**Process Design Decisions and Project Economics**
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Module - 8
Chemical Project Economics
Lecture - 43
Measures of Profitability and Project Evaluation (Part I)

Welcome, in the previous lecture we saw the concept of interest and time value of money, like how does the value of money increases with time does or how we can predict the present value of money that we are going to earn in future. We saw simple compounding simple interest, compound interest, and then also we saw the concept of annuity capital recovery factor, and then we derived several compounding and discounting factors. Now, in this lecture we shall see as how all of these concepts and we used for evaluation of a project.

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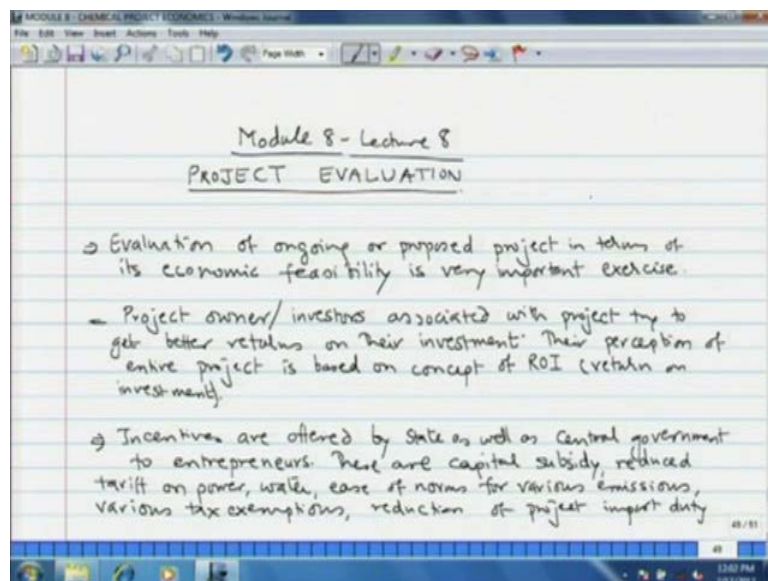
Evaluation of an ongoing or sponsored or a proposed project is in terms of its economic feasibility is very important exercise. The project owner or investors, those are associated with project who invest money in the form of buying shares or stocks, they try to get better returns on their investment. Their perception of the entire project is based on the concept of return on investment, but in addition to monitory returns there are several other returns of the project.

These are the social returns, the community development of the country, so the state as well as central government offers many essentives to entrepreneur who want to implement new projects. These are in terms of capital subsidy reduced tariff on power water ease of norms for various emissions gas liquid solid emissions. Then various tax exemptions tax hauls dates exemption from sales tax or reduction of project import duty. So, they somehow try to encourage the enter entrepreneurs to take of new projects.

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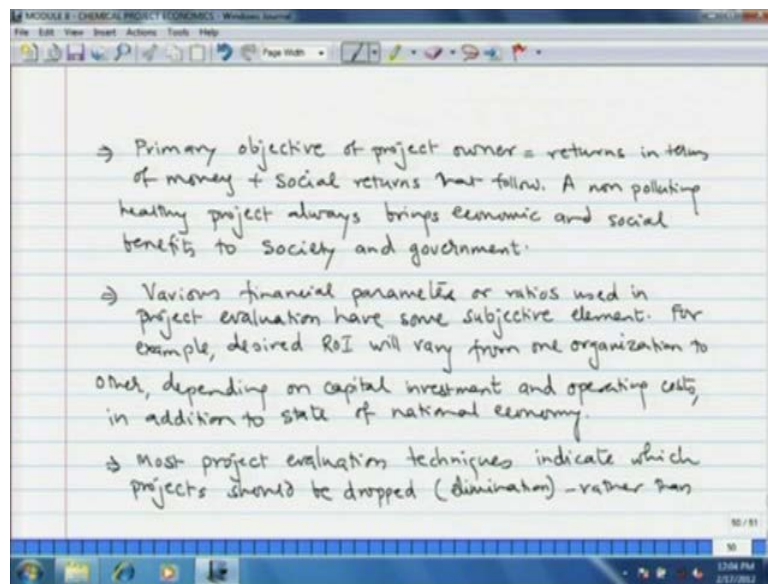
The primary objective of the project owner and investor is to have as high returns in terms of money as possible for that for social returns. That will follow obviously a non polluting healthy project will always bring economic and social benefits to society and government for the evaluation of various projects for production of the same product. These can be evaluated on the basis of various financial parameters or ratios, now all of these parameters and ratios have some subjective element.

