

MINERAL ECONOMICS AND BUSINESS

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Week 9

Lecture 41 : Cost accounting in mining

Welcome once again. Today, we will be discussing cost accounting in mines. And how it is different from other businesses, what are the different aspects, and what we understand or what we project this cost accounting in mines from different perspectives. Now, in this particular lecture, we will be covering this concept. One is the cost accounting in mining and introductory part, then there are components of mining costs, fixed and variable costs in mining, cost drivers in mining operations, capital budgeting in mining, and its relation to cost. Cost accounting methods in mining, cost allocation in different mining operations, then the cost related to environmental and compliance costs, regulatory compliance costs, then we will have a brief comparative study between the cost accounting for open-pit and underground mining, how they differ from each other. Now, to start with,

CONCEPTS COVERED

- Cost accounting in mining
- Components of mining costs
- Fixed and variable costs in mining
- Cost-drivers in mining operations
- Capital budgeting in mining
- Cost-accounting methods in mining
- Cost allocation in mining operations
- Environmental and compliance costs in mining
- Cost-accounting for open-pit vs underground mining



we will try to define cost accounting itself in mining operations. This talks about the systematic tracking, recording, and analysis of all costs incurred throughout the mining operations, from the very start of exploration to the production process, marketing, and sales all together. The importance of cost accounting is that it helps in understanding the cost structure and profitability of the mining business. This will help in budgeting once we know the cost of different operations under which is going on, or say we are trying to expand our business in different fields or we go for the installation of new machines. Then, what kind of budget allocation has to be done?



Cost-accounting in mining operations

- Cost-accounting in mining refers to the **systematic tracking, recording, and analysis** of costs incurred throughout mining operations, from exploration to production and sales.
- **Importance:**
 - Helps in understanding cost structures and profitability.
 - Assists in budgeting, cost control, and decision-making.
 - Ensures compliance with **financial and regulatory standards**.
- **Specific importance in mining:** Unique challenges like fluctuating ore quality, geological uncertainties, and environmental costs make mining operations cost-intensive, requiring precise cost management.



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So, costing is a part of that capital budgeting. We must know whether we are spending more or not. In that case, cost control will require proper costing and proper reflection of the cost involved in the particular job or particular unit, where we need to understand whether we are expensive or not, can we control the cost, bring down the cost. These kinds of activities are basically decision-making activities, decision-making. This also ensures the cost accounting also ensures compliance with financial and regulatory standards. In regard to costing or many other financial activities, we have regulatory standards which we need to maintain.

The format in which you prepare the report all these things are complied with when you do cost accounting in proper way as per the standards. Now, in mining we have specific

importance to cost an important I mean an cost accounting, because in this case everything is not fixed it can change anytime. We face challenges like fluctuating ore quality, the geological uncertainties certain you will be encountering with certain an discontinuities, faults or folds which will behave in such a way that your planning for cost will be completely changed or the environmental cost also due to mining operations say for example, in the especially in underground, it makes the whole mining operation cost intensive that require overall a very precise cost management. Otherwise, the the investment will be too high compared to the return that you get from the mining operations.



Unique characteristics of mining costs

- **High Capital Investment:** Includes expenses for exploration, drilling, heavy equipment, and mine development. Often involves significant upfront costs before operations commence.
- **Variable Costs:** Influenced by factors like ore grade, depth, and extraction methods. Examples include fuel, labor, blasting materials, and transportation.
- **Environmental and Regulatory Compliance:** Costs related to environmental impact assessments, land rehabilitation, and meeting government regulations.
- **Geological Uncertainty:** Unpredictable factors such as ore quality and unexpected geological challenges can significantly impact costs.



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What are the unique characteristics of mining cost? First thing it is for most of the mines not the small and not very small queries or minor minerals, it is high capital investment business, it is capital intensive operation. Now this includes expenses for exploration when you are not getting anything other than some information for the an ore body modelling or say coal reserve estimations, then drilling, heavy equipment and mine development which is very very expensive. This involves significant upfront costs. before actual operation commence.

