MINERAL ECONOMICS AND BUSINESS

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Week 4

Lecture 16 : Feasibility study and Hypothetical project financing

Hello everyone. We will be discussing ah today about feasibility study and hypothetical project financing. The feasibility study is a major or rather a milestone for starting any business or understanding the prospect of any business. We also have certain case examples we would also demonstrate hypothetical project financing that means, where we do not have the project in hand, but we can visualize the ah the prospect of the project based on ah certain parameters assume parameters and the cost figures that is available.

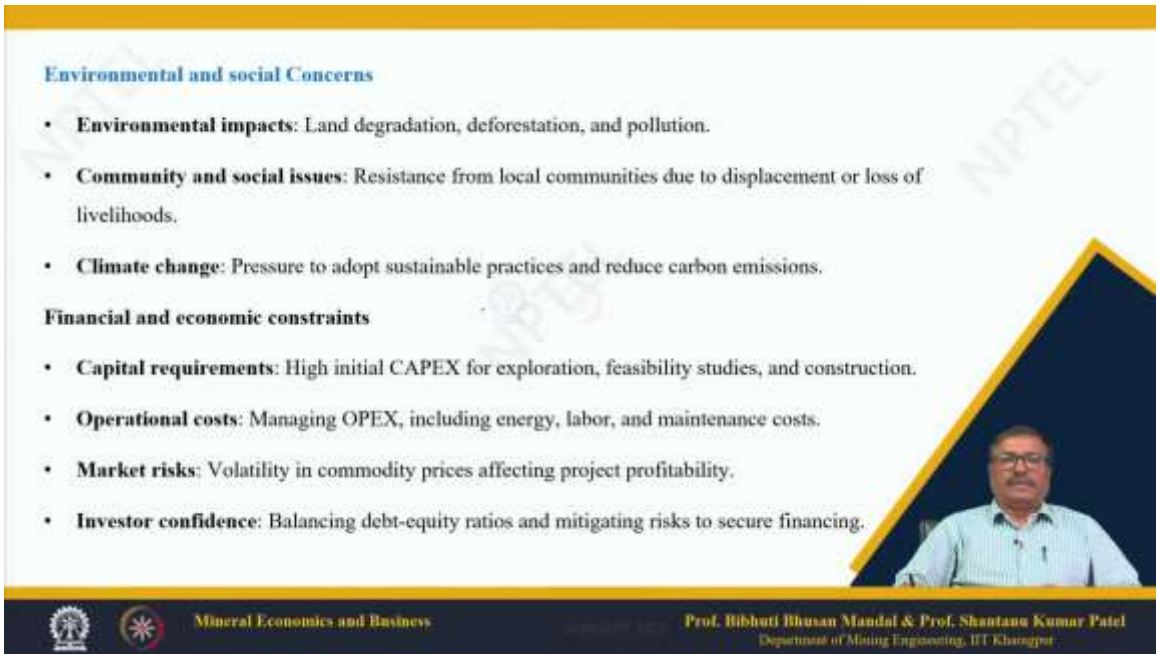
So, the concepts that will be covered here in this particular lecture are certain critical issues in mining project starting mining project, the risk involved and how to minimize that risk, how to mitigate the risk of financing and running the business, certain critical issues ah that means, there are certain other critical issues also related to mining projects,

then the feasibility studies and then hypothetical project financing as I was talking in the beginning. So, what are the basic or other fundamental ah critical issues in mining projects, especially for new mining projects. we face a range of challenges that can significantly impact their success. And identifying and ah the addressing of these particular critical issues that will ensure the project feasibility that will minimize the risk and that will promote sustainable business and sustainable development.

What are the key categories of of of the of the different issues that is related to the mining project? Number 1 is the political and regulatory challenges and then the environmental and social concerns, then financial and economic constants. For example, for the political and regulatory challenges we have in different countries we have different norms and the national policies. So, in the beginning it can be delayed. even though in our country we are trying to make it as fast as possible, but I mean we are talking about the global scenario, there could be delays in securing the mining licenses and permits.

And also there will be certain local employment demands, local content demand and the profit sharing agreements that means, whether the social benefit is there or not. unless and until you ensure these things you cannot just get a go ahead with the ah with the with the project a proposal. We need to adhere to the local mining laws, tax regimes and the royalty payments that is specific to that particular country. Now for the environmental

and social concern as you understand at this point of time that the mining of any project any mineral resources will definitely cause land degradation, deforestation and pollution. That means, we have to adopt the method in such a way that it minimizes all these things and as low as reasonably practicable.



and also see that the environmental laws are followed and the rehabilitation and reclamation has to be a part of the entire project execution. The community and social issues are equally There will be resistance from the local communities because they will be displaced from the area because of the mining activity. There would be loss of livelihoods that means the income sources. So, they will definitely ask for compensation or they may simply resist that no mining in that area.

So, we have to tackle all these things there. Then the issues related to the climate change like pressure to adopt sustainable practices that means, to reduce the carbon footprint carbon emissions. So, that we do not contribute to the environmental degradation anymore. So, the process has to be designed in that way only. Then comes the financial and economic constraints.

where we require huge capital requirement. In most of the cases mining will in the beginning will require good high initial capital expenditure for exploration, for feasibility studies and for the construction right in the beginning. So, the operational cost is also important here because managing operational expenditure that includes energy, labour, maintenance cost they are high. So, this we have to manage means the financial support has to be there. Then there is market risk there is volatility in commodity prices it could be ah it could be a sudden change or sudden fluctuations.

