

MINERAL ECONOMICS AND BUSINESS

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Week 10

Lecture 49 : Business risk and Mining

Hello and welcome, everybody. Today's discussion topic will be business risk and the risks related to the mining business, specifically how they are related. The topics we will cover are business risk in general. And how they are managed—what are the management strategies related to it? Wherever possible, I will give examples related to mining or connect them to mining so that we better understand in the present context. In the end, we will also refer back to project selection, keeping in view the risks of the mining business. Business risk, in general, refers to the uncertainty of any company's financial performance due to internal or external factors that affect operations. For example, in the mining and mineral industry, business risk can impact production, cost, revenue, and long-term sustainability of mining operations, which is a significant issue nowadays. The key factors influencing business risk are market fluctuations, which can sometimes be absolutely unwarranted.

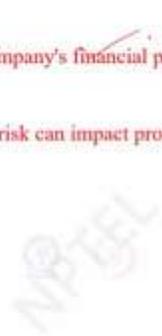
CONCEPTS COVERED

- Business risk
- Managing risk
- Project selection under risk



There can be a pattern, or there may be no pattern; there could be certain changes. Then, regulatory changes—the legal terms and conditions—if they change, how do they affect operations? Including tax regimes also. The operational challenges, which are sometimes very geotechnical in our context, and macroeconomic conditions—how they affect mining operations. Strategic planning and other measures, like diversification of operations or efficient cost management, can help reduce risk.

So, this can help reduce the risk. So, while running or starting a business, we must consider strategies like strategic planning and diversification of operations. So that if one sector or part of the business is severely affected, it can be managed with the other part. You will see that big business houses have multiple operations. Not in one product or one business.



Business risk

- Business risk refers to the **uncertainty in a company's financial performance** due to internal and external factors affecting operations.
- In the mining and mineral industry, **business risk can impact production, costs, revenue, and long-term sustainability.**
- Key factors influencing business risk:
 - Market Fluctuations
 - Regulatory Changes
 - Operational Challenges
 - Macroeconomic Conditions
- Strategic planning, diversification of operations, efficient cost management, and compliance with regulations help **reduce risks.**

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And there are people, they are not only into the goods, they are also in producing something, they are also in the services also. Sometimes you will see that some companies are relying more on their service sector, less on their manufacturing sector because of macroeconomic conditions, market things. So, if the service is in high demand, so they are giving more importance to the service sector. Now, the if there is risk though we must think about the managing how to manage the risk. So, how to mitigate the risk there should be ways and means to mitigate the risk.

So, this risk reduction strategy also have a cost associated with them, whether they are profitable in a given situation that will vary from business to business, how much you are investing in implementing the risk mitigation strategies. For example, we will take up in one by one simple examples of how you manage the risk. Like a common way to modify the risk of an investment is to change the proportion of the fixed and variable cost. So, to reduce the variable cost we can outsource certain operations which are being now regularly done by mining companies that even production, maintenance many things are simply outsourced. This reduces the variable cost.



Managing risk

Every business wants to explore **ways and means of mitigating risk**. These risk reduction strategies have a cost associated with them, and whether they are profitable in a given situation will vary from business to business.

- **Fixed and Variable Costs:** A common way to modify the risk of an investment is to change the proportions of fixed and variable costs. Ex: **outsourcing certain operations to reduce variable cost**
- **Pricing Strategy:** Pricing strategy is used by many firms to manage risk. **A lower price increases potential demand, but also raises the break-even level.**

NPTEL

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If you own it then there will be other liabilities related to it. If it is outsourced to some other party then it becomes easier to manage and it generally reduces the variable cost. Let us think about the pricing strategy. To stay in the business sometimes we may think about bringing down the price but the lower price does not always give the assurance that you will stay in business but that increases definitely potential demand. But also to reach the break-even level in that case, you have to produce more to reach the same break-even level.

That means you have to go for an optimization of that. Now, we can also think about improving information. In what form? We gather more information about the market and technology, and then we go for an investment. That means this is an informed decision.

