FEASIBILITY AND VIABILITY OF MINING PROJECTS

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Abstract: The feasibility study for a mining project, as well as for other projects, must be done in order to give to the owner relevant information about the viability of the project. It is a complex, technical and an economic study and it should be conducted by persons with experience both of operations, planning, equipment selection and of capital budgeting.

Keywords: mining project, feasibility study, sensitivity analysis, schedule, capital cost, estimate, profit, financial analysis

1. THE IMPORTANCE OF FEASIBILITY STUDIES

A feasibility study should be made by persons preferably with experience in operations, planning, equipment selection and capital budgeting. All of these areas are very important but the least understood and subject to greatest error is the capital budget. The reason for the lack of expertise in this area is the lack of opportunity for experience. Every operation in its life only has one start, which might take two to four years to plan, construct and commission. The operational phase might last for 7, 20 or 40 years. Therefore, many more people have the opportunity for operational and planning experience than those involved at the start-up. The capital start-up budget is the one figure that does not get discounted during the NPV analysis, and, if it does, it is discounted by a minimal amount hence its impact is greatest. It must be as accurate as possible as a blow out can ruin a project before start-up.

If the study is conducted by experts, the owner should be confident of the viability of the project and hence the next corporate step to develop the project. The owner of the property is not quite sure of what is under the ground, in terms of value, until this study is completed. The owner may intend to use the study results to place shares on the market or for an application for some form of a loan.

The owner needs to know if the feasibility study is accurate and bankable. A good review will unearth all areas of weakness in the potential borrowers’ study as it is

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the reviewer’s task to indicate to the lender the magnitude of its risk. Following a successful review, the owner and the lender are both confident of the viability of a project. The major purpose of a feasibility study is to determine the viability of a project. But other essential criteria become available through a good feasibility study. These include schedule for the following: production; planning; procurement; construction; completion; payments.

As a consequence of combining all schedules, requirements and dates of availability of information, plant and equipment, a critical path schedule (CPS) may be developed. The CPS details over what period of times money have to be borrowed and hence what interest payments are likely to be. It indicates that on certain activities spare time is available.

Also, here, cash-flow is addressed in significant detail, this in turn indicating:
- maximum exposure
- project periods of financially vulnerable
- loan repayments schedule

A sensitivity analysis of a project may be assessed as a result of the financial analysis. Most consultants and engineers produce the results of a study on some form of computerized spreadsheet. This final analysis can be done in a form as to allow various technical or financial parameters to be altered. The effect that individual changes or combinations of changes have on the project may be determined. Some of the items that may be assessed:
- change in sale price of commodity
- change in grade of the ore mined
- increase/decrease in capital or operating costs
- delays or decreased production

2. CONDITIONS FOR PROJECT FINANCING

In order to finance a mining project it is necessary to provide substantiated evidence that the project is technically and economically viable. Enough data has to be presented describing the project objectives in detail that assesses all technical and financial implications and indicates the magnitude of the potential profit. To ascertain the accuracy of these data it is important for the project to be review by a credible body, in order to ensure the validity of the document.

For the projects in the resource sector, the initial consideration is that of the ore reserves. Suitable geological information should identify the ore reserve available for mining, the existence of which being quantified to a high degree of confidence. This initial step is the most important for the success of any potential project, because a lack of knowledge and understanding causes doubt and uncertainty from the outset.

The geological interpretation of ore resources must make allowances for data inaccuracies to ensure that a conservative assessment is done at each stage of evaluation. The less geological information that is available the more conservative is the reviewer’s assessment. Optimistic evaluations are of little use to all concerned and
if insufficient geological information is available, it must be stated and additional exploration undertaken.

The specified mine design and methods of mining are assessed during the review to ensure their practicality and conformance to the physical parameters of the orebody and the location of the project. A rigorous analysis of ore samples determines the process by which the method of metallurgical treatment is selected and the percentage of mineral recovery is estimated. It is necessary to know that this data is utilized during the design of the complete mineral processing system. In addition to the technical aspects of the project, all services and utilities necessary to sustain the mining operation have been identified and included during the project evaluation. After the establishing of the technical credibility of the project, it is necessary to that the capital and operating costs have been correctly estimated.