So, we need to be ready with the ah the the process should be designed in such a way that the project profitability does not go down. So, that that has to be ensured. And knowledgeable people who handle the market risk should be employed to tackle these things. Then the investor confidence is balancing a debt equity ratio that we will take up in separate lectures, but the investor confidence means the people will have less risk in investing in this. If you are asking for shares or stocks, then people should be ready to invest in that and the balance of the debt equity ratio. This is to secure the financing for the project. About the risk mitigation part, what are the strategies for to handle this challenges? We need to conduct a thorough feasibility study. We will talk about this thing and also sensitivity analysis that means, that if you are assuming certain change in

certain assumption assume parameter, how is it affecting the overall profitability of the business.

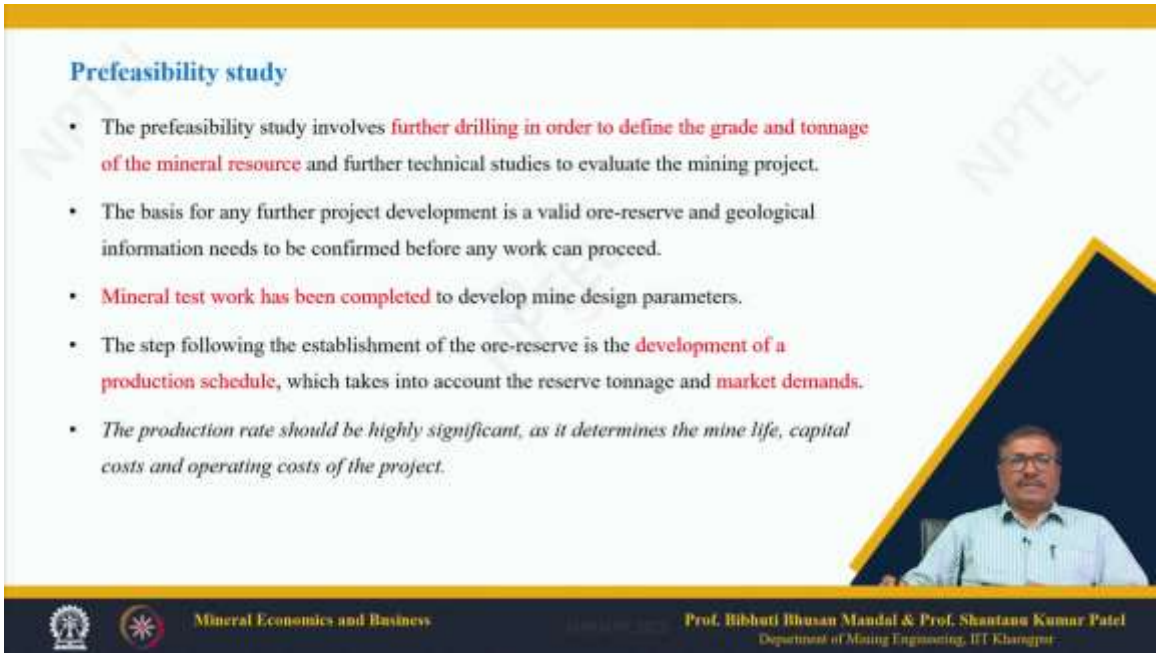
And then we must engage the stakeholders early, right from the beginning, so that there is transparent communication between all the stakeholders. There is no hide-and-seek game here. We also implement sustainable practices to meet the environmental and social standards, which we just discussed—diversifying funding sources and building financial resilience. This is what we just talked about in the previous slide. We have summarized these in four sentences. These are the basic strategies to address the challenges that we described earlier. The feasibility study is a tool for the identification of critical issues and their possible resolution.

They play a pivotal role in addressing the critical issues of any new mining project because they evaluate the technical, economic, environmental, and social parameters we are talking about. Now, they provide a structured approach to analyze potential risks and formulate mitigation strategies for those risks. Now, the feasibility study also bridges the gap between critical issues and practical solutions. This is a well-researched, written document from which we can find out what the potential risks are and what mitigation strategies we should adopt to handle them. So, a thorough feasibility study will definitely increase project confidence—number one.

There has to be confidence from the investor side, from the operating people—everybody involved, all the stakeholders—will have confidence in starting and running the project. It will minimize the risk and pave the way for successful project execution in the future if it is taken up. Now, this is several stages—it is not a single document. So, we can start with a concept study, then we go for a pre-feasibility study, and then something called a bankable feasibility study—a feasibility study on the basis of which we can get finance or financial support. The concept study is also known as very well known as scoping study. This is a preliminary evaluation of the mining project based on general assumptions and parameters from similar project. That means, we know that similar projects are being conducted somewhere, if not exactly similar thing at least certain parameters and the scenario in which the mining is being done is common. So, we can take the data from there. It also identifies key technical and economic factor including the target mineral reserve, mining and processing method.

So, the basic things the production target, logistics available, customer potential and the cost estimates based on the data available. From there we can have a scoping study that prima facie there is an evidence that it has some economic attraction. So, what is the accuracy level? It is about 50 percent. 50 50, but still a positive thing that means, with much detailed study now we can the project now warrants further investigation by providing the initial analysis of the capital and operating cost.

So, the project feasibility can be further studied based on the scoping study initial study. Next comes a pre-feasibility study that requires further drilling that means, for the borehole in order to define the grade and tonnage with full confidence of the mineral resource and further technical studies to evaluate the mining project itself. So, the basis for any further project development is a valid ore reserve and geological information that needs to be confirmed before any work can proceed because unless we know the extent of the ah deposit, depth, characteristics, grade and size and shape everything we cannot make a proper over reserve estimate.



