6.0 Feasibility Studies

6.1 Introduction

A feasibility study is an evaluation of a proposed project to determine whether and how it can be mined economically. Detailed Feasibility Studies extend the evaluation to determine the maximum profit or most secure profit to be obtained and provide a blue print for implementation. Three types of feasibility studies are described in the following paragraphs; however, the remainder of this chapter is mainly devoted to the preparation, execution, and appraisal of the Detailed Feasibility Study. The financial evaluations incorporated into feasibility studies are pursued separately in Chapter 7 – Mineral Economics.

Order-of-Magnitude

Order-of-Magnitude Feasibility Studies constitute an initial financial appraisal and are often carried out by a single individual. To be effective, this study should include an elementary mine plan. Order-of-Magnitude Studies may evaluate whether to initiate or proceed further with an exploration project that has an indicated mineral resource. When an underground entry (shaft or ramp) is required to complete an exploration program, this type of study is employed to determine the benefit to (and possible interference with) subsequent permanent entries. Order-of-Magnitude Studies are accurate to ± 40-50% and are usually obtained by copying mine layouts and factoring known costs and capacities of similar projects completed elsewhere.

Preliminary Feasibility

Preliminary Feasibility or "Pre-feasibility" Studies are the second order and are useful in the following cases.

- Due diligence work
- Determining whether to proceed with a Detailed Feasibility Study
- A "reality check" on detailed estimates to pin point areas meriting further attention

Preliminary Studies are accurate to ± 25-30% and are typically obtained by factoring known unit costs and estimated gross dimensions or quantities once conceptual or preliminary engineering has been completed. Preliminary Studies are usually completed by a small group of multi-disciplined technical people.

Detailed Feasibility

Detailed Feasibility Studies are normally the highest order and most important because they are the litmus test for proceeding with a project. Typically, Detailed Studies are the basis for capital appropriation and provide the budget figures for the project. They may be completed with a financial accuracy of ±10% provided that a significant portion of the formal engineering is completed. In some cases, Detailed Studies are completed to an accuracy of ±15% with quantities derived from general arrangement drawings only. When the engineering is later sufficiently advanced, a second estimate is made to an accuracy of ±10% to provide confirmation and firm budget numbers.

6.2 Rules of Thumb

Cost

- The cost of a Detailed Feasibility Study will be in a range from ½% to 1½% of the total estimated project cost. *Source:* Frohling and Lewis
- The cost of a detailed or "bankable" feasibility study is typically in the range of 2% to 5% of the project, if the costs of additional (in-fill) drilling, assaying, metallurgical testing, geotechnical investigations, environmental scrutiny, etc. are added to the direct and indirect costs of the study itself. *Source:* R. S. Frew

Time

- The definitive feasibility study for a small, simple mining project may be completed in as little as 6-8 weeks. For a medium-sized venture it may take 3-4 months, and a large mining project will take 6-9 months. A world-scale mining project may require more than one year. *Source*: Bob Rappolt and Mike Gray

Accuracy

- ± 15% accuracy of capital costs in a Detailed Feasibility Study may be obtained with 15% of the formal engineering completed; ± 10% accuracy with 50% completed and ± 5% accuracy may be obtained only after formal engineering is complete. *Source:* Frohling, Lewis and others

Production Rate

- The production rate (scale of operations) proposed in a feasibility study should be approximately equal to that given by applying Taylor's Law. (Refer to Section 6.6)
- Annual production should be one-third of the tons per vertical foot times 365 days in a year for a steeply dipping orebody. *Source:* Ron Cook
- In the case of an orebody that is more or less vertical, the daily tonnage rate may approximate 15% of the tonnes indicated or developed per vertical meter of depth. *Source:* Northern Miner Press
- At many mines, the annual production is equal to 30 vertical meters of ore. Others vary between 25 and 40m. *Source:* Wayne Romer
- For a steeply dipping orebody, annual production should not exceed 30 to 40m of mine depth. *Source:* Robin Oram
- For a steeply dipping orebody, the production rate should not exceed 60m (vertical) for a small mine. At mines producing over two million tons per year, 30-35m per year represents observed practice. *Source:* McCarthy and Tatman

Development

- Preproduction development should be six months ahead of production. *Source:* METSInfo
- Six months of production ore should be accessible at all times to ensure stope scheduling and blending. *Source:* Kirk Rodgers

6.3 Tricks of the Trade

- Due diligent appraisal of a feasibility study should not neglect to consider whether the future of those individuals who sanctioned its approval is enhanced by a project go ahead, especially when excessive optimism is expressed. *Source:* Dennis Arrouet
- The pre-production capital cost should not include sunk costs already paid or committed, whether or not the project proceeds. *Source:* Roland Parks
- A conservative estimate for the capital cost can make heroes of the mine builders while one that is under-estimated can lead to unforeseen problems when ill advised short-cuts are taken to overcome a budget deficiency. *Source:* Jim Ashcroft
- The capital cost estimate of a Detailed Feasibility Study should normally consider all new plant and equipment sized and built to provide optimum extraction and recovery. In this manner, a benchmark reference is provided. Opportunities to provide particular items of used plant and equipment may be compared to the benchmark and included as a side study. When feasibility is dependent upon the incorporation of second hand components to meet a financial hurdle, certification should be provided that the components will still be available at the time of building. *Source:* Jack de la Vergne
- Capitalized interest during construction is often left out or underestimated in the capital cost estimate. It must be included as it may be a large number. *Source:* Ronald J. Vance
- The rate of return on investment predicted in a feasibility study may have been distorted by the application of accumulated debt to lower the rate of taxation. *Source:* L.D. Smith
- The cash flow (and hence the rate of return on investment) predicted in a feasibility study will be altered favorably if leasing instead of purchasing the equipment fleet is contemplated. (This procedure is an example of employing "hidden" leverage.) *Source:* Jack de la Vergne
- A mine in the arctic is required to store the concentrate during the long winter. This is a major detriment to the cash flow and the rate of return on investment, unless the concentrate is sold forward to the smelter before shipment. *Source:* Hank Giegerich
- A "straight-line" financial analysis in constant dollars (escalates neither revenue nor costs and all capital is depreciated on a straight-line basis for the life of the project with no salvage value or closure cost) is a reliable economic appraisal, particularly in times of high inflation. *Source:* George Beals
- A "bare bones" financial analysis (current dollars, no inflation, no interest on debt, and no tax reduction) provides a base case for project evaluation (and a means to better compare alternate investment opportunities). If a project shows itself well under these "bare bones" circumstances, it should show itself well under any real circumstance. *Source:* L.D. Smith