For example, the desired rate of return on investment will vary from one organization to another. Depending on the capital investment whether the capital is completely internal or it is in terms of some depth borrowed from financial institutions or it is in terms of both depth and equity money that is that is borrowed from issue of shares to the public. So, depending on capital investment that it has return on investment it will vary, it will also depend on the operating cost. Finally, the overall state of national economy most of the project evaluation techniques or elimination based.

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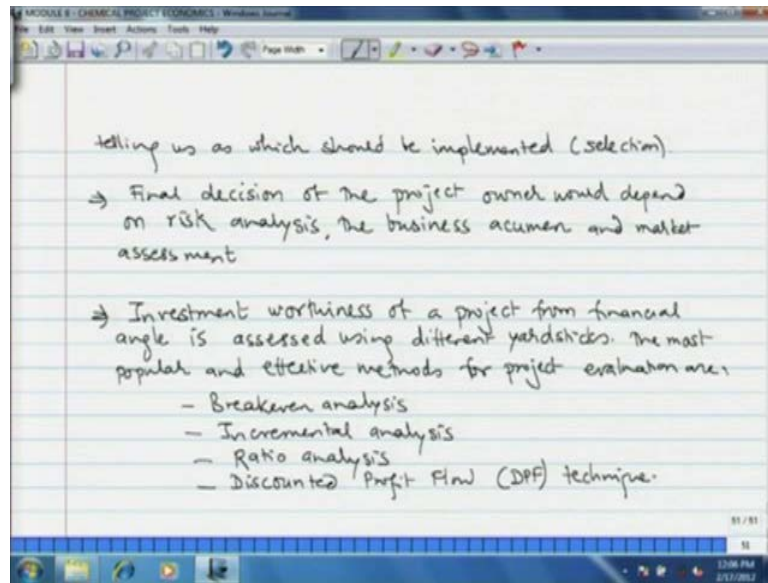
That means they will indicate which project should be dropped rather than telling us which project should be implemented or selection. So, it is more of elimination than selection the final decision of the project owner would depend on the risk analysis the business acumen and a market assessment. Now, here there are we shall mainly evaluate project on the basis of monetary returns.

So, the investment opportunity of a project from financial angle is accessed using different yardsticks the most popular and effective method for project evaluation are break even analysis, incremental analysis then ratio analysis and the discounted project profit flow technique. Now, each of these techniques has their own merits and demerits, we shall see these techniques one by one starting with break even analysis.
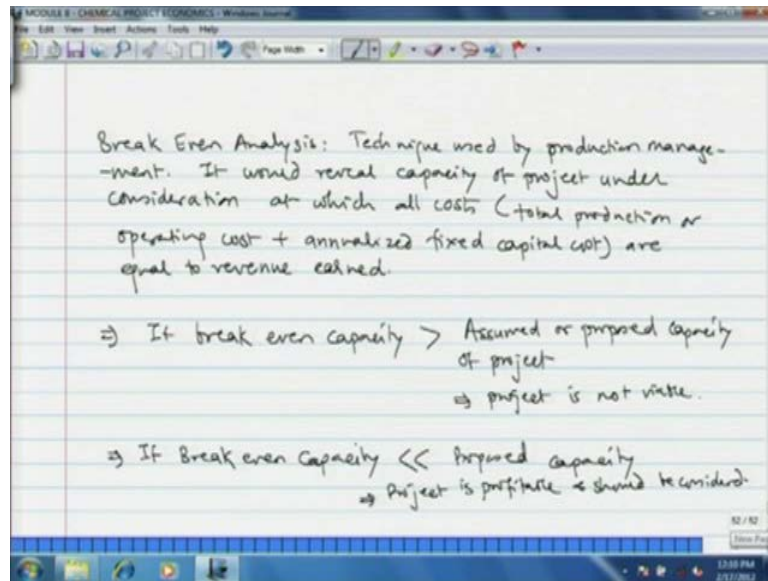
Now, this technique is mainly used by the production management to evaluate the profit or loss of any project. It would reveal the capacity of a project under consideration at which all cost operating as well as annualize fix capital cost are equal to the revenue earned, so that point we note.

This is a technique used by production management, it is essentially the capacity of the project and under consideration at which all cost the production cost or operating cost as well as the annualized fix capital cost are equal to the revenue earned in the market survey report that is generated at a time of project construction. It gives on estimate of the project cost of definitive capacity based on the demands of plan analysis and based on this the break even capacity is computed. Now, if the break even capacity is more than the assumed capacity of the project then it is concluded that the project should not be considered or it is a non viable project.