And when you are when the testing part is involved some processing is involved then the mineral test work should have been completed. at this stage to develop mine design parameters. And the step following the establishment of the ore reserve is the development of a production schedule. Now, if I mean what are the what method you are adapting, what is your reserve and the basic infrastructure required from there or the machines that you want to deploy Then you can make a production schedule year by year every 5 years and then year by year you can just go on making a production schedule.

and that will take into account the reserve tonnage and of course, the market demand if you are producing too much you cannot sell it. So, depending on the market demand and what you have as a reserve and the technology that you are adopting you can make a schedule which is realistic and which is possible. Now, this production rate should be

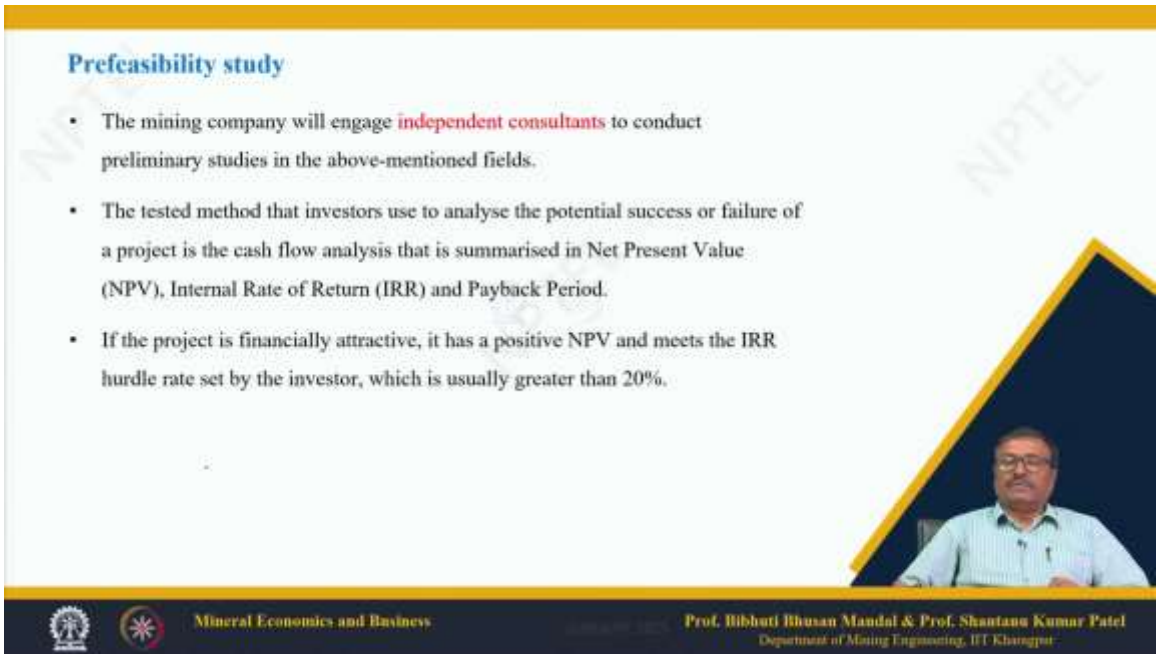
highly significant as it determines the mine life also because if you are depleting it very fast the mine life will be shorter. And and depending on the production rate, it will also demand for the capital cost involved and the operating cost involved for running the project. Now, if the pre-feasibility study a typical pre-feasibility study ah should contain the information and analysis of around say 25 percent or so.

That means, it is very in the beginning itself we have the ah basic data, but it is ah investigated properly to take care of this following points. Number 1 the resources and reserves available, mining method and production areas. Then the processing method, what mineral processing or beneficiation you want to adopt. Mine infrastructure like water supply, power supply, site civil structures, how do you manage the mine waste, where do you discard the dump and discard the waste materials and tailings. It is a huge costly thing, tailings management, ah the tailing dam, transportation of tailing, the ah embankment and maintenance.

Mine logistics, mine to market, what transport facilities are you adopting? Then human resource planning, the deployment of manpower in different shifts, in administration, in workshops, in safety, and everywhere. So, all the human resources planning is to be detailed now. The environmental and community considerations are equally important, as we have talked before, but the important part is that it has to be a written document. The

capital and operating costs involved in all these processes, then you go for an economic analysis, then a risk management plan to reduce the risk involved in the project.

The mining company will engage independent consultants to conduct the preliminary studies in the above-mentioned fields. So, usually, the company will engage some consultants, and they will conduct the preliminary studies. The tested method that investors use to analyze the potential success or failure of a project is the cash flow analysis. That means, we will also have our professor Patil talking about or teaching this part, the net present value. or IRR and payback period for the project.



So, at this stage, the document will definitely take care of the analysis that evaluates the project, depending on the net present value, and find out the internal rate of return and the payback period when we can expect the payback. If the project is financially attractive, it has a positive net present value and it meets the IRR hurdle rate set by the investor. Now, the feasibility study is much more detailed; it will refine all the assumptions and design parameters from the pre-feasibility study. So, in the pre-feasibility study, there could be some doubts or a larger margin of error.