So, you need to have lot of capital infusion before you get start getting the return. Secondly, the variable cost this is highly influenced by say ore grade depth of working

where you are and then extraction method depending on the extraction method, depending on the level of mechanization. So, that will decide our fuel consumption, the labour deployment pattern, the requirement of the explosive detonators on or other blasting facilities and transportation. how far you are from the loading points, where you are blasting, where from you are collecting the material.



Components of mining costs

Direct Costs: Costs directly attributable to mining operations.

Examples:

- Labor: Wages of miners and operators.
- Materials: Explosives, lubricants, and spare parts.
- Utilities: Electricity, water, and fuel used in mining and processing.

Indirect Costs: Overheads not directly linked to production but essential for operations.

Examples:

- Equipment maintenance and depreciation.
- Administrative expenses: Salaries of office staff and managers.
- Insurance and safety compliance costs.

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Not only that, when you bring the material from the mines, it does not mean that it ends there. You may have to take it to the wagon loading point, sidings, or say, port. All these things are required to run the mining operations. And the variable cost will definitely depend on the other parameters that we will discuss. Now, environmental and regulatory compliance. The cost related to the environmental impact assessment (EIA), which we call EIA, the environmental impact assessment, environmental management plan, is also prepared. Then, land rehabilitation is required because we are disturbing the land thoroughly in opencast mining, where huge land is affected. And therefore, meeting all other government regulatory provisions requires investment, which means that will incur a lot of cost there.

As I said earlier in the previous slide, there are unpredictable factors such as the ore quality, which may suddenly change. Or unexpected geological challenges like discontinuity or certain intrusion of material that was not previously fully reported during

the reserve modeling based on the borehole data. So, this will significantly impact the cost of mining. What are the different components of mining cost? This depends on the perspective from which you are looking at the mining cost.

For example, there could be direct cost. So, if you try to find out, what is direct cost? So, these are related to labor, wages of miners and operators, materials, explosives, lubricants, spare parts—they are all directly involved in production. Then utilities like electricity, water, fuel used in mining and processing everywhere. So, all these are directly involved in production; we call them direct cost.

Indirectly like the indirect cost is say for example, overhead this is not directly linked to any production, but they are essential for operations. For example, equipment maintenance then depreciation. So, if this is this you are not doing you are not equip doing the maintenance of the equipment ah eventually you will have to stop operations because of the because of the machine breakdowns and failures. The depreciation is is a part of the costing because we add these things every year to depreciate the the amount spent for purchasing a big machines or installations. This we learn in separate chapters separate lectures when we discuss depreciation in details and different methods of depreciation how to do that that will be doing in details.

There are administrative expenses related to this like salaries of the office staff and managers. They are not directly related, but they are essential and indirectly related. Then you go for the different insurance provisions, safety compliance which is compulsory you have to do it even though they are they may not be directly linked to production, but this is essential in escapable cost. Now let us ah change our perspective. Now let us talk about fixed cost.

So, this this will remain cost to constant Irrespective of whether you are producing this volume or that volume, your changing volume will not instantly change anything any fixed cost. Like the depreciation of mining equipment, this will not change you have already purchased every year you are depreciating in the balance sheet showing the depreciation amount, this will not change whether you use them or do not use them. this you have decided for example, in 7 years I want to depreciate. So, the that that cost will be loaded every year.

Fixed and variable costs in mining

- **Fixed Costs:** Costs that remain constant irrespective of production volume.
Examples:
 - Depreciation of mining equipment.
 - Salaries of permanent staff.
 - Lease or rental payments for machinery and infrastructure.
- **Variable Costs:** Costs that fluctuate with production levels.
Examples:
 - Fuel and energy consumption.
 - Cost of explosives and drilling supplies.
 - Transportation costs for ore.
- Understanding the balance between fixed and variable costs is crucial for managing expenses and optimizing production.