We call it an informed decision. So, this additional study that we carry out improves the quality of the forecast that we make, depending on the data that we collect, but it involves both direct costs and the opportunity cost of delayed action. You do these things, complete this analysis, then you take a decision that may defer certain actions. Of course, we need to be aware of that delay and how it can adversely affect your business. Then we are talking about reducing fixed operating costs or, in broad terms, the financial leverage.

Managing risk

- **Improving Information:** Gather more information about the market and technology before making a investment. Additional study often improves the quality of forecasts but involves direct cost and opportunity cost of delayed action.
- **Financial Leverage:** Reducing fixed operating costs can help lower risk. Similarly, relying less on debt also reduces risk since debt comes with fixed repayment obligations, whereas equity does not. If a project already has high operational risks, it's usually smarter to keep financial leverage low.
- **Insurance:** Insurance helps protect against various risks like property damage, theft, or the loss of key personnel. It acts as a safety net, but you need to pay premiums to stay covered. Example: having insurance of all machines is essential.



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This can help in lowering the risk. Similarly, relying less on debt also reduces this because, as we have stated in the cost of capital, debt comes with fixed repayment obligations. That means whether you make a profit or not, you have to pay the interest. Whereas in the case of equity, it does not. So, the dividend depends on how you perform in the market.

So, less reliance on debt is a better strategy. So, if a project already has high operational risk, it is usually smarter to keep financial leverage low. Now, about insurance: this is another risk management strategy. This helps protect you against various risks like property damage, theft, or the loss of key personnel. This definitely helps, but you need to pay premiums; otherwise, you cannot get this insurance benefit.

So, all the machines can be insured, and insurance can also take different forms. But we have to know how much benefit you are getting by paying the premiums, and the premium is also not low—the total amount may be quite high. Now, can we go for long-term arrangements with suppliers and employees? Yes, because long-term agreements with suppliers, employees, lenders, or customers So, this can give certain benefits.

Managing risk

Long-term Arrangements:

- Establish **long-term agreements with suppliers, employees, lenders, and customers**. For example, securing long-term contracts with buyer ensures a stable supply chain of mineral ores (transportation) at predictable prices, while long-term wage agreements provide clarity on labor costs. Similarly, **locking in debt terms reduces uncertainty about interest rates, and long-term sales contracts with customers help stabilize revenue**.
- Many long-term contracts also include price adjustments based on economic indicators like inflation. For example, a supply agreement might have a clause linking prices to an index such as the **Wholesale Price Index**. This ensures that both buyers and sellers are protected from inflation, keeping the real value of prices stable over time.



For example, if you secure long-term contracts with buyers, they ensure a stable supply chain of mineral ores and transportation at predictable prices. Similarly, long-term wage agreements provide clarity on future labor costs. Similarly, locking in debt terms reduces uncertainty about interest rates. And long-term sales contracts with customers will help stabilize revenue because if you have a long-term contract with a customer, your customer base is defined. So, they will definitely stabilize your revenue, meaning the cash inflow will be regular and have less risk.

So, as I said, the long-term contracts have certain advantages. They do, but then you can get more benefits if you include price adjustments based on economic indicators. For example, if you have a supply agreement and we link a clause that the price will be decided based on the wholesale price index. In that case, the effect of inflation can be mitigated or minimized there. This will ensure both buyers and sellers are protected from inflation, keeping the real value of prices stable over time.

Now, let's think about strategic alliances. This is the business strategic alliance, and we understand that, especially in mining, the capital requirement and the size of the business are usually high. So, when more resources are required and more risk is involved, a single company usually cannot handle all of them. So, it is better to form a strategic alliance. This can act as a solution, also well known as joint ventures.

Managing risk

Strategic Alliance

- When a project requires more resources or involves risks that a **single company cannot handle alone**, forming a strategic alliance can be a solution (also known as a **joint venture**), this involves two or more independent companies collaborating to achieve a shared goal.
- In such alliances, partners invest in the shared venture, contribute key resources like technology, infrastructure, distribution networks, brand value, and skilled workforce, and jointly manage operations. Given the **high costs and risks in mining business environment**, even traditional competitors are finding it beneficial to work together, leading to a **concept known as 'co-opetition'** — where competition and cooperation coexist for mutual advantage.