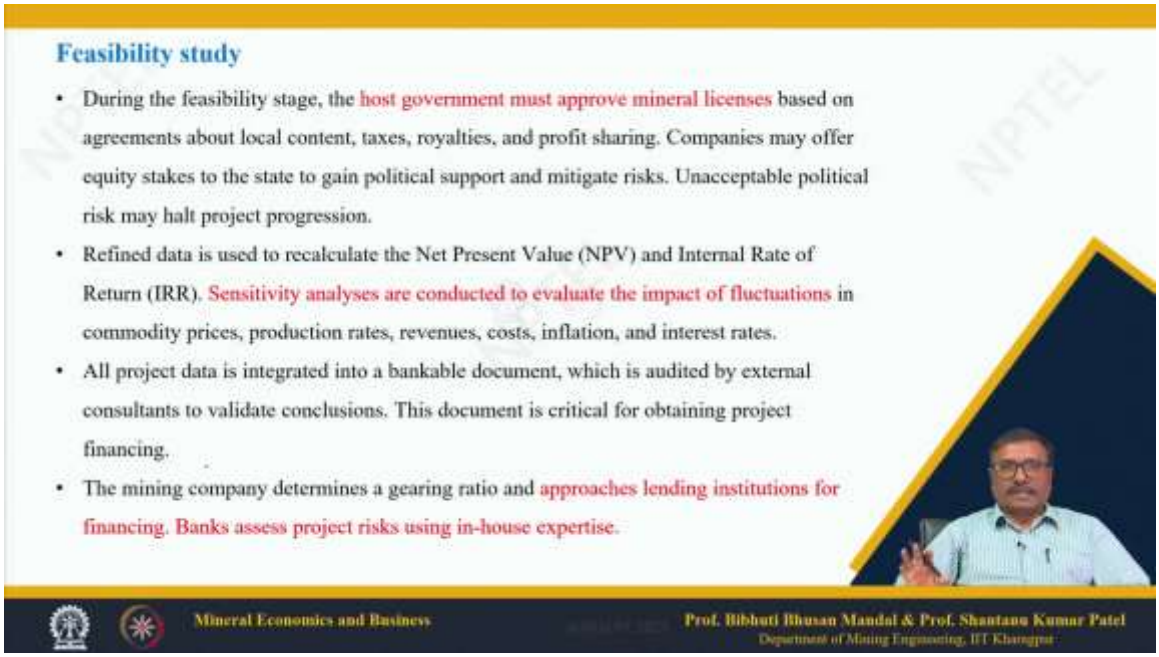
But here the technical and financial feasibility will be within only a 10 percent margin of error, within 10 percent margin of error. So, like the error was 25 percent in case of, say, a pre-feasibility study, but here we have a 10 percent plus-minus margin of error. So, an extended drilling campaign provides accurate geological information. That means now

we are going to get much more detail, and this is final for preparing the mining plan or the detailed feasibility study report.

This is to have a detailed plan inside the mine—how it will be done—that is why you need all the information required about the deposit and the geology, geotechnical information in detail. That will also boost investor confidence because now you are giving them a detailed idea about the project and its viability. So, any person who is competent to scrutinize the document presented by the company for the purpose of, say, market investment or to attract investors, they will be able to understand from the document presented by the company, and of course, that will boost investor confidence because the risk will be less. On-site pilot plant trials should have been completed at this stage for the mining and beneficiation part. And the specialist studies to assess the project's social and environmental impact by the experts should have been done at this stage.

So, in-house and external consultants will again conduct detailed research on mining, beneficiation, marketing, infrastructure, transport, and human resources to project to ensure that the project is viable. That means it is a complete document for the purpose of taking up the project for execution. At this feasibility stage, the host government should

approve the mineral licenses. That means you should have the mineral license with you based on agreements about local content, tax, royalty, all these things.



And refined ah data now we are talking about the refined data that means, much more sophisticated, much more ah research data ah will be used now to recalculate the NPV and the internal rate of return that is IRR. sensitivity studies will be conducted to evaluate the impact of any fluctuation. That means, if there are 7 parameters critical parameters, if you change by 10 percent or 2 percent ah depending on the the characteristics of that parameter, then how it is impacting the overall viability of the project. Say how it is is it ah affecting the ah project if there is fluctuation in commodity price, production rate, revenue, cost, inflation and interest rate. If you test all these things you can see what is the range of the impact and understand the risk involved that whether it can at any time go to the range or not.

So, all this project data is integrated into a bankable document which is audited by external consultant to validate the conclusions this is very important that you are getting a an independent ah comment opinion by a third party. And, then only it becomes validated document. The document is very critical for obtaining project financing. The mining company also determines a gearing ratio and that they will approach the lending institution for financing. And, this bank then if you are approaching the bank, the banks