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Now, the salaries of the permanent staff. So, if you are not you are reducing the production volume or increasing it this will remain same this will remain same more or less. Then there are lease I mean the payment related to lease or rental different rental payment for machinery or infrastructure. So, this you have to pay since you are using them, these are independent of the production volume to certain extent.

So, these are all fixed cost. Now for variable cost, this will fluctuate. These variable costs are those costs which will fluctuate with the production level. For example, fuel and energy consumption. If you are running more dumpers or using them more frequently, more number of machines, then the fuel and energy cost will be higher.

For example, if you are running in 2 shifts then the electricity consumption and when you are running 3 shifts all 3 shifts together then the fuel and energy consumption will change drastically. The cost of explosive drilling supplies this will vary with the amount of the rock that you blast that means, these are all related to the production. So, these are

variable cost depending on the production volume. Now, transportation cost if you produce more the transportation will be there more transportation means more cost.



Cost-drivers in mining operations

- Ore Grade and Quality:
 - Higher-grade ores require less processing, reducing costs.
 - Low-grade ores increase expenses due to additional processing requirements.
- Depth and Accessibility:
 - Shallow, open-pit mines are generally less expensive than deep underground mines.
 - Transportation and ventilation costs rise with depth.
- Energy Consumption:
 - Mining is energy-intensive; fuel prices and electricity rates significantly impact costs.
- Environmental Regulations:
 - Compliance with environmental standards can increase costs for waste management, emissions control, and land rehabilitation.

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So, these are not fixed; these are variable with the production volume. Understanding the balance between fixed and variable costs is very crucial for managing expenses and optimizing production. All these factors must be known very clearly so that we can optimize the cost for different variables. What are the things, what are the factors that change or influence the mining operation, the cost related to the mining operation? Let us look at them, like the ore grade and quality.

Higher-grade ores require less processing, reducing cost, but remember that if you have designed your process for a particular grade or up to a maximum grade of some percentage, then you should be limiting the feed to the process up to that. If you are feeding very high-grade ores into a plant not designed to process them, then you may be losing. What we are saying here is that higher-grade ores definitely require less processing to recover the value minerals. For example, that will reduce the overall cost because with less money, we get more production—the value minerals we want to recover. Conversely, low-grade ores will increase expenses due to additional processing requirements. There will be more expenditure to recover the same amount of value

mineral compared to a situation where we have high-grade ores, which will reduce overall cost.

Now, depth and accessibility are very easily understood. Shallow open-pit mines are generally less expensive compared to deep underground mines for access, support, and then, say, for making declines or inclines, connecting roadways, and development. So, this will vary; it will definitely increase a lot depending on the depth and the accessibility design. Now, transportation and ventilation costs will rise with depth. Naturally, the network will be bigger; the path or the transportation network will be huge. The ventilation cost to ventilate the entire mine when it is much bigger and at a larger depth will increase. Now, we are coming to energy consumption.

Mining is energy intensive. Why? The fuel prices and electricity rates are for running all the machines. So, for example, in underground mines, the ventilation fans, the LHDs underground, the lighting, and all installations, pumps, everywhere. So, it is energy intensive. Also, for open-cast mines, we have a large number of vehicles that consume a lot of diesel or petrol.

Cost-accounting methods in mining

- Job-order Costing:
 - Used for specific, custom mining projects.
 - Tracks costs associated with individual jobs or operations, such as exploratory drilling or equipment installation.
 - Benefits: Precision in cost allocation for unique tasks.
- Process Costing:
 - Applied to continuous operations, such as ore processing.
 - Distributes costs across all units of output to calculate per-unit expenses.
 - Benefits: Efficient for standardized, large-scale production processes.

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So, that significantly impacts the mining cost. Now, environmental regulations are also a driver. These impacts include complying with environmental standards: dust, noise, vibration, fly rock, or ground vibration—all these things. So, and not only that, the

ecological balance, the adverse effects on air, water—everything needs to be controlled. So, you need to invest to implement the methodology for compliance with environmental standards.