The estimation of the capital expenditure should consider not only the cost of equipment but also procurement, freight, customs and excise duty, taxation etc. In most situations, in mining projects, the cost of equipment commissioning is significant and must be included in estimate. Construction costs associated with the project have to be identified. Such items include construction pads for draglines or other equipment, mill and crusher foundations, airstrip, road and rail line construction, accommodation and employee recreation facilities etc.

The operating cost estimates should be presented for each portion of the operation and should reflect the total expenditure incurred for the mining or treatment of each tone of ore. The reviewer considers then all estimates with current operations of a similar type to confirm their validity.

In addition, the review considers the total expenditure incurred during each month of the year that is estimated from the scheduled production of ore.

To obtain the project cash flow, expenditure is compared with the revenue generated from the sale of the mineral product. The value of product at the time of sale is dependent on contract-on contract sale agreements, forward sale agreements or the current spot market price. The value adopted is confirmed during the review process.

The total cash-flow analysis indicates the annual profit or loss of the project. The Net Present value may be calculated for various discount rates. The main objective is to satisfy the reviewing body that, in financial terms, the project is potentially viable, having assessed the majority of economic ant technical variables.

3. THE CONTENT OF THE STUDY

In a feasibility study of a mining project have been addressed the following areas: the ore reserve, the mining method, the ore processing &treatment, the maintenance/engineering function, services and utilities, capital cost, operating cost, and financial analysis.

The ore reserve is the single most important item in the feasibility study. However good or smart the mining method is, or how new the technology is in the process plant, it is completely negated if the ore reserve is over stated or if the geology
is incorrectly interpreted. As a geological entity a deposit progresses with increasing confidence as a resource from ‘inferred’ through ‘indicated’ to ‘measured’. As soon as production and processing parameters and costs are addressed it becomes a reserve being ‘probable’ or ‘proved’ with ‘proved’ being the higher category. As a resource with a minimum of exploration drill holes it may be referred to as an ‘inferred’ resource of a certain tonnage. The ‘indicated’ resource would state a grade with ‘measured’ having a greater degree of accuracy in significant figures for both tonnage and grade. During the above assessment it is important that the level of confidence in the deposit be increased. This increases with the number of holes or exposures available. The geological sequences, the mineralization, the faults etc. have then to be interpreted to obtain the structural model. It is necessary to be confident that the results obtained are representative for the ore body and the structure being drilling. Some consultants and companies conduct both a classical as well as a geo-statistical ore reserve estimate. This approach gives an additional degree of confidence to a reserve and can warn of a fundamental flaw in ore estimation. Following this geological assessment the resource is transferred to the reserve category. This means that allowances are done for dilution and mining recovery, this being sometimes referred to by the engineers as ‘mineable reserve’. The increasing degree of confidence is reflected by ‘probable’ reserve or ‘proved’ reserve. The study must determine the recoverable reserve, which is the tonnage and grade of the ore deposited in the bin head of the process plant. This varies according to the product price, operating costs etc. which in turn determine the ‘cut-off grade’.

The mining operations as a section of the feasibility study determines if an open pit or underground mining method is to be used. It may determine at what depth an operation switches from open pit mining to underground. In the case of an open pit, the feasibility study should be able to recognize the limit of the economic pit at any set of economic parameters (eg. labor cost, product sale price). There is only one economic final pit outline for any single set of economic parameters. If one tone less or more is extracted it detracts from the final profit. In an underground mine the geometry of the mineralization and the characteristics of the ore body and the surrounding rocks determine extraction methods. Physical constraints such as the speed of sinking a shaft or a decline to a large extent determine the extraction rate. In the case of open pits the extraction rate depends on the physical size of the pit. This includes how much equipment can effectively be operated within the pit at any time. After extraction and treatment rates have been decided, it is necessary to produce ore and waste production schedules. These schedules are determinant in the selection of equipment and of how many pieces of equipment are required to meet a schedule. The different types of equipment must match each other and the correct matching is obtained when most of the equipment works for most of the time. After the production schedules have been assessed and the equipment selected, the levels for operations and maintenance may be decided upon together with ancillary and service equipment. This manner the complete mining management structure can be determined.