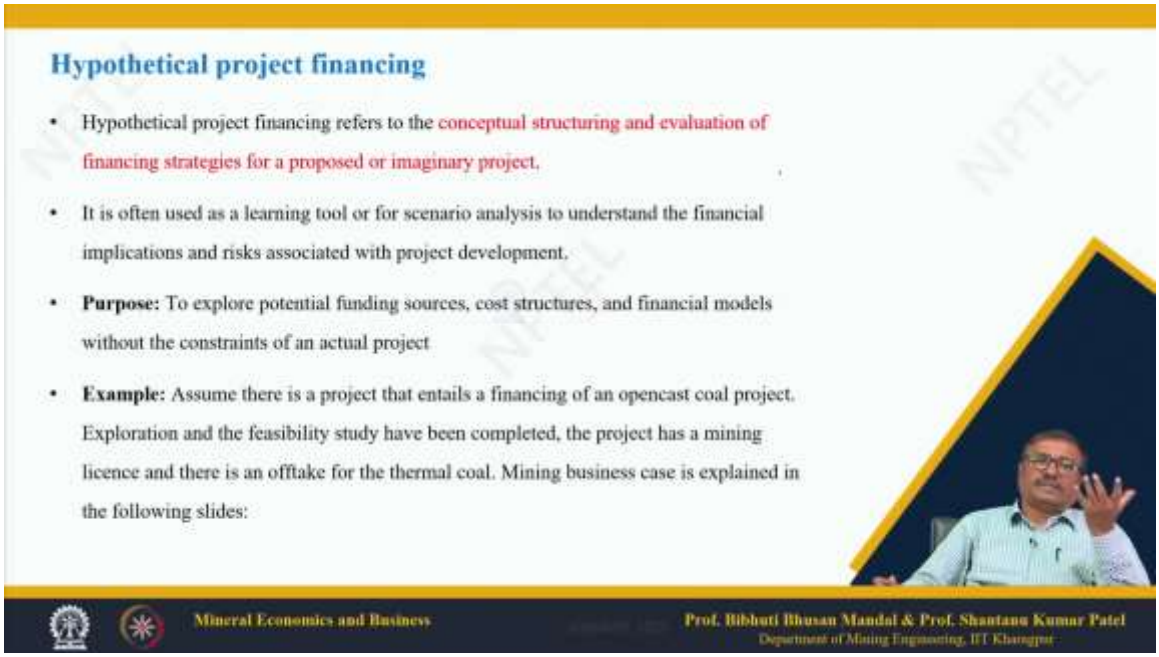
will assess project risk using their in-house expertise before lending the amount to the company.

We will take an example from here. We said that we can bank upon the existing data that is available, from there you can imagine what is the trend of the data and you can forecast with reasonable assumption that this will be the figures when I am going to do mining in future. For example, a company has a similar mining data from another mine like the mining cost, if you look at this rupees per ton from 2015-16. You can see a trend fluctuating, but there is a clear trend here and administrative overheads

Right from 406 to say 733 in 2021-22, there is again a trend. There are fluctuations, but the trend is very clear. Similarly, in the selling and distribution overheads, we also have a clear-cut trend, and there is a sudden rise between 2021 and 2021-22—there is a sudden change. So, that means we can expect that these things in future also, and then we can find out a trend through trend analysis and assume these figures for the purpose of a project which is hypothetical in nature and does not exist. But if we assume that these figures are to be taken for a scoping study in the beginning, then

So, we can take this data and try to visualize the viability of a hypothetical mining project. So, if you have the market price of the commodity that you are going to sell,

from there, you can develop a cost-price forecasting model. So, you can find out what could be our expected revenue—long-term revenue for 10 years or by a trend analysis with some margin of error. The operating cost—estimated operating cost—from there, using the capital cost and other figures, you can find out the gross margin that you can have.

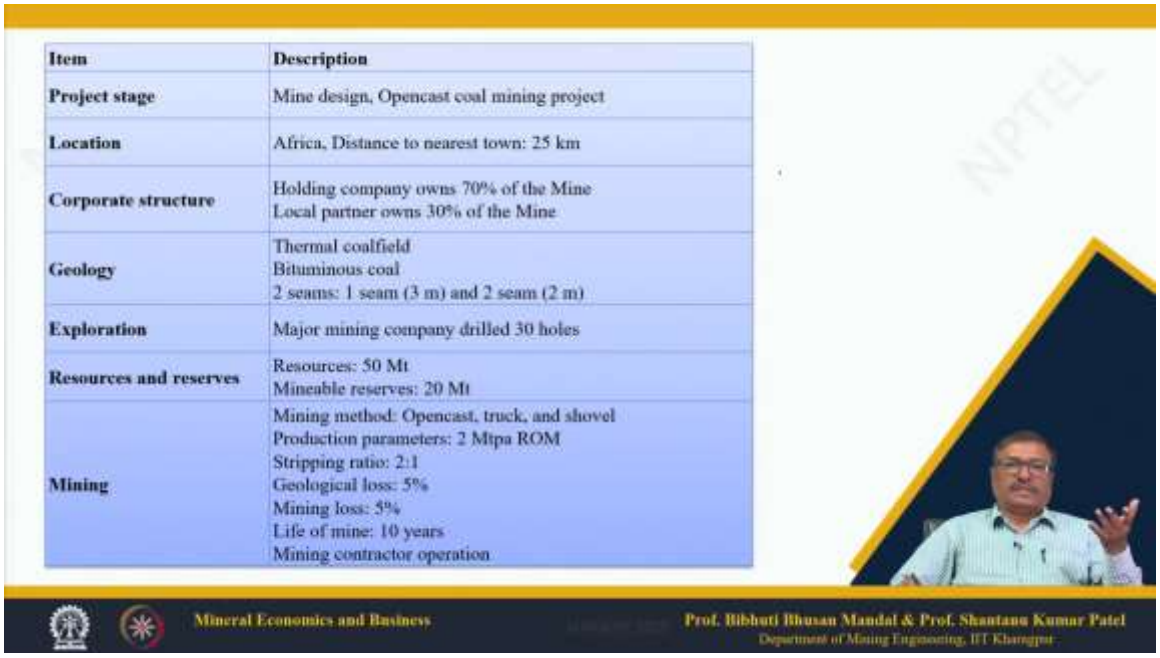


Now, if the tax and royalty that you are supposed to pay to the government—all kinds of taxes, including income taxes—from there, you can project, with some margin of error, the net profit and the viability of the project. Once you see that it is quite positive in nature, then only you go for the detailed feasibility study. So, the hypothetical project for financing will give you what the study of the hypothetical project feasibility will give you—an idea whether to go ahead or not with the data available and do some trend analysis based on the database you have in hand. So, this is nothing but a conceptual structuring and evaluation of financing strategies for a proposed or imaginary project.