If the break even capacity is very much lower than the assumed capacity then the project is worth studied further, so that point we note. Here, if break even capacity is higher than assumed or proposed capacity of the project then it means that project is non viable. On the other hand, if break even capacity is much, much smaller than proposed capacity project is profitable and should be studied further. Now, the final decision will be substantiated by way of other project evaluation criteria in support of this, so this is not the soul Criteria over which the decision will be based.
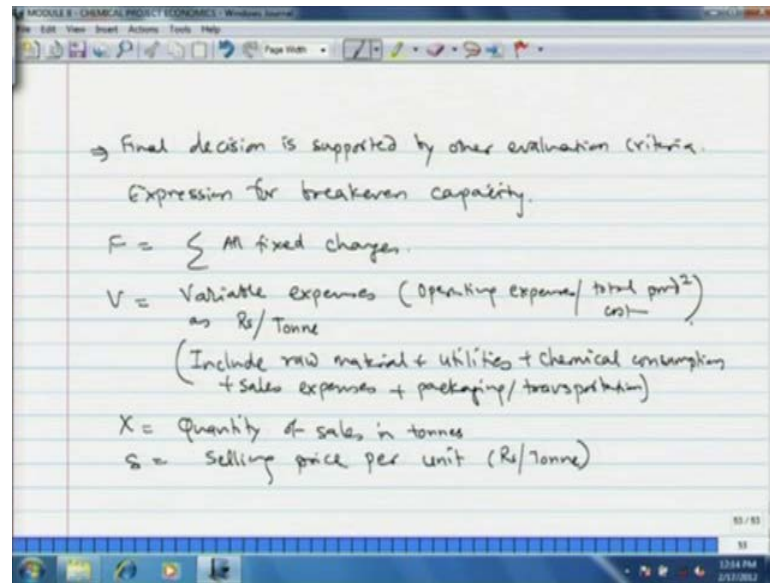
Final decision point we note final decision is supported by other evaluation criteria. Now, there are certain assumptions in break even analysis, in the first case we assume that all expenses can be bifurcated in terms of fixed and variable cost or production cost. Then second market conditions are ideal whatever is produced is sold, immediately there is no inventory or finish products by products or co products. Then we also assume that the selling expenses are fixed as some percentage of the sales then fourth assumption is some fix charges are not dependent on the capacity utilization. These fix examples of this fix charges are the interest charges and turn loan depreciation salary and wages factory over head and administrative expenses.

Then, we also assumed at the estimate project cost is carried out for definitive capacity and then the break even analysis done. Now, all of the fix charges are added and indicated by let us try to derive an expression for the break even capacity we assume that f is summation of all fix charges. Then the variable expenses are denoted by v or this is operating expenses or total production cost whatever you call and the variable expenses are expressed as rupees per tonne it. So, it per unit expenses these would include the cost of raw material plus utilities plus chemical consumption plus the sales expenses setting up offices.

Sales offices in different part of country then transportation at the sales site then ware houses, local ware houses to store the products those are the sales expenses plus the

administrative staff employed at the at particular sales location. So, all of these are included in sales expenses plus packaging and forwarding or transportation. So, these are all some dump under variable expenses which we denote as rupees per tonne. Let x denote the quantity of sales in tonnes then S is the selling price per unit this is again the rupees per tonne now.

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At break even capacity all the sales accruals match with the variable expenses and fixed expenses. So, at break even capacity all net cash accruals, we have already derived a formula for this in previous lecture equate or a or equal to the variable expenses plus fix charges. So, S that is selling price rupees per tonne in to x the production tonne is equal to variable cost per tonne in to the production capacity plus F. So, x the break even quantity of sale x is equal to F divided by S minus v or percentage capacity percentage break even capacity is 100 in to x divided by the total plan capacity or total proposed capacity.

Now, you can see here that a break even capacity is directly proportional to F and inversely proportional to S minus v S is the total revenue that is earn through sales. So, the difference S minus v is high, if either S is high for a given v or v is low for given S, we can earn higher revenue from sales, if we have a monopoly of any product. However, this situation may change with globalization when other international companies were also entering the market and they make the same product available at a cheaper price.

