, only in the minus side. So, for such examples, finding the IROR, is not possible. So, if you want to use the Concepts of Incremental Analysis, we have to slightly modify the cash flow diagram.

And, you had to understand it, in a slightly different manner. So what is happening here, we have to understand it like this. At time T is equal to 0, in outsourcing, we are not spending any money. So, this is zero money here. But, if you are manufacturing, you have to invest 18 Lakhs. So, if you are investing 18 Lakhs, at time T is equal to 0, we will see, what is the benefit, we are getting out of this. So, we can revise this cash flow diagram, in a slightly different manner, and we do it like this.

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So, the way we understand it like this is, what is the benefit you are getting, if you are investing 18 Lakhs, at time T is equal to 0. So if you remember, in the self-manufacturing case, we have to invest 7 Lakhs, for the year 1. Whereas, if you are going in for outsourcing, we are investing 14 Lakhs. So, that means, we have a saving of, $14 - 7$ in year 1. In year 2, what is the saving. We have a saving of $14 - 7.7$. And, in the third year, we have a saving of, $14 - 8.4$.

So, this is how, we have to interpret. So, we are saying that, if we are investing 18 Lakhs extra, at time T is equal to 0, I am getting a benefit of 7 Lakhs here, 14 - 7.7 at the end of year 2, and 14 - 8.4 at the end of year 3. So, if you continue to do this, you will find, you are getting a cash flow diagram, as shown in this particular slide.

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Illustrative example 2 (cont...)

- Only cost related information is available, thus, it is not possible to calculate the rate of return for individual options.
- Thus, incremental rate of return method will be used.

At time zero, the supplier needs to invest Rs. 1,800,000 in equipment, which will give saving of: Rs. 1,400,000 – Rs. 700,000 = **Rs. 700,000 in year 1**; Rs. 1,400,000 – Rs. 770,000 = **Rs. 630,000 in year 2**; Rs. 1,400,000 – Rs. 840,000 = **Rs. 560,000 in year 3**



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So, it very clearly shows that, time T is equal to 0, you are investing 18 Lakhs. Here, it is. At the end of year 1, you are getting a saving of 7 Lakhs. At the end of year 2, 6.3. And, at the end of year 3, it is 5.6 Lakhs. Now, the moment you have got this cash flow diagram, you can very easily find out, either the rate of return, and compare it with the Minimum Attractive Rate of Return, or you can as well find the net present worth, at the given MARR.

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Illustrative example 2 (cont...)

There are two options before the supplier:

- Option of outsourcing
- Buy the equipment and start manufacturing on his own

The cash flow diagram for option 1:

The total cost of outsource is: Rs. 4,000 x 350 = 1,400,000 for years 1, 2 and 3.

Values in Rs. Lakh

Year	0	1	2	3
		↓	↓	↓
		Rs. 14.00	Rs. 14.00	Rs. 14.00

+ve incoming
-ve outgoing

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So, if you see, the MARR here is, 15%. So, the easiest way that you can do is, you can find it out, what is the value of Net Present Worth, at I is equal to 15%. So, you can write it, like this. NPW is - 18 Lakhs + 7, P given F. Remember, all these values, are to be considered as F. And, we want to bring it to its, time T is equal to 0. So, we are writing, P given F, interest rate is 15%, 1 year. Then, it is 6.3, P given F, 15% and 2 years, plus next one is 5.6, P given F 15%, 3 years.

Now, depending on, whether this value is positive or negative, we can make the conclusion. So, as far as this example is concerned, NPW value at 15% is coming to be negative. So, the negative means that, we are getting a return, less than 15%. So, what does this mean? That means, it is still preferable to go for outsourcing. Because, if you remember, what is the basic principle of incremental analysis, that every Rupee is, as good, or as bad, as the other Rupee.

So, if you are investing 18 Lakhs extra, over and above the outsourcing option, and if this is not yielding a return more than MARR, there is no point going in for additional investment. So, the additional investment of 18 Lakhs is not desirable, right. So, this is how, you can manipulate the cash flow diagram. So that, wherever it is not feasible, to find the Internal Rate of Return, we can compute it using the Incremental Analysis concept.

So, just to summarise, what we studied in this lecture, we studied a particular method called Incremental Analysis Method, which is used, when we have to evaluate alternatives, more than 2 in numbers. You can still employ this, even if you have got, less than 2. But, whenever

you have got one alternative, to choose from two alternatives, in those cases, you can go in for Present Worth, Future Worth, or Annual Equivalent Method of Comparison.

But, more than two, necessarily we have to go in for, incremental method. Because, it is not enough to know that, you are getting a return, in excess of MARR. But, it is also to be in force that, we are also getting a return more than MARR, on our additional investment. Then only, you can say that, additional investment is desirable. So, for that, what we need to do? Organise the alternatives, in their ascending order of investment. List investment, first, then the next higher investment, and so on, the highest investment at the end.

Then, find the IROR, if it is possible. Compare it with MARR. Take those alternatives only, in the next stage of analysis, which is giving you an IROR, more than MARR. After you have done this, then you take two alternatives at a time, compare them, and choose the one, which is better out of the two. This way, you continue doing this, till all your alternatives are exhausted, and you are left with the one best choice. So, this is how, you have to apply this particular method. So, with this, I stop this particular lecture, and see you in the next lecture. Thank you, very much.