This will definitely increase costs, for example, for waste management. Emission control, as I was saying—dust, fumes, gas, all those things—and land rehabilitation, reclamation, all these things will incur huge costs in mining. Now, what are the different methods? There are—I mean, we can say that we can go for job-order costing or cast the existing data in different formats, like job-order costing. This is used for specific or custom mining projects.

So, this tracks the cost associated with individual jobs. So, you are dividing, you are just identifying a particular job and loading the cost. So, you can identify what cost is involved in that job. For example, how much we have invested or spent in exploratory drilling or for equipment installation. So, if you go the I mean in details about for example, an equipment installation, then can you reduce it, can you optimize it, you can understand from the different component of that equipment installation which is within that particular job.

So, what benefit we get in this kind of costing? That it gives a very precision in cost allocation for unique tasks that you are focusing on that particular job and then trying to optimise or rather minimise the cost that can be the money that can be spent for doing the completing the task. Now, there is process costing applied to all continuous processes for example, over processing. This distributes the cost across all units of output to calculate per unit expenses. For example, we are we are we are we are calculating the cost for the mine, for the processing plant, for say transportation from one unit to the another unit and then again processing for example, in smelting operations.

what we can do that all these outputs ore or concentrate or say some metal. So, this can be used the cost involved can be used as an indicator for per unit expenses. So, we can use that per unit expenses to compare with the other part of the country or global standards and try to understand why our cost is more or we are better than the global standard. So, this is how the process costing can be utilized. So, the benefit is that it is efficient for a standardized large scale production process as I was telling large scale production process unit wise we can divide and this process costing method is very helpful in that.

Now, it also helps in capital budgeting, as I was telling you at the beginning of my lectures. If this involves evaluating or valuing long-term investment decisions in mining projects—for example, purchasing heavy machinery or developing new mines—the cost involved and its implications for long-term investments must be considered. So, we can evaluate the effect of these long-term investments on our mining operations. What are the techniques that we have already studied? Net present value measures profitability by comparing cash inflows and outflows over the project's life.



Capital budgeting in mining

- This involves evaluating long-term investment decisions in mining projects, such as purchasing heavy machinery or developing new mines.
- Key Techniques:
 - Net Present Value (NPV): Measures profitability by comparing cash inflows and outflows over the project's life.
 - Internal Rate of Return (IRR): Determines the discount rate at which the project breaks even.
 - Payback Period: Calculates the time required to recover initial investments.
- Importance:
 - Ensures efficient allocation of resources.
 - Reduces financial risks associated with large-scale mining projects.



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So, cost is a very essential part of net present value; unless we know this, NPV cannot be calculated. Similarly, when you calculate cash inflow or cash outflow, you are actually talking about cost. So, when you try to find the rate of return where net present value is zero, you can determine the IRR, as cost is very much involved in calculating the series of cash outflows or inflows. Now, in the payback period, you also try to find the time required to recover the initial investment. So, there too, how much you spend and how much you earn—in both cases, you need to understand the cost of running the operation and how much you recover.

So, a ratio will tell you how many years it will take to recover your initial investment. The importance is that it ensures efficient resource allocation—unless you know, you cannot say how much money is required to get a certain return from the investment. This

reduces the financial risk associated with large-scale mining projects. When you expand or run large-scale mining projects, you must know the allocation—how much to invest in which sector next year, depending on production targets and past experience with money utilization. So, accordingly, we will be able to do capital budgeting with your target production in mind.



Cost allocation in mining operations

- The process of distributing shared costs among different projects or departments.
- Key areas of allocation:
 - Infrastructure Costs: Shared use of facilities like roads, utilities, and storage.
 - Equipment Costs: Allocating usage-based expenses for shared machinery.
 - Administrative Costs: Salaries of support staff, insurance, and office expenses.
- Allocation Methods:
 - Usage-based Allocation: Costs distributed based on actual usage or output.
 - Activity-based Costing (ABC): Allocates costs based on activities that drive expenses (e.g., drilling hours or processed ore).
- Importance:
 - Ensures fair cost distribution for accurate project profitability analysis.
 - Supports better decision-making and budgeting across mining operations.