So, S depends on the total market demand and the prevailing market price, so that is a factory dependent on many other situations. It is it completely dependent on government policy and the overall scenario of the of the market sale so on and so forth. So, what we can do is that we can be reduce v other means of lowering break even capacity is to have lower variable cost v through lower price of raw material. That is one case now or more efficient process which has lesser utility consumption so on and so forth. Now, low value of F can also bring down x lower value of F means superior and cheaper technology requiring less capital investment and man power.

So, that point we note x decreases, if S increases or v decreases or F decreases S increases, if we have product monopoly v decreases. If we have efficient process requiring cheaper raw material and less utility more energy efficient process and F going down fix charges going down means we have superior and cheaper technology requiring less capital investment and man power, so that point we note. Here, so under this circumstances x will be smaller, now we have to take in to consideration the overall operation of the project over a long period of time may be 10 years or 15 years if the profit x being low means the pro project is more profitable.

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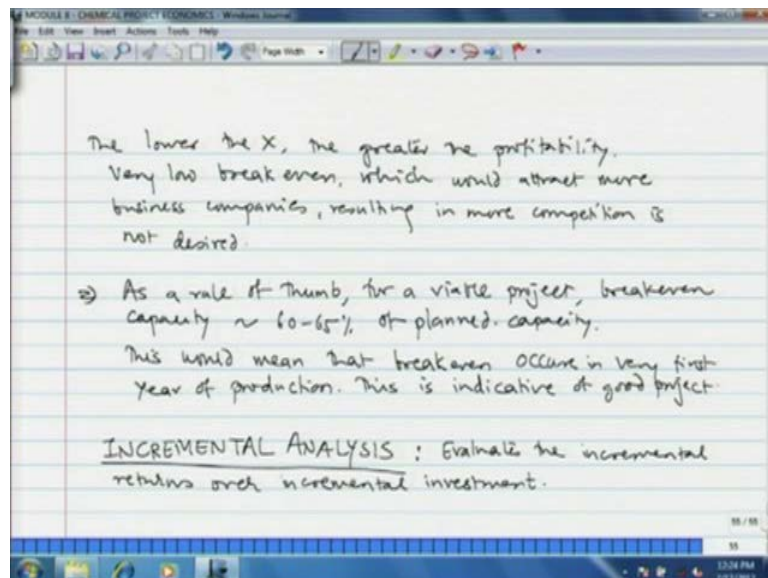
Then, that point we note the lower the x, the greater the profitability of the process, however if the profitability becomes very high then it will attract other layers or other investors in the business and that will result in more competition. So, very low break

even is not preferred that point we note here very a breakeven which would attract more invest business man, more business, company. Resulting, in more competition which will bring down S is not desired. Then what is a typical value of x the typical value of x is about to 60 to 65 percent as a rule of thumb for of viable project, the break even capacity should be about 60 to 65 percent of the planned capacity.

Now, this means that break even occurs in the very first year of investment. Now, we must note this point that all though we have planned we have made the cap the total capacity let us say 100 tonnes per day right from the first day of operation. The, planned may not reach that capacity the typical capacity utilization is 60 to 65 percent in the first year. Then it increases to about 80 percent in the second year and from the third year onwards or third year it could say 90 percent. From fourth year onwards you have fully capacity utilization, but if the break even capacity is 60 to 65 percent.

That means you have the break even in the very first year of production and which is a desired this is this indicates a good project. Now, break even capacity helps the project owner in deciding the minimum production capacity, however the project if the production capacity is increased beyond this much have than break even then it may result in reduction in price.

So, the analysis may not hold true of course, the v also will go down because of the economy of scale. However, S will also go down if more and more product appears in the market, so that is about the break even analysis. Now, let us see the second concern that is incremental analysis this is a second yard stick for evaluation of a project incremental analysis evaluates the increased returns or incremental returns that is a better word over incremental investment.

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Now, let us see this with an simple example numerical example, let us say I have three projects project A, B, C. The first project cost in lakhs is 2000 or 20 crore, the second project has investment of 2400 lakh or 24 crore and the third project has investment of 2800 lakhs or 28 crore. The profit after tax in these projects again expressed in lakhs is 400 for project A, 550 for project B and 600 for project C.

Now, let us see, what is the incremental analysis, however we first calculate the percentage return on investment for these three projects. For the first case, it is 20 percent, 22.9 percent for B and 21.4 percent for C if we assume that desired rate of very rate return on investment is 20 percent or higher then all of this three projects qualify, but then which one to choose A, B or C. Now, let us see what happens if we go from one project to another or now we try to answer a question as how extra benefit we will get if we move from project A to B and from B to C. Project A has least investment, project B has highest return on investment and project C has highest total profit.

