



MINERAL PROJECT EVALUATION

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As commodity prices rise, together with restricted labor markets and fluctuating material costs, the role of mineral project evaluation plays a vital role for all mining professionals. The art of mineral project evaluation involves understanding the key principles and project drivers, as well as identifying and quantifying the level of risk to determine the viability of a project.

There are three key questions that must be answered before entering the process of evaluating mineral projects. These questions comprise the following:

1. Where are we now? Does the mineral resource have the potential for positive economics?
2. Where do we want to be? Typically, we would like the project to be a low cost producer and maximize value to the shareholders. It is important to note that value includes managing the company's new investments and current operations to achieve sustainability, profitability, solvency, liquidity, growth (by adding value) and survival.
3. How do we get there? How do we extract what is in the ground into a mineral product that can be used as a raw

material, or finished product for customers at maximum return and minimum risk.

Various project study stages are used to evaluate mineral projects and prepare a deposit, ranging from "Greenfield" (no previous mining history) to "Brownfield" status (previous mining in the immediate area, or within a known mining district). Often these project stages are required to be undertaken in line with international codes such as JORC or NI43-101, to determine what is required and includes their associated confidence levels. The project stages are carried out with a degree of confidence levels and PAH recommends the following accuracy levels as acceptable for mineral project evaluations:

Project Phase	Accuracy Level
Scoping Study	50%
Prefeasibility	35%
Feasibility	25%
Detailed Feasibility	15%

In any mineral project the key areas of evaluation include exploration, geology, resources, reserves, mining, processing, infrastructure, hydrology, environment, capital and operating costs, economic analysis and risk evaluation. Risk is important in the assessment of a mineral project for two reasons. Firstly, the value of the project may differ from what it was forecast to be. This type of risk represents a potential loss to the owner of the project. Secondly, the risk of the project contributes to the risk for both the company and investors. The level of risk should be evaluated for each project item with a degree of contingency applied.

The risk items often require the involvement of a Qualified Person (QP) to quantify the level of information attained for each project item, determine the associated level of risk and provide input on risk mitigation methods. A quantitative risk assessment is advocated for use in all financial evaluations and it is commonly based in accordance with international guidelines such as ISO 31000. These standards provide principles and guidelines on risk management. They also help identify an educated judgment of the probability or likelihood of occurrence of issues associated with each risk, the impact that these issues will have if they are (or are not) realized, and an overall risk rating based on the combination of both. The life of a mine can be simplistically divided into three key phases that consist of preproduction, production and mine closure with each phase having their own project strategies.

Preproduction is associated with expenditure of available capital funds and the focus is managing project creep and securing production, as stakeholder expectations are high. This period is often subject to high OPEX and Capital investment requirements. Key project evaluation techniques include the following:

- Tradeoff study on Owner or Contractor mining for all or part of mining activities during preproduction years to reduce CAPEX and transfer skilled operator knowledge;

- Reduced operating costs in owner operated method for life of mine but the consequence is high CAPEX, but this may be offset with Joint Venture agreements;

- Many mineral companies often increase the NPV by placing operational expenditure incurred during this period within the capital expenditure, to show high initial investment but low operational cost throughout the project life.

The production phase is all about managing operational costs in order to payback the initial investment and maintain production to secure revenue at fluctuating metal prices. Common practices used to improve project economics during this period are:

- Mining areas which have low strip ratios and high grade material.
- Reducing operational costs through low diesel emitting equipment such as autonomous mining fleets and LCC (Life Cycle Costing) to get more life from the mining equipment. These two strategies are becoming more evident throughout the world due to government rebates on carbon emissions, restricted access to skilled labor and reduced supplies of mining consumables and equipment.
- Management of subcontracting activities through the negotiation of loading, hauling, drilling and blast activities based on tonnage, and not meters or bank cubic meters (bcm) moved.

Mine closure is centered on aligning the final mining footprint with environmental, health, safety and local legislative requirements. The effort is designed to integrate low costs to remediate the mine and try to return the project site to a sustainable level of rehabilitation. Common activities include dozing of waste dumps and backfill of mined out pits.

Risks for projects vary depending on each project's unique characteristics. Some common project risk factors include;

- Mining – Permitting and dust control;
- Plant– high carbon emissions and storage of chemicals;
- Infrastructure – A common ratio for capital equipment is 35% of total plant infrastructure. This may vary depending on process, scale of operation and geographic region.
- Socioeconomic – Mining in tribal regions in Africa or management of localized water near mining communities.
- Environmental – Mining in national parks of Western Australia or the Amazon rainforests in Brazil. Major projects worldwide now must show conformance to the Equator Principles.