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Now, in the cost allocation part, the process is actually the distribution of shared costs among different projects or departments, as I was mentioning how to allocate these things. So, how—what are the key areas of this allocation? In infrastructure, how much are you investing in roads, utilities, storage, equipment, usage-based expenses for shared machinery, administrative costs like salaries of support staff, insurance, office expenses? What are the allocation methods there? So, you can use the usage method—so much usage, so many hours, so many thousand hours—depending on that, you will require so much power, so much fuel. So, like that, depending on your production target, you can find out the hours of usage and, based on that, allocate costs for budgeting purposes.

And there is also activity-based costing, which allocates costs based on the activities that drive expenses, like drilling hours, as I said earlier, or processed ore per ton. If you are producing—if you have the experience and if you are happy with that—for example, I am spending 300 rupees per ton or 400 rupees per ton. And next year, if I am going to

produce this much, then per unit, if I know it is 400 rupees, you can easily allocate that this much money will be required for the mining operations. What is the importance of this kind of cost allocation? It ensures fair distribution and accurate project profitability analysis.



Environmental and compliance costs in mining

- Costs incurred to meet environmental regulations and legal standards during mining operations.
- Examples of Costs:
 - Rehabilitation and Reclamation: Restoring land after mining operations.
 - Environmental Impact Assessments (EIA): Required before project approval.
 - Emission Controls: Managing carbon emissions and other pollutants.
- Significance:
 - Ensures legal compliance and avoids penalties.
 - Enhances sustainability and reduces environmental harm.

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This also supports better decision-making and budgeting across mining operations, leading to better control of the mining business. What are the environmental and compliance costs? Here, once again, I will try to summarize: the costs incurred to meet environmental regulations and legal standards during mining operations. Like rehabilitation and reclamation, which is compulsory—you must restore the land after mining operations—it is very expensive. Environmental impact assessment is required before project approval.

You need to engage certain standard agencies, pay them, and then you get the reports. Accordingly, you need to make an environmental management plan. Before you get the mining project approved, you have to attach those documents and get them approved. And it also helps us in managing carbon emissions and other pollutants. So, if you want to meet the environmental regulations and install all those facilities, equipment, and instruments, then it will manage carbon emissions and control the emission of pollutants.

This ensures that the legal provisions are complied with and will definitely avoid penalties, which can be as severe as the closure of the mine.

So, this is compulsory legal compliance. This enhances sustainability. You can continue your operations without disturbing the environment, and if you comply with the regulations, your business will continue, reducing environmental harm due to mining operations. Now, we are talking about labor costs. The direct labor costs are related to salaries, wages, and benefits for miners and operators. What are the indirect labor costs?

Labor costs in mining

- **Direct Labor Costs:** Salaries, wages, and benefits for miners and operators.
- **Indirect Labor Costs:** Training programs, safety equipment, and supervisory staff.
- **Impact of Automation:** Reduces direct labor costs but increases costs for maintaining automated systems.
- **Importance:** Labor is a significant portion of mining expenses and requires efficient management for cost control.

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Training programs, safety equipment, and supervisory staff are indirect labor costs. Those involved in training programs, safety departments, or supervisory roles are not directly related to production but are very much required. So, they are indirectly related to production. Now, the impact of automation can reduce labor costs, but in the beginning, you may spend more. Overall, labor is a significant portion of mining expenses and requires efficient management. For cost control, labor costs are very important—how many you are engaging, their skill level, and efficiency.

So, the better you have to know them you have to appoint appropriate people and control the direct labour and the indirect labour in such way that it can you can optimise the labour cost in the mining operations. What are the cost control techniques that we can suggest that budgeting and variance allowance? You have allocated certain budget for a particular job and in after 1 year or so in a financial year or in a review after say 6 months

or so, you are reviewing that how much you are actually incurring the cost. So, you have to identify the discrepancy, the planned and the actual expenditure and you try to understand why this has happened. If it is more

Then, why it has happened, where we have failed to inform ourselves or control the process. Then energy efficiency program, this reduces energy consumption in equipment and processing. we have to have a particular drive ok. We our whole target is to reduce energy consumption by you can engage consultant, you can study through in house ah manpower that how to reduce energy consumption at different places at different units of the mining operation. Then, the maintenance optimization.