So, all of these three projects have some merit, now let us see when we go from A to B, project A to B we invest extra 400 lakh or 4 crore, however we earn 150 lakh extra profit or additional profit. Then the return on extra investment is 150 by 400 that is 37.5 percent. Let us say what happens, if we go from B to C here again we have to invest extra 4 crore or 400 lakhs, however these extra investment will increase our profit only by 50 lakhs. So, the return on extra investment is 50 by 400 that are 12.5 percent.

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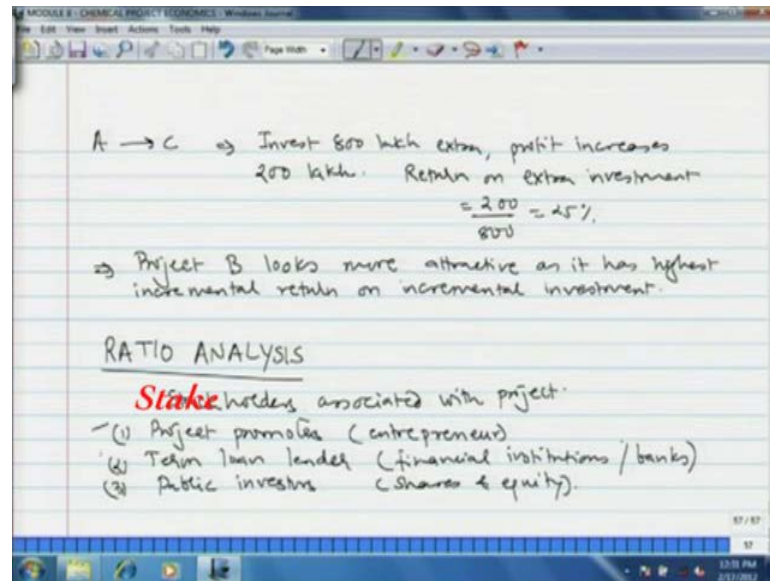
Now, let us see what happens if we you directly from A to C here we have to invest 800 lakh extra, however our profit increases by rupees 200 lakh. So, here the return on extra investment is 20 percent or 25 percent, sorry 200 by 800 that is 25 percent. Thus, it means that considering the minimum this had return to be 20 percent, one can say that incremental analysis by incremental analysis. Project B looks more attractive because here the ray incremental return on it incremental investment is highest, that point we note project B looks more attractive as it has highest incremental return on incremental investment.

So, that is as per as the incremental analysis is concerned, now we see the third type of evaluation that is a ratio analysis. Now, there are three different types of take holder associated with chemical project, first are the project owner or entrepreneur then but we also included. In the project promoter that is the people are the institutions who lend money for setting a project, its take under associated with project first project promoter. That is entrepreneur plus financiers then that financier we can put separate entrepreneur that is then second these term loan lender.

Here, we can put the financial institutions banks and finally, the people who invest money in the venture in terms of shares. So, the public investors who invest in terms of hears and equity, now the interest of these three stack holders is different. Let us see what is that the promoters are interested in early pay back of their investment, the people

who invest their money entrepreneurs. Then the financial institutions are project financiers, they are interested in proper repayment of the term loan plus that interest payment of the interest of the on the loan as per agreed schedule.

Finally, the public investors or the share holders, these are interested in the stock market and they wish to have good price of the shares as well as high dividend on the share. Now, we can evaluate the project from all three angles for from promoter's angle from the financial institution angle and public investors using simple ratios.
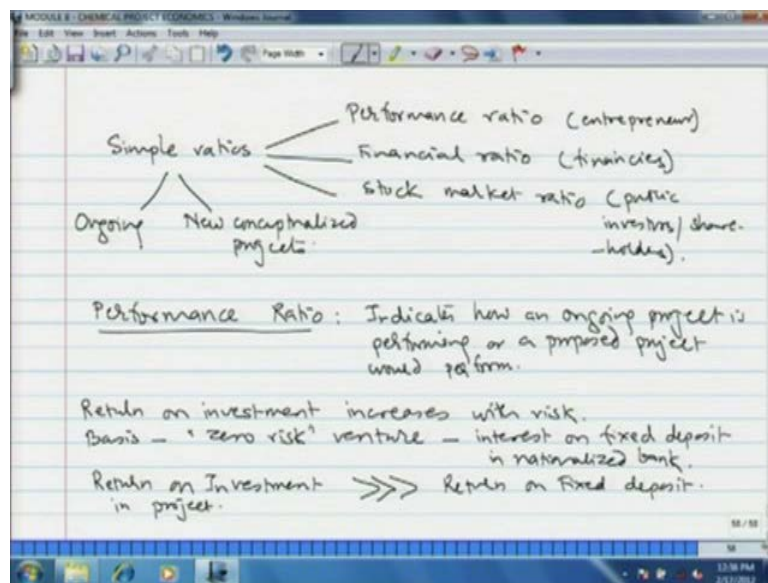
Now, what are these ratios the first ratio is a performance ratio the second, so this is for the entrepreneur or project promoter then the second is the financial ratio. This is in the inter staff financiers financial institution banks we have lent the money for setting of the project. Finally, the stock market ratio this is for the public investors or shareholders, now some of these ratios or for ongoing project and some of these ratios are for new conceptualize projects. We shall see these ratios one by one, now let us see the performance ratio these ratios indicate as how a project performs or is performing depending on the return on investment.