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This will involve two or more independent companies collaborating to achieve a shared goal. Shared goal. That means we have different independent companies, different expertise—I will come to that later—and different types of contributions, as well as different roles in managing the risk, but we have a shared goal. So, we can collaborate to achieve that goal. So, in this kind of alliance, the partners invest in a shared venture, contribute key resources like technology—some can supply better technology—infrastructure, distribution networks, brand value, and a skilled workforce, and they can jointly manage the mining operations.

So, as I said in the beginning, the high risk and cost involved in or associated with the mining environment make traditional competitors find it beneficial when they work together. So, this led to a concept called co-opetition. That means a combination of two words: competition and cooperation. Competition and cooperation coexist for mutual benefit. This is something like, I mean, you are jointly working for the benefit of all.

So, this is how we can coexist for our mutual advantage, share the risk, and contribute according to our own expertise in different fields, achieving the shared goal by collaborating with each other. We will talk about certain market-related things here, such as how the derivatives or hedging instruments That means something to counteract when the risk becomes very apparent. So, how do you take a position to counteract that?

So, the hedging instruments, like options and futures, which I will also describe, help manage financial risk as well. For example, an option gives the holder the right, but not the obligation, to buy or sell an asset at a price before or on a specific date. For example, we have two options to illustrate this: one is the call option, and the other is the put option.

Managing risk

Derivatives (hedging instruments):

- Derivatives like options and futures help manage financial risk. **An option** gives the holder the right, but not the obligation, to buy or sell an asset at a set price before or on a specific date.
- A **call option** allows the purchase of an asset and is especially useful in unpredictable markets.
- Similarly, a **put option** gives the holder the right, but not the obligation, to **sell** an asset at a predetermined price before or on a specific date. It acts as a form of protection against falling prices.

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This call option will allow the purchase of an asset. It is especially useful in unpredictable markets when the price is fluctuating. I will show how it is done. Similarly, a put option gives the holder the right, but not the obligation, to sell an asset at a predetermined price before or on a specified date. This acts as a form of protection against falling prices.

So, how are these two things done? So, from, say, we will just try to link with the mining company's perspective: both call and put options can be used to manage price risk and financial stability. So, in case of, for example, a call option. We have the fuel and equipment procurement case. So, the mining company might purchase a call option on diesel fuel to lock in a specific price.

That means if the fuel price rises in the future, the company can exercise that option and buy fuel at a lower predetermined price. Reducing the operational cost. If I think that the price can rise, then I can lock that price by paying a marginal amount that we will see, and even if the price really rises, then you can buy at a predetermined price. That means, which is lower than the now market price in the future. And if you see that the market price is lower than what we have predetermined, then you can forego that.

That is no obligation that you have to exercise the call option. You have the right to buy when you think that you are in an advantageous position. Otherwise, you can forget. No problem at all. Now, one more example: for example, hedging against metal prices.

Managing risk

From a mining company's perspective, both call and put options can be used to manage price risks and financial stability. Here are some examples:

Call Option (Right to Buy at a Fixed Price)

- **Fuel and Equipment Procurement** – A mining company may purchase a call option on diesel fuel to lock in a specific price. If fuel prices rise in the future, the company can exercise the option and buy fuel at a lower, predetermined price, reducing operational costs.
- **Hedging Against Rising Metal Prices** – If a mining company requires **Copper concentrate** for processing and fears rising prices, it can buy a call option on copper to secure the right to buy it at a fixed price in the future.



You see, the mining company requires copper concentrate for processing and fears rising prices in the future, for example. So, it can buy a call option on copper concentrate, on concentrate. To secure the right to buy this at a fixed price in the future if the concentrate price rises, you can buy at this price provided you have a call option you have already booked. Now, what is the put option? This is the right—the previous one was the right to buy; this is the right to sell. So this is hedging against falling commodity prices when they may fall. The previous one was rising; now this is falling.