Cost control techniques in mining

- **Budgeting and Variance Analysis:** Regularly comparing actual costs to budgeted amounts to identify discrepancies.
- **Energy Efficiency Programs:** Reducing energy consumption in equipment and processing.
- **Maintenance Optimization:** Implementing predictive maintenance to reduce equipment downtime and repair costs.
- **Supply Chain Management:** Streamlining logistics to reduce material transportation costs.

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So, we can we can or we should in implement the predictive maintenance should not wait for the machine to breakdown and then you start incurring cost both ways because the production will be halted not only that you may require costly the spares for repairing the ah ah the the down your the machine that which is under breakdown. Then the supply chain management streamlining logistics to reduce material transportation cost in such a way that you minimize the transportation cost, you need to understand the supply chain properly. There are certain technological aspects we which we can think of which we are already implementing in many mining companies that artificial intelligence and machine learning can be used for forecasting cost of different component. Whatever cost we are talking about we have the data for last 10 years or so 20 years or so we can study

the trend and we can forecast the cost also and we can identify the inefficiencies in the process. And, using predictive analytics we can forecast the cost that we may incur for a particular process.

Now, also we use now almost all big companies they will use ERP systems like the SAP or Oracle that streamline the cost allocation and budgeting. They also help us in taking decisions very fast because of the softwares in build capacity. For open pit and underground mining as we are discussing so far we can understand that the cost accounting for open pit mining has significantly lower cost compared to underground mining if you are going say per unit of production. primarily due to the easier access to ore near the surface. This will allow us large scale equipment to be deployed.

Technology in cost-accounting for mining

- **Predictive Analytics:** AI and machine learning for forecasting costs and identifying inefficiencies.
- **Cost-Management Software:** ERP systems like SAP and Oracle streamline cost allocation and budgeting.

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This is simpler extraction process, but in underground mining what happens? That is more complex infrastructure, a specialized equipment is required. You cannot use a huge machine in a place which is confined. It increases the labour cost. And, that overall results into a higher overall cost per ton of ore extracted.

The key differences in cost accounting between open pit and underground mining is that initial capital cost ah due to open pit lower initial capital cost due to simpler infrastructure. but in your underground mines it is high. In open pit like large excavators, haul tracks, then surface facilities, these are required for the open pit. These are not very I mean cheap at all either, but what happens? Compared to underground where the initial

capital cost is has to be high because of the installation of shafts crores and crores, hundreds of crores of rupees that you have to spend there.

Cost-accounting for open-pit vs underground mining

- In cost accounting, open-pit mining generally has significantly lower costs compared to underground mining, primarily due to the easier access to ore near the surface, allowing for larger-scale equipment and simpler extraction processes, while underground mining requires more complex infrastructure, specialized equipment, and increased labor costs to access deeper deposits, resulting in higher overall costs per ton of ore extracted.
- Key differences in cost accounting between open-pit and underground mining:
 - Initial Capital Costs
 - Open-Pit: Lower initial capital costs due to simpler infrastructure needs like large excavators, haul trucks, and surface facilities.
 - Underground: Higher initial capital costs due to the need for shafts, tunnels, specialized equipment like loaders and mining machines, and ventilation systems.