So, the performance ration indicates how and ongoing project is performing or a proposed project would perform now this is based on the return on investment. So, return on investment increases with risk, so we have to consider some basis for evaluation of performance ratio. So, the basis often adopted is the zero risk venture and this is in most

of the cases is the fix deposit in bank or the interest on fix deposit in the bank. That means we evaluate returns on any investment done in a chemical project in comparison to the return that we will get.

If we invest the same money in the form of a fix deposit in a nationalized bank which is the safest risk free investment, now obviously the return on investment should for exceed the return on fix deposit to attract the investor. Only then the investor would be ready to invest money in a project, so it is not just increase, but I have put three returns. So, the return investment in project should be much higher, significantly higher than return on the fix deposit, now how to do we quantify this or how do we estimate the return?

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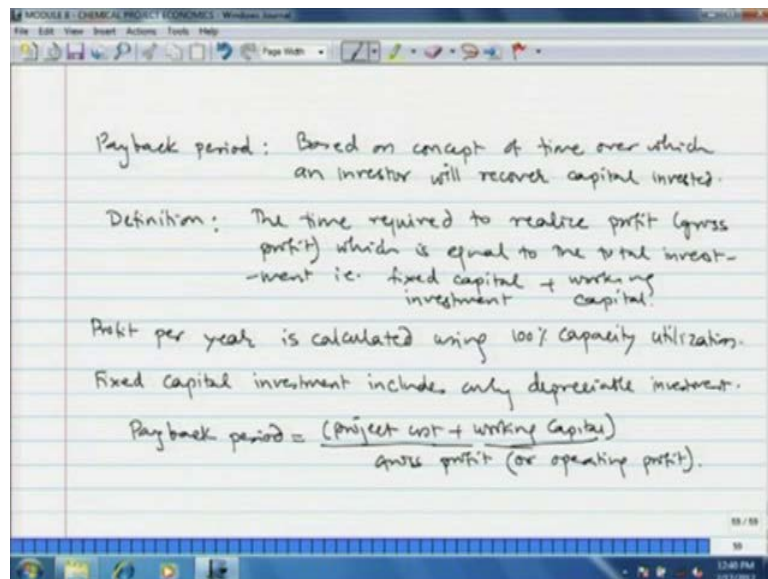
The first ratio is the payback period; the project has to earn money to pay interest on the term loan the working capital the corporate tax dividend. Therefore, the concept of time and project can recover investment is highly significant, so the payback period is based on concept of time over which and investor will recover capital invested after payment of the dividend.

The term loan working capital corporate tax so on and so the exact definition of payback period is then the time required to realize profit or gross profit which is equal to the total investment that is the project cost plus working capital. That point, we note the time required to realize profit this is of course a cumulative profit gross profit which is equal

to the total investment that is the project cost capital investment plus working capital profit per year.

Year is calculated on the basis of 100 percent capacity utilization which is obviously not possible, as I mentioned before in the first year about 60 to 65 percent of the total planned capacity is utilized. However, when we estimate the property, it is on the basis of 100 percent capacity utilization, in some cases when we consider the project cost we consider only the depreciable investment of the project cost. So, that point we note the fix capital investment includes only the depreciable investment instead of gross profit.

If we consider the operating profit, we define payback period as project cost two ways of payback period project cost plus working capital divided by gross profit or operating profit that is profit after tax. Profit after tax and the depreciation fund, if we use that then we have to take only the equity part of fix capital because the debt will be paid through the depreciation fund and interest on the depth is already subtracted, so that point we note.