If I want to invest in this area or country, then what could be the viability? So, in the beginning, it is quite vague in nature, but with the assumption that I am going to take this lease where I have this kind of material or ore body with some proof or data from the internet, and then if I am going to invest there, what could be the valuation of the project? So, that can be done through hypothetical project feasibility studies. It is often used as a

learning tool or for scenario analysis to understand the financial implications and risks associated with the project development. What is the purpose of this kind of thing?

To explore potential funding sources, cost structures, and financial models—that means you are assuming that you are going to invest in this kind of project. So, in that case, what would be the viability, and what could be the financial models, and what will be your potential customers? Everything can be visualized based on a hypothetical project. So, assume there is a project that involves financing an open-cast coal project, and the exploration and feasibility study have been completed. The project has a mining license, and there is an off-take for the thermal coal—that means there is a demand in the market for thermal coal, which means the supply of coal for power generation. So, the mining business case is explained.

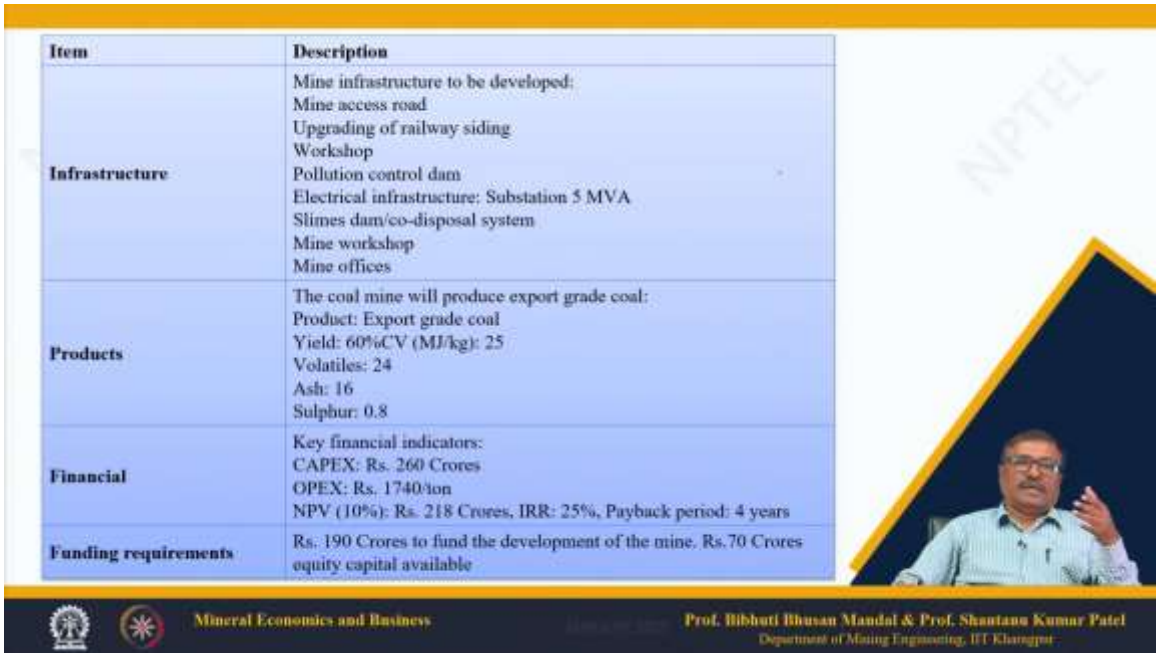


Now, in a few slides, we will try to see the business prospects of the hypothetical project. So, at this project stage, the mine design Imagine that we are going to have an open-cast coal mining project, and the basic design and extent of these things can be assumed. The location is Africa, and the nearest town is about 25 kilometers away. The corporate structure: the holding company owns 70 percent, and the local partner has 30 percent of the mine. For example, the geology is a thermal coal field—bituminous coal—with two seams, and some data is already available.

major mining company drilled 30 holes that means, we have the borehole data for the purpose of modelling geostatistical modelling an estimation of the total reserve available where they are what are the rocks in between what are the partings between what are the thickness of the seam all these things can be understood by this data which is available. Now the resources estimated is 50 million ton, mineable reserve is 20 million ton. So, the mining method here we have assumed that it is an open cast, we are using track and shovel. So, we are assuming in the beginning that we will produce only 2 million tonnes per annum ROM and stripping ratio here is 2.1, geological loss and mining loss all this is assumed and mineable reserve being 20 million tonnes and production parameter is 2 million tonnes per annum. So, we are assuming that the life of the mine will be 10 years and we will be engaging contract based mining operations.