So, for example, a gold mining company might buy a put option, which we are describing here, on gold to lock in a minimum selling price—minimum selling price. So if the gold prices drop significantly in the future by the date that we are specifying, the company can

exercise the option and still sell gold at a profitable price, protecting its revenue. For example, another example: the selling of mining equipment. So if a mining company plans to upgrade its machinery, it can buy a put option. We can buy a put option here.

on used mining equipment to guarantee a minimum resale value. This can reduce the risk of price depreciation easily. Now, for example, coal export contracts also. The coal mining company selling to power plants can buy a put option on coal futures to ensure that it can sell the coal at a stable price, even if the market prices decline.

Managing risk

Put Option (Right to Sell at a Fixed Price)

- **Hedging Against Falling** Commodity Prices – A gold mining company might buy a put option on gold to lock in a minimum selling price. If gold prices drop significantly, the company can exercise the option and still sell gold at a profitable price, protecting its revenue.
- **Selling Mining Equipment** – If a mining company plans to upgrade its machinery, it may buy a put option on used mining equipment to guarantee a minimum resale value, reducing the risk of price depreciation.
- **Coal Export Contracts** – A coal mining company selling to power plants can buy a put option on coal futures to ensure it can sell its coal at a stable price even if market prices decline.



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So, we have to exercise that option and maintain that price. So, this is how you can also mitigate the risk of business in other ways. Now, there is a futures contract. So, this is a deal between two parties. So, this is compulsory; this is a contract, not an option.

The difference between the call put and this future is that both are also linked to the future market prices, but here we are going to have a contract. This is a deal between two parties to trade an asset at a later date for a price agreed upon today, so this will remove the uncertainty about price changes. So, you are going for an agreement that on such and such date, this will be the price, and you have to buy this or somebody who is selling. So, for example, a gold mining company might purchase a gold futures contract to lock in today's price for future delivery. This protects itself from price fluctuations. So, almost all mining companies mitigate some of their risks using options and futures.

Managing risk

Derivatives (hedging instruments):

A **futures contract*** is a deal between two parties to trade an asset at a later date for a price agreed upon today. This removes uncertainty about price changes. For example, a gold mining company might purchase a gold futures contract to lock in today's price for future delivery, protecting itself from price fluctuations. Almost all the mining companies hedge some of their risk using options and futures.

*Compulsory/no option like call/put, no premium paid



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So, we can see that also from the stock exchange listing. As I said earlier, these future contracts are compulsory, with no options like call or put, and no premium is to be paid here. This is a contract between two parties. Now, we can see the National Stock Exchange website. Here, if you can see the very small letters, for example, we have 27 March 2025, we have a call option here, booked, and the strike rate is 450, and then the premium to be paid varies depending on the price going up and down.

In case of equities:

CONTRACT TYPE	EXPIRY DATE	STRIKE	OPEN	HIGH	LOW	BID	ASK	PREMIUM	LAST	CHNG	VOLUME	OPEN INTEREST
Stock Futures	27 Mar 2025	471.75	467.25	467.00	466.00	466.00	466.40	1000	470.00	3.20	6500	47000.00
Stock Options	27 Mar 2025	Call	460.00	540	500	500	4.00	7.20	540	47.00	6470	100.00
Stock Options	27 Mar 2025	Call	450.00	540	500	500	0.00	10.00	450	40.00	6411	100.00
Stock Options	27 Mar 2025	Call	440.00	540	500	500	0.00	10.00	440	40.00	6370	100.00
Stock Options	27 Mar 2025	Put	460.00	570	570	500	4.00	2.00	470	40.00	4500	100.00
Stock Options	27 Mar 2025	Put	450.00	710	510	500	10.00	3.00	460	40.00	4470	100.00
Stock Options	27 Mar 2025	Call	440.00	440	34.70	34.70	14.00	17.15	440	47.00	3070	100.00
Stock Options	27 Mar 2025	Put	400.00	510	34.70	34.70	10.00	3.00	400	40.00	3270	100.00
Stock Options	27 Mar 2025	Put	410.00	540	34.70	34.70	10.00	3.00	410	40.00	3000	100.00

Premium to be paid



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So, this means that on 27 March 2025, if I am going to buy it and if the price is more than 450, then I am still allowed to buy at 450. For that, we have to pay a small amount to the NSE, a small amount to the NSE, to protect that right. Similarly, we can have a put also, like 460 here. For Vedanta Limited. This is all about equities; we are talking about equities and how call and put are exercised in the equity sector.