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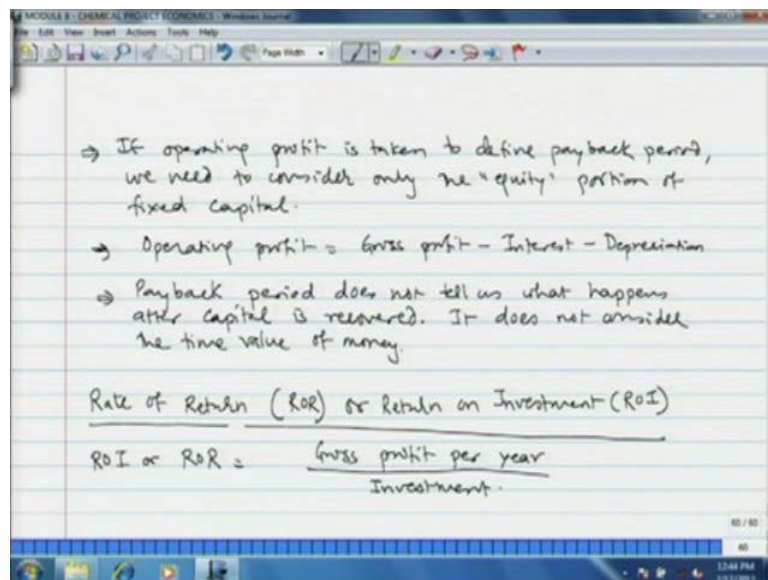
If operating point profit is taken to define payback period, we need to consider only the equity portion of fix capital and not the depth and here we also note that operating profit is gross profit minus the interest on loan minus depreciation fund.

So, we assume here that the depreciation fund is used to pay the debt or the principle portion of the depth interest is already subtracted. Now, pay back analysis will tell us how soon investment is recovered, but it will not tell us as what happens after investment is paid back. It does not give the total profit offer the motional service life of the project nor at nor does it give the present value of the return on investment beyond the payback period. So, payback period has several limitations, but still it is a good way or a quick way of estimating the profitability of the process. So, that point we note here that payback period does not tell us what happens after capital is recovered. It does consider the time value of money, now the second ratio that is used is the rate of return or return on investment ROR or ROI return on investment. Now, this is defined in a number of ways the easiest way is the gross profit per year divided by the investment.

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The second method is second way of expressing ROR is operating profit per year divided by investment or the third method is a profit after tax, but before depreciation divided by investment. So, this is at this is a very easy method of estimating the profitability of the process, another ratio that is used with return on equity. The money that is borrowed from public R O E, ROE is defined as gross profit minus the interest minus the corporate tax divided by equity.

Now, this is of course per year, now gross profit can be calculated using 100 percent capacity utilization, while financial expenses is the interest or the interest is during the

monitored period. Now, another ratio that is used is the profit margin ratio profit margin ratio is defined as the ratio of profit to the sales gross profit to net sales.

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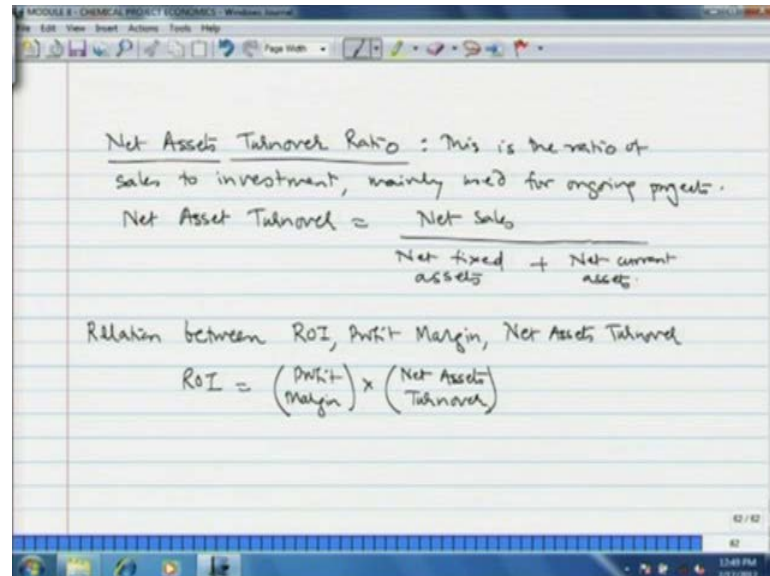
Another performance ratio is the net assets turn over this is defined as the ratio of sales to investment, however this ratio is mainly for an ongoing project and not for a new proposed project, so that point also we note. Then this is the ratio of sales to investment mainly used for ongoing projects net asset turnover is equal to net sales divided by net fixed assets plus net current assets. Now, if this ratio is high it reflects the ability of a project owner to make good use of the resources for an ongoing ratio. If this ratio declines, then the owner project owner has to take majors to increase the sales.