So, the mining fleet that will be required that from there we can find out what what other we can assume that this will be required for producing that 2 million tons per annum. So, the detail you can you can assume the ah the number of machines that will be required, what machines you require, what are their present market cost that you can find out easily. and and then from there the cost or the capital cost will be calculated. Now, here we are assuming that the process plant will be outsourced to a contractor. So, the the

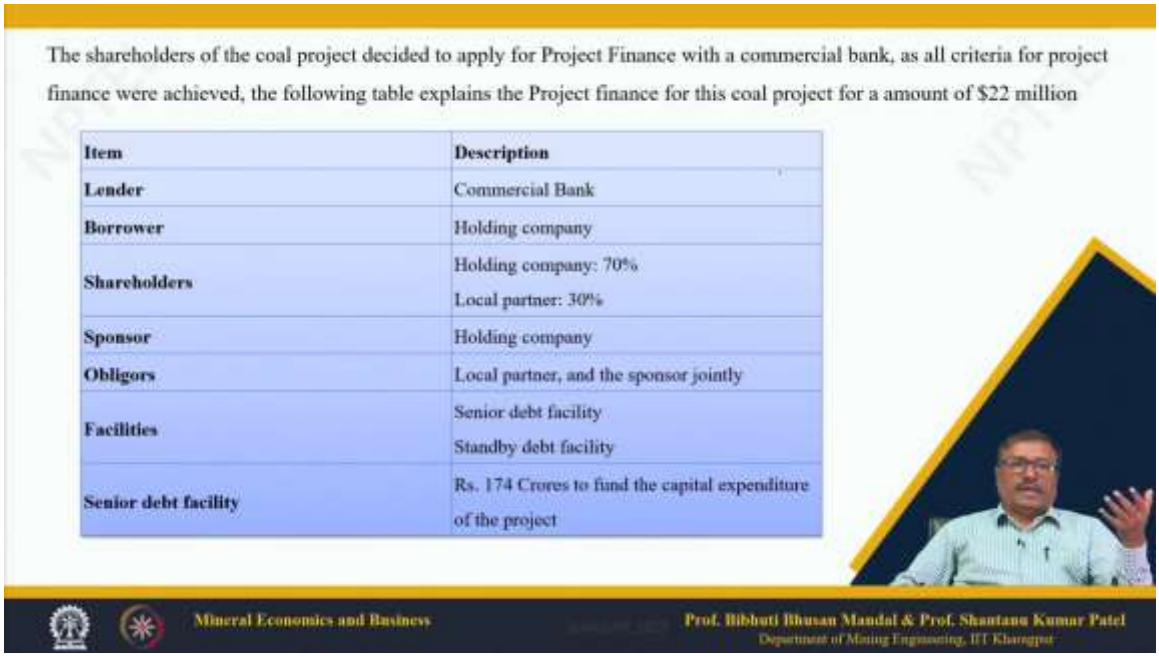
the the contractor will charge per ton of of the crashing and screening or dense media separation of the coal and will be paying directly.



So, we are not installing anything, we are actually asking a contract to and operate the plant. So, we will be paying him part ton of coal not anything else. So, that figure is not added here we can add a figure which is available ah ah from also from different sources. Now, the production parameters as I said ah these are the product the basic ah ah production parameters and the infrastructure required will be the mine infrastructure mine access road

The upgrading of railway siding for transportation of coal, workshop, pollution control dam, electrical infrastructures, and all these things—this lime dam, core disposal system, and then mine workshop, mine offices—these things all infrastructure from there you can find out the cost of these infrastructures, approximately cost. Then these are the productions of product in what coal, what type of coal, what is their calorific value, what is the volatile matter, ash content, sulphur from the samples. The financial aspects are the capex required from all the things that we have said earlier that will be requiring some 260 crores. And the operational expenditure is estimated to be 1740 rupees per ton, say. From there and the parameters involved, we can calculate the net present value using the

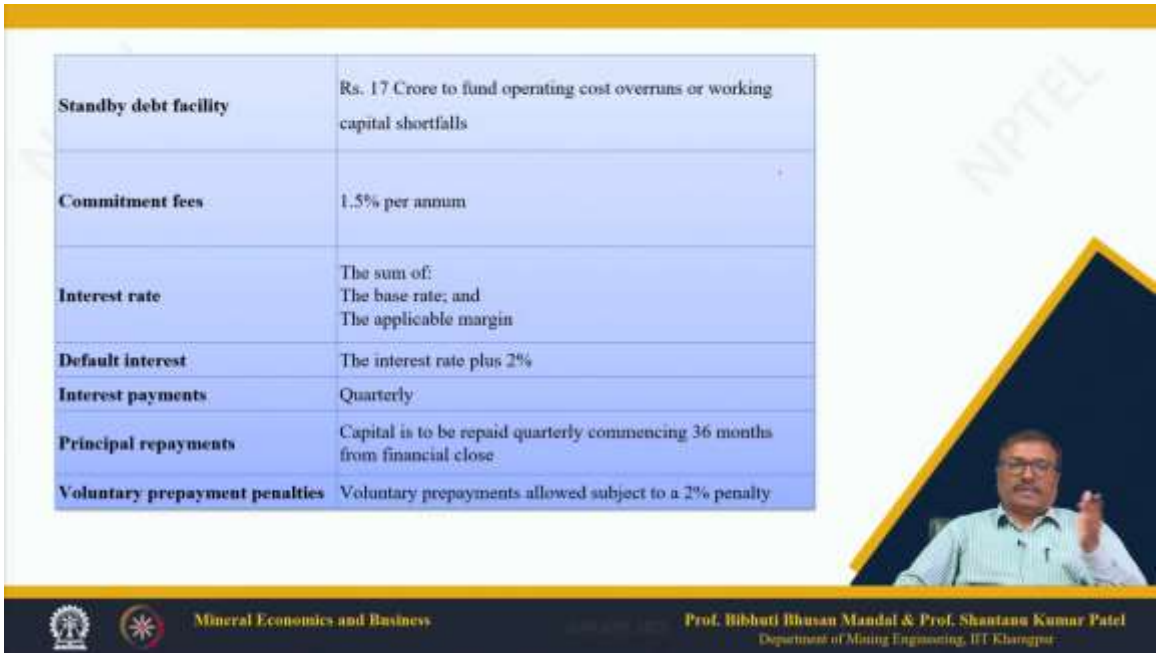
10-year production schedule over the period of life of the mine at 2 million tons per annum.