So, the put, for example, 27th March 2025, 460, even if the price falls, I have the protection that I can exercise and then I can sell it at 460 rupees per share. For that, of course, I have to pay a certain premium to exercise that option. In case I get more benefit, for example, that 450-rupee share is there, and if the market prices go high, even then I can use this exercise; I can use this 450 rupees; I can buy at 450 rupees. Now, if it goes below 450, then what happens to the buyer? They will simply forego.

In case of metals/commodities:

MCX METAL & ENERGY
Trade with Trust

Contract Specifications of Aluminium

Symbol	ALUMINIUM
Description	ALUMINIUM/AMMFFV
Contract Listing	Contracts are available as per the Contract Launch Calendar.
Contract Start Day	1 st day of contract launch month. If 1 st day is a holiday, then the following working day.
Last Trading Day	Last calendar day of the contract expiry month. If last calendar day is a holiday, then preceding working day.
Trading Period	Mon-Fri 9:00 AM - 3:30 PM
Trading Session	Monday to Friday: 9:00 a.m. to 11:30 p.m. (11:00 a.m. to 11:30 p.m. based on US straight time period)
Trading Unit	5 MT
Quotation Basis	1 kg
Tick Size	5 paise per kg
Price Quote	Ex-Manresious (Export direct) (includes only GST)
Maximum Order Size	150 MT
Tick Movement	5 paise per kg
Daily Price Limits	The Exchange has implemented a narrower limit of 4%. Whenever the narrower limit is breached, the volatility will be allowed up to 8% without any cooling off period in the trade. In case the daily price limit of 8% is also breached, then after a cooling off period of 15 minutes, the daily price limit will be relaxed up to 9%.

NSE

COMMODITY DERIVATIVES

INSTRUMENT TYPE	PRICE	UNIT	OPEN	LAST	CHG	PERC	TIME	PREV	PREV
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	
Aluminium	5500	5 kg	25-Sep-2025	5475	-25	-0.45%	09:00:00	5500.00	

This is an option. Call and puts are nothing but options. I can exercise that option or otherwise simply purchase at the lower value compared to the 450 rupees. Only loss, what is that? A small amount that we pay as premium to the stock exchange, nothing else.

In case of equities, this can be done. Similarly, we can see the ah metal exchange also. This is a contract first page only this is a long contract where we have the tick size is given 5 paisa per kg. So, maximum order size is also a fixed. So, we have a we have a contract.

So, here we can see here that ah this is for the aluminum contract. So, here we have the commodity derivatives in NSE like gold. So, this is the unit is in 1 kg that means, you can buy and sell in terms of 1 kg, 2 kg, 3 kg like that and what you see is here is in 10 grams strike rate. So, we have both call and put. and the specified date you can see 25th September 2025.

So, this is a call option for 84100. If the price rises and if I have already the call option, purchased the call option, and if the prices go high, even on that day, 25th September 2025, I can buy at the predetermined price. If it falls lower, I have the option to buy at lower prices, and I can forego these things. So, the only thing is there will be a premium to be paid to the NSE, nothing else.

Managing risk

- **Contingency Planning:** Apart from taking steps to reduce risk, **well managed companies prepare for the worst.** This means listing the things that could go wrong with a decision and then identifying the actions that would be taken to cope with those adverse developments. Put differently, a contingency plan is prepared that will help the firm to recover from bad outcomes.
- For example, if a key piece of machinery breaks down unexpectedly, the company may have backup equipment.

The slide features a video inset of a man in a light blue shirt speaking. The background of the slide is white with a blue triangle on the right side. The slide is part of a presentation with a yellow header and footer.

Similarly, we can see the put options here. 29th July 2025, the predetermined price is 91500 per 10 grams, and if the prices show a falling tendency, we can sell to the person who has exercised; they can sell at 91500. So, these options can be exercised to mitigate the risk of price fluctuations in the market. This is all I wanted to explain—I mean, just wanted to introduce the ideas of how these things can mitigate the risk associated with the business. Now, some general ideas—those are certain techniques that we have taken.