The Equator Principles (EPs) are a credit risk management framework for determining, assessing and managing environmental and social risk in Project Finance activities. The EPs are adopted by financial institutions and are applied where total project capital costs exceed USD 10 million. The EPs are primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making.

The evaluations of mineral projects are often commonly based on a Discounted Cashflow (DCF) methodology. A cash flow

is designed to capture all cash inflows and outflows over the whole life of a project and avoid inclusion of non-cash accruals. The cashflow model must recognize the time-value of money by discounting at an appropriate discount rate to obtain their present value and other DCF criteria values such as the following:

- Gross Profit as defined by revenue minus the cost of product sold.
- Earnings Before Interest, Depreciation and Amortization
- (EBITDA) is a measure of a company operating performance without taking into account taxation, financing and accounting decisions and simplistically is the gross profit minus the cash operating expenses.
- Earnings Before Interest and Taxes (EBIT) = EBITDA - Depreciation - Amortization
- Net Present value (NPV) is an indicator of how much value an investment or project adds to the firm and indicates the maximum value that firm should pay for a project at year 0.
- Internal Rate of Return (IRR) is a financial indicator used to measure and compare the profitability of investments. It is important to note that the IRR of a project cannot be evaluated in isolation as it does not account for the magnitude of the cash flows, just profitability on a per-dollar-invested basis.
- Payback Period (PYP) is the period of time required to payback the initial investment from future cashflow. Although the method does not account for time value of money, it is a useful evaluation parameter because it provides an indication of how long the company has to wait to get its return on investment.

The table shown below is a guide-line for discount rate factors at each study level.

A common error in auditing cashflows is the use of Real and Nominal Dollars. Often mining companies will analyze projects based in real dollars and financial institutions commonly use nominal dollars (include inflation). Most company financial statements and reports are in nominal dollars and can serve as a basis for risk evaluation when assessing joint venture and acquisition projects. The focus is to include or disregard inflation effects on projects under assumed certainty to further increase confidence in the economic analysis. The golden rule in DCF analysis is Real discount rates must be used with cash flows expressed in real dollars and vice versa.

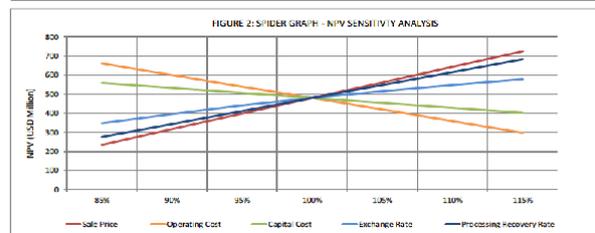
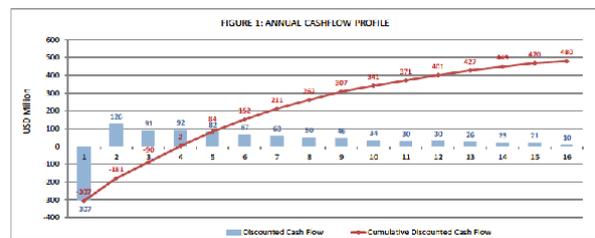
Sensitivity analysis is required to evaluate the economics of a project under various levels of sensitivity for the key project drivers. There are many forms of conducting sensitivity analysis that include spider graphs, tornado diagrams, decision trees and Monte Carlo simulation to assess probability of failure and success. The most common minerals industry software for financial evaluation of mineral projects is XERAS that was designed specifically for the resource sector. Figures 1 and 2 are examples of a project cashflow profile and sensitivity analysis. Any resemblance to an actual project is merely coincidental.

It is important to remember that all mineral projects have a

value, but assessment of projects includes all processes of the value chain from "Mine - Mill – Port - Customer", and evaluation of market supply and demand has to be assessed on economic, social and environmental merit to make a project both financially successful and sustainable.

Table 1: Discount rate factors

Risk	Study Level	Discount Rate
Low	Feasibility	8%
Medium	Prefeasibility	10%
High	Preliminary Economic Assessment	12%
Extremely High	Scoping Study	15%



References

1. Crundwell, F.K, 2003. Finance For Engineers: Evaluation and Funding of Capital Projects, 12 p.
2. Equator Principles, 2012. <http://www.equator-principles.com/index.php/about-the-equator-principles> (accessed May 30, 2019).