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Then make tunnels, meaning the roadways connecting declines, and specialized equipment like the loaders, mining machines, ventilation system, pumping system—all these things are underground facilities. So, that is supposed to be the initial cost, which is high. Also, the operational cost in open-pit mining is lower per ton of ore due to higher production rates. Labor-intensive operation is not there; it is less labor-intensive

Cost-accounting for open-pit vs underground mining

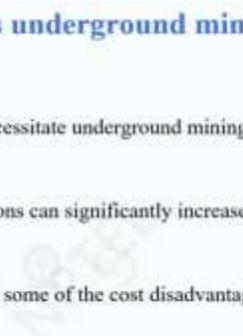
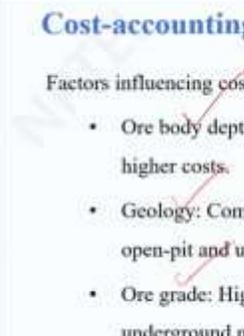
- Operational Costs:
 - Open-Pit: Lower operational costs per ton of ore extracted due to higher production rates, less labor-intensive operations, and easier access to the ore body.
 - Underground: Higher operational costs due to the need for more labor, specialized equipment maintenance, and complex underground access and transportation systems.
- Major Cost Components:
 - Open-Pit: Dominant cost components include fuel for heavy machinery, labor for operation and maintenance, blasting costs, and haulage.
 - Underground: Major cost components include development and maintenance of underground infrastructure, ventilation costs, labor for underground operations, specialized equipment, and ore transportation.



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compared to underground mining, and we have easy access to the ore body. In underground mining, the operational cost is higher due to the need for more labor. So, the output per man-shift (OMS) is definitely much lower.



Cost-accounting for open-pit vs underground mining

Factors influencing cost variations:

- Ore body depth: Deeper ore bodies necessitate underground mining, leading to higher costs.
- Geology: Complex geological formations can significantly increase costs in both open-pit and underground mining.
- Ore grade: Higher grade ore can offset some of the cost disadvantages of underground mining.
- Environmental regulations: Strict environmental regulations can add to costs in both mining methods, especially for waste management and reclamation.

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So, we need specialized equipment, maintenance facilities, and complex underground access and transportation systems. The major cost components in open-pit mining include fuel for heavy machinery. Now, labor for operation and maintenance, blasting cost, and haulage cost. In underground mining, major cost components include mine development and maintenance of underground infrastructure. Ventilation cost.

Labor for underground operation, specialized equipment suitable for underground mining operations, and a transportation network, which is again complex. So, these are the factors which influence the cost variations. As I said, ore body depth and geological disturbances can significantly increase costs. If the ore grade is sustained—more or less not fluctuating—then you can think of the cost of operations to be the same. But if it varies, then you can expect that there will be a lot of disadvantages, especially when you deal with suddenly getting low-grade ores. Environmental regulations also impact the cost, as I have discussed.

Now, for the challenges, we can again rephrase the things that we have already learned so far into major items like fluctuating commodity prices that will affect revenue prediction. And cost planning accordingly. Geological uncertainties, I have said several times. Environmental regulations, technological integration, adapting new technology that will require significant upfront investment. Labour and skill shortages.

Challenges in cost-accounting for mining

- **Fluctuating Commodity Prices:** Price volatility affects revenue predictions and cost planning.
- **Geological Uncertainties:** Unexpected variations in ore quality and accessibility impact cost estimates.
- **Environmental Regulations:** Increasing compliance requirements add to operational costs.
- **Technological Integration:** Adopting new technologies requires significant upfront investments.
- **Labor and Skill Shortages:** Difficulty in hiring skilled labor can increase costs and delay operations.

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Difficulty in hiring skilled labour; this can increase costs. You may have to deploy more manpower instead of having skilled labour, which can delay our operations. Now, whatever we have said so far. If you want to learn more specifically about the cost accounting process or specifically what is related to mining, then we can study Introduction to Managerial Accounting. This is for general study. Then, Classification of Mining Cost, this is the World Bank's publication. And there are several others like job order and process costing, fixed and variable costs, NPV, IRR, payback period techniques for capital budgeting in mining, Deloitte insights. So, these things can be used as references.

So, in the next part of the lecture series this week, we will be handling specific methods, specific analytical methods, and we will also be solving numerical problems related to cost-volume-profit analysis. There are many other topics related to costing in mines. Thank you very much.

REFERENCES

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- Job-order and process costing: "Cost Accounting: A Managerial Emphasis," Horngren et al., 2021.
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