Now, there are some more generalized ideas. So, apart from the steps we are talking about to reduce the risk, well-managed companies prepare for the worst—that this is the

worst thing that can happen. And then, we can take certain strategies—if this happens, then what we do. That means we have a contingency plan. A contingency plan is prepared to help the firm recover from very bad outcomes.

For example, if a key piece of machinery or even a machine breaks down unexpectedly, the company may have backup equipment or some arrangements from where the backup can be supplemented to start the operation within a very short period, and we can be back in business instead of losing heavily. What is this systematic risk? This systematic risk is also known as market risk. This affects the entire mining industry and cannot be eliminated through diversification alone, as we have mentioned as a strategy before. This arises from external factors beyond our control.

Managing risk

Systematic Risk

- Systematic risk, also known as market risk, affects the entire mining industry and cannot be eliminated through diversification. It arises from external factors beyond a company's control, such as **economic conditions, government policies, and global market trends**.

How this happens in mining:

- **Commodity Price Volatility:** The prices of metals and minerals fluctuate due to global supply and demand, trade policies, and macroeconomic conditions. A sharp decline in prices can reduce profitability for mining companies.
- **Natural Disasters and Climate Change:** Mining operations are vulnerable to extreme weather events, such as very heavy rainfalls, which can disrupt production.

The slide includes a video inset of a man in a light blue shirt speaking. The background features a yellow and blue geometric design. Logos for IIT Kharagpur and NPTEL are visible. The footer contains the text: 'Mineral Economics and Business', 'Prof. Bibhuti Bhuvan Mandal & Prof. Shantanu Kumar Patel', and 'Department of Mining Engineering, IIT Kharagpur'.

Like economic conditions, government policies, and global market trends that will affect all businesses equally. No matter how much diversification we adopt, it will still affect us. For example, commodity price volatility—the prices of metals and minerals fluctuate due to global supply and demand. The trade policies that we have recently seen—now, the taxation between the US and India is going to change very soon, and it has already started affecting our market. And the macroeconomic conditions.

A sharp decline in prices can reduce the profitability of mining companies. Now, for example, natural disasters and climate change—I mean, I do not have to explain all these things. These operations, especially mining operations, are very vulnerable to extreme

weather events. For example, heavy rainfall can completely stop open-cast mining, which can disrupt production. So, we need to plan accordingly—how do we manage the business during those days?

Like that was the systematic part. The unsystematic is known as the company-specific risk, not related to the specific system or large macroeconomic factors. This is related to the specific company. These are related to factors unique to a particular mining company or mining project. So, this can be minimized through proper management and diversification.

Managing risk

Unsystematic Risk

- Unsystematic risk, also known as company-specific risk, arises from factors unique to a particular mining company or project. Unlike systematic risk, it can be minimized through proper management and diversification.

How this happens in mining:

- **Geological Risk:** The uncertainty in mineral reserves, such as inaccurate resource estimates or unexpected geological conditions, can impact the profitability and feasibility of a mining project.
- **Operational Risk:** Equipment failures, labor strikes, or supply chain disruptions can cause production delays and increased operational costs, directly affecting a specific mining company rather than the entire industry.

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So, how can this happen? For example, suddenly you see certain geotechnical disturbances underground that were not predicted or well predicted. So, this uncertainty in mineral reserves, or inaccurate resource estimates, unexpected geological conditions, can impact the profitability and feasibility of a mining project in the beginning, but during operation also these things can impact. The reserve calculation or the grade that we expected may not be as good as you expected; it could be worse than that. Then operational risk.

Equipment failure, labor strikes, supply chain disruptions—these can cause production delays and increase operational costs. They will directly affect the specific mining company rather than the industry. This is internal to a company, but this can happen. The

equipment failures, the labor strikes. So, we need to be aware of all these things and then how to manage the business when such things occur.