Now, these particular ratios the profit margin and return on investment the last three ratios that we have seen are related. So, the relation between return on investment then profit margin and net assets turnover is R O I is equal to profit margin in to the net assets turn over. These were the performance ratios which are from the view point of the entrepreneur of the project owner, now let us see some ratios from the term loan lenders the financial institutions, we point financial ratios.
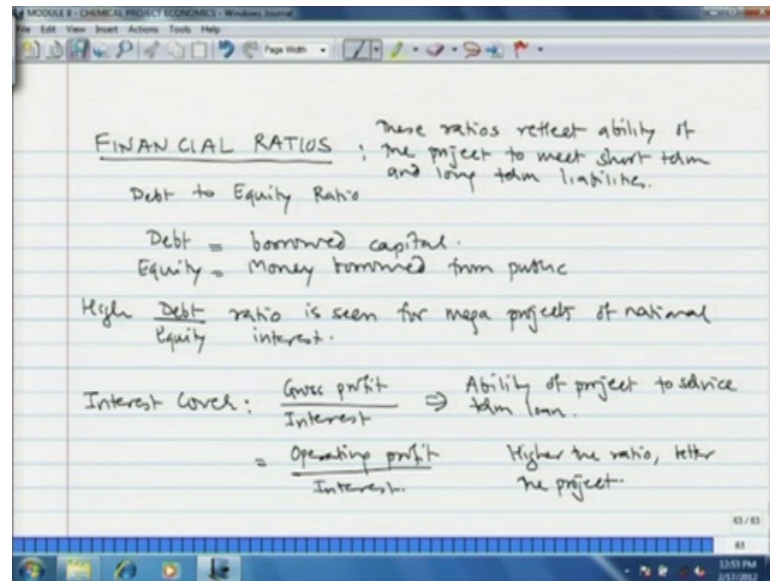
The first ratio is a depth equity ratio, now one point we note that all of these all of the financial ratios, they reflect the ability of the project to meet the short term and long term liabilities that point we should note here. Before we go for the definitions of the ratios these ratios reflect ability of the project to meet short term and long term liabilities. So, first financial ratio is a depth equity ratio depth is the borrowed capital from banks or other financial institutions. Then equity is money borrowed from public in the form of shares now high term loan if the depth equity ratio is high then it indicates the faith of the financial institutions in the project.

Now, high depth to equity ratio are seen for mega projects which are of national interest such as a petroleum refinery then the second ratio is the interest cover. This is defined as the gross profit divided by the interest, so as a definition suggests this is the ability of the project to service the term loan by way of interest high ratio is good sign for both project owner and financier. Now, the numerator could be profit minus tax in some cases that is the operating profit divided by interest. So, the higher the ratio the better it is for both entrepreneur as well as the financial institutions, that point we note the higher the ratio the better the project.

Now, the third ratio is depths service coverage ratio, now this is defined as the ratio of profit after tax plus depreciation by straight line method plus the interest divided by interest plus the loan re payment. This is again mainly for ongoing project, so these acronyms we define here p a t profit of pre tax, then d p is depreciation, but by straight line method, then interest INT is interest on term loan and LRP is the loan re payment instalment. Typically, DSCR this depth coverage ratio should be about 1.7 for available project, then finally is the current ratio current ratio is defined as the ratio of current assets to current liabilities.

Now, again this ratio is a relevant for ongoing project not for a conceptualize project and it reflects ability of the project to convert the liquid assets in to cash to meet the liabilities of the business, so that point we note. Here, it reflects ability of the project to convert liquid assets in to cash to meet the liabilities. Today, we have seen various methods of evaluation of the project from view point of the project owner entrepreneur from the financial institutions. In the next lecture, we shall see thus ratios performance ratios from the stock market point of view, however all of these ratios have the demerit that do not consider the time value of money. So, in the next lecture we shall also see the discounted profit flow analysis which takes in to account the tie value of money.