The process plant design has to be based on an adequate number of ore
samples that are statistically relevant. The samples must be representative. The process plant is invariably the biggest user of power and water so its requirements need too be accurately estimated and the correct plant selected for specific tasks. Following this step, labor allocations are derived. Policy decisions generally influence this selection as automation and remote control techniques must be addressed.

The maintenance engineering function is assessed after the determination of the main production parameters. This must include a philosophical decision as to what proportion of maintenance is to be conducted on site and what is to be contracted to outside engineering works. This decision depends on the size of the project and its life expectancy. As a consequence, if this decision manning levels are set and workshop sizes are decided as well as the tool and equipment requirements in such workshops. Then the overall maintenance labor structure is determined at supervisory and management level.

The requirement for services and utilities that must be assessed includes the following:
- Warehouse facilities office facilities;
- Town: houses, single quarters, club, shopping complex, recreation facilities, school;
- Power generation;
- Water;
- Sewerage treatment;
- Compressed air generation;
- First aid post and hospital;

These items are addressed to greater or lesser extent, depending on the size of the project and its life.

The estimation of the capital cost can be a small task (only the costs of some drilling, some bore hole pumps, a generator set and some transportable unit are determined). A big task involves a team of people detailing many items for purchase.

The hidden costs of capital and delays will occur in supply have to be recognized at this juncture. These include transport in the source country, wharf storage costs, loading costs, shipping and insurance, off loading, excise and duty, transportation to the project site. In the case of large items such as draglines or stripping shovels allowances have to be made for the clearing of construction/assembly sites, the costs of assembling the item. A dragline takes a team of workers and mobile equipment and between three and five months to assemble and it normally requires an ordering lead time of between twelve and thirty months. This has to be recognized in the capital budget and schedule. After that, the capital budget estimate and expenditure flow can be built up. In addition, procurement order schedule may be determined.

The operating cost, for any project, consists of labor, consumable items, maintenance items and power. As a result of determining the operational parameters, the number of people employed on the project at any time may be assessed. Labor schedules shift and holiday allowances. All worker categories and numbers are itemized. Consumable costs that have to be estimated are required for such items as
rails, dog spikes and fuses underground or cable bolts in an open cut operation. The
warehouse stock level has to be estimated as well as the amount of stationery required
by the office. Usually the major part of the consumables cost centre covers the cost of
fuel and oil, which is why these items must be carefully estimated. Maintenance items
include parts of trucks or hoists or bearings for conveyors. These allowances are
generally made up as a result of considering the manufacturers’ recommendation and
also considering experience in the field. Power requirements costs are assessed by
estimating the number of kilowatt hours used by period, an allowance being made for
the maximum demand. The power cost is normally a uniform cost per month.

The financial analysis as a part of the feasibility study is produced on some
form of computer software that allows different technical and financial parameters to
be varied. It includes all the production statistics together with the various factors that
influence the final product recovery. Also, here are summarized the operating costs,
consisting of independently listed fixed and variable costs together with a percentage
contingency allowance. This produces the total operating cost. Total revenue is
obtained by multiplying the product in any time period by the selected unit sale price.

The capital budget, also, is listed as a total together with its contingency
allowance. Having determined revenue and expenditure, the project profit before tax
can be calculated. Then will be estimated and listed the allowances for amortization
and depreciation and, after that, the tax deductible and after tax profit may be
estimated. This type of financial analysis spreadsheet allows the sensitivity analysis in
order to determine how robust the project is to change (the project risk). The financial
analysis is the bottom line of the feasibility study and is the concentration of all that
goes before it.

4. CONCLUSIONS

In order to obtain finance for a mining project, it is necessary to provide
substantiated evidence that the project is technically and economically viable. Enough
data must be presented in a paper describing the project objectives in detail, which
assesses all technical and financial implications and indicates the magnitude of the
potential profit. This is the feasibility study; the main study investment decision is
based on.

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