Now, for example, when you have a certain risk in mind that you think about—that this risk can happen—but still, you are very optimistic and you are trying to evaluate a project using standard measures or metrics like NPV or, for example, IRR, and the level of risk involved is known to you or you can at least appreciate it. So, what you can do is go for an adjusted evaluation. So, since the returns are uncertain in this case, the business can use different methods to factor this risk into their decision-making process. So, this is a judgmental evaluation and certainty equivalent, which means when you have an uncertain thing and then if the risk is adjusted.

Project selection under risk

- When deciding whether to approve a project, companies look at both the expected return—measured using metrics like net present value (NPV) or internal rate of return (IRR)—and the level of risk involved. Since returns are uncertain, businesses use different methods to factor risk into their decision-making, such as **judgmental evaluation and certainty equivalent**.

Judgmental evaluation:

- Sometimes, managers rely on their own experience and intuition rather than complex calculations to decide whether a project is worth pursuing. This involves discussions with committees or executives, who collectively assess the risks and potential returns. While this method lacks structured analysis, it's similar to how people make everyday decisions—like choosing a job or investment—by **using judgment instead of strict formulas**.



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So, you can get a certainty equivalent of the matrix that will give you a more realistic present picture of the future of the company. For example, sometimes managers rely on their own experience and intuition rather than very complicated mathematical calculations to decide whether it is worth pursuing or not. On pen and paper, it can be shown that the project is attractive, but of course, by experience, many people who have worked for decades together can say, 'Do not go for these things.' While this method lacks structured analysis or mathematical support, it is similar to how people make everyday decisions, sometimes almost like fuzzy logic, such as choosing a job or

investment. We use more intuition there, and this is also a kind of judgment that we give for making decisions when risk is involved.

Now, we are going to a more systematic way to find a certainty equivalent of the business which has risk involved in it. The certainty equivalent is a method that helps in project selection by adjusting the uncertain future cash flows to the risk-free equivalent. That means the cash flow is there with risk. This is with risk. This is adjusted by a factor, and this will give you the certainty equivalent.

Project selection under risk

Certainty Equivalent Method:

- The **certainty equivalent method** helps in project selection by adjusting uncertain future cash flows to their risk-free equivalents. It converts risky cash flows into a guaranteed amount that a decision-maker would accept instead of taking the risk.
- A certainty equivalent factor (α) is assigned to each cash flow, where α is between 0 and 1. It represents the proportion of the expected cash flow that a decision-maker considers equivalent to a **risk-free** cash flow. It adjusts the risky cash flows to their **certain equivalent values** before applying a discount rate.
- Risk-adjusted cash flow is calculated as:
- Certainty Equivalent Cash Flow = Expected Cash Flow $\times \alpha$
- These adjusted cash flows are then discounted using the risk-free rate instead of a risky discount rate.

CF
E_{CF}

NPTEL

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So, this is the transformation from the risk to risk free the risk free term we are using for the because we are using a factor to make it ah mentally risk free rather that this this is the risk involved. So, we use a factor to make it risk free I will just demonstrate how it is. So, the certainty equivalent factor for example, alpha if we denote is assigned to each cash flow, where alpha is between 0 to 1, if it is 1 then it is certain, if it is less than 1 there is some risk involved in these things. So, this represents a proportion of the expected cash flow that a decision maker considers equivalent to risk free.

That means, if you have a cash flow and if you think that a certain part is risk free, it will come whatever happens. So, that is risk free cash flow. So, it adjusts the risk key cash flows to their certain equivalent values before applying the discount rate for calculating the net present value or other things. Certainty Equivalent Cash Flow = Expected Cash Flow $\times \alpha$

Now this adjusted cash flow are then discounted again using the risk free rate instead of a risky discount rate.

For example, a mining company is evaluating a project with certain future cash flows. Now, we have just for an example, use the certainty equivalent method. For example, in crores we have shown 100, 150 and 200 and we can use the certainty equivalent method to advise the company on determination of the project's viability part. So, otherwise what we can do we can use this expected cash flow we have the discount rate and you can find the NPV and all other things. So, the risk adjusted discount rate is 10 percent.

Project selection under risk

Example:

A mining company is evaluating a project with uncertain future cash flows. Use the certainty equivalent method, to advise the company on determination the project's viability. The risk adjusted discount rate is 10%. The initial investment for this project is 200 crores.