So, every year how much you are going to invest, how much you are going to get as return. So, the cash flow depending on the cash flow, we find out that the NPV is rupees 218 crores, the IRR is good enough at 25 percent, and the payback period is 4 years only, 4 years. So, the funding requirements we need 190 crores to fund the development of the mine in the beginning, and rupees 70 crores equity capital is available. Now, the lender we are approaching, we will approach a commercial bank. The borrower is the holding company, the shareholders holding company 70 percent and the local is 30 percent as we said.

The sponsor is the holding company, and the senior debt facility is rupees 174 crores to fund the capital expenditure of the project. Now the standby debt facility that we need is rupees 17 crore to fund operating cost overrun or say working capital. So, this much should be available as a standby. The interest rate is as usual the base rate plus some applicable margin that is set by the company. This is a part of the contract that the default interest rate is the interest rate plus 2 percent.

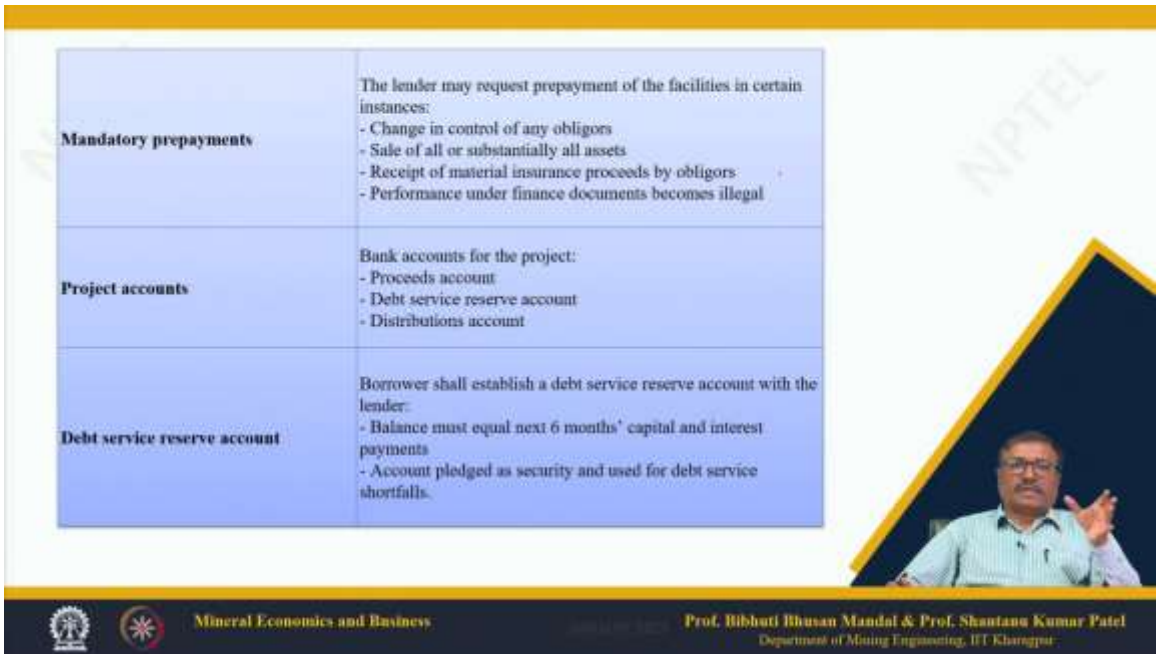
Interest payment you have to pay quarterly and then capital is to be paid quarterly commencing 36 months from the financial close. So, in the beginning you are getting some kind of relief after that you start paying the interest, but if you want to voluntarily prepay that means you have money. you are earning. So, what do you have you have taken a loan from the bank. So, you want to prepay to close the loan.



So, but then it will be allowed, but there will be a 2 percent penalty. This is very common in case of a housing loan also it prepayment also in many cases when you take a loan you cannot do a prepayment there will be penalty that this could be a clause in many many this term loans. Now these are the mandatory prepayments you can see from the list and the project account, the bank account for the project, proceed account, debt service reserve account and distributors account. These are ah standard account that we have to Now, the borrower shall establish a debt service reserve account with the lender.

So, the balance should be there for next 6 months capital and interest payment because in case you default then the bank will take money from that account that means, that balance has to be maintained there. Now, what we understood from what we discussed so far is the importance of the scoping, the feasibility and the feasibility studies. Also we have an imaginary or hypothetical project and the basic data based on which we can imagine we can find out the prospect of the project and based on the requirement of the capital

expenditure and operational expenditure. a basic idea I have given then what could be the source of fund for starting that project. We will take up this matters also in details in the following ah lectures.



Ah, you can go through the Mining Capital Methods, a very good book—Best Practices and Case Studies by Michael Segar. It is a very good book for mining, financing, and capital methods. You can study this; it can be downloaded from the internet also. Thank you very much.