Year	Expected Cash Flow (₹ crore)	Certainty Equivalent Factor (α)
1	100	0.9
2	150	0.8
3	200	0.7



So, the initial investment for this project is 200 crores which is cash outflow. Now, for expected cash flows, we have a certainty equivalent factor alpha denoted by alpha and that is given on this column, 0.90 percent. That means, 90 percent sure you have, 80 percent sure you are, 70 percent sure you are. This depends on the discussions between the among the people experts and they they decide the certainty equivalent factor how practical is to estimate depending on this cash flows that we have estimated.

So, how risky they are the depending on that we have decided the certainty equivalent factors which will be using to find out the certainty equivalent amount. So, from the given data that we have seen earlier these are the cash flows and the ah the ah in the beginning we have certain expenditure as we have shown the cash outflow. The certainty equivalent factors are given over the adjusted factors are used and 100 becomes 90, 150

crores becomes 120 crores, 200 crores becomes 140 crores. Now, so when you use this then the present value of the cash flow on decided on the basis of the adjusted cash flow, here you can see that 100 has become 90, then the 150 has become 120, then the 200 has become only 140 crores here. So, based on that we have the present value of cash flow, these are adjusted value.

ah using the using the ah the factor this alternative equivocal factor alpha we have and then we found NPV by deducting the cash outflow which is in the beginning of year. So, net present value of the all the cash flows is still positive 86.16 crores. Just try to imagine if I do not use this if I do not use this certainty equivalent factors alpha 0.9, 0.8 or 0.7. Then what happens?

Project selection under risk

Solution:

From the given data, we find certainty equivalent cash flows:

Year	Expected Cash Flow (₹ crore)	Certainty Equivalent Factor (α)	Adjusted Cash Flow (₹ crore)
1	100	0.9	$100 \times 0.9 = 90$
2	150	0.8	$150 \times 0.8 = 120$
3	200	0.7	$200 \times 0.7 = 140$

$$NPV = \sum_{t=1}^{t=n} \frac{C_t}{(1+r)^t} - \text{Initial Investment}$$

$$NPV = 81.81 + 99.17 + 105.18 - 200$$

$$NPV = 86.16 \text{ crores}$$

Present value of 1st cashflow = $\frac{90}{(1+0.10)^1} = 81.81$
 Present value of 2nd cashflow = $\frac{120}{(1+0.10)^2} = 99.17$
 Present value of 3rd cashflow = $\frac{140}{(1+0.10)^3} = 105.18$




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We calculate on the basis of 100 crores, 150 crores, and 200 crores. These are pictures that we are going to get in the future. But since we have experienced people in the team, they have calculated and found out the certainty equivalent factors and alpha for each of these cash flows. Then we have adjusted using the cash flow, using the factors, and we have used the realistic values, which are 90, 120, and 140. The NPV has come down definitely to 86.16 crores, but remember that this is more or less risk-free and it is positive.

So, project selection under risk depends very much on making the cash flows risk-free by understanding the risk associated with it and determining the most probable equivalent

factor, the certainty equivalent factor. So, we can transform the risky cash flows into risk-free cash flows, and from there, we can use our knowledge of how to use the NPV and other metrics to find out the realistic projection of the future of the project. So, this is a good example of how to use the certainty equivalent factor for ascertaining the future prospects of any project for the purpose of selection. We have discussed the general risk associated with any business and how they are specifically applicable to the mining business. I have tried to give you examples which I have in this particular presentation.



The slide features a dark blue background with a light blue rounded rectangle containing the text. The title 'REFERENCES' is in a white box at the top left. Below it is a list of references. To the right of the list is a small, square image of a rough-cut diamond.

REFERENCES

- *Financial Management by P C Chandra. McGraw Hill Publishers, Chennai, India*
- www.icai.org
- www.nseindia.com
- www.mcxindia.com



You can also consult many books and websites and keep watching the websites of nseindia.com or mcxindia.com or similar exchanges worldwide to understand these things much better and the risk involved in the mining business. How to mitigate this risk and then make it as risk-free as possible. So, with this, we come to the end of the business risk associated with the mining operations. Thank you very much.