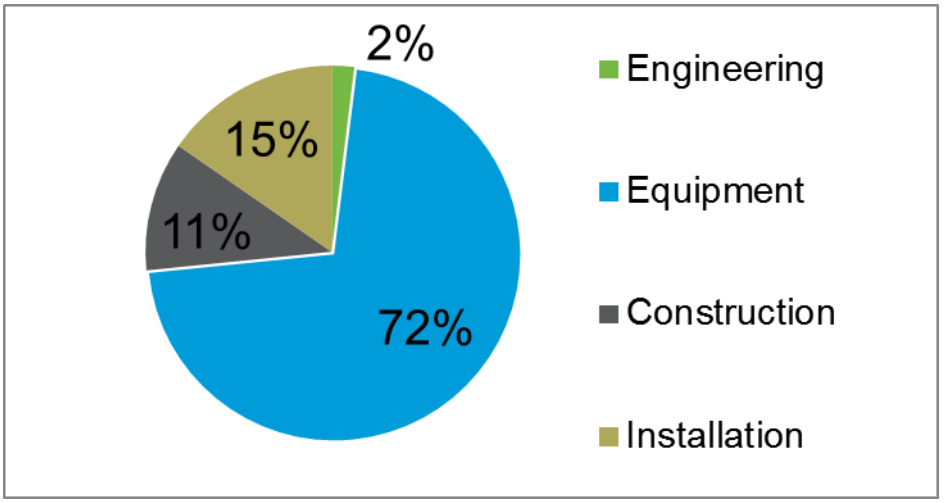

FEASIBILITY STUDIES – FOUNDATION OR FANTASY?

August 2016

Feasibility studies are a vital part of the sometimes tortuous path leading from a resource discovery to a profitable operation. Yet they come in all shapes and sizes - cheap or expensive, good or bad, well thought out or "off the cuff", valuable or valueless - and can be a firm project foundation or a fantasy. With this in mind let's take a look at some fundamental issues.

Feasibility studies are carried out at different stages of project development.

A common approach is to carry out feasibility studies at three levels of development. These come under various titles, but common designations are:

- Scoping Study - carried out early in the project life, with relatively limited information. It is frequently used to assess the potential of the project, and as a basis for deciding whether to invest time and money in further development.
- Pre-Feasibility Study (PFS) - undertaken at an intermediate level, when data on every aspect of the project has been generated. The data should be in sufficient depth to support realistic estimates of technical performance, capital cost, staffing requirements, operating cost, product value and marketability, project profitability, environmental and social impact, and project risks. It provides a basis for whether or not to commit to the large expenditure and effort involved in a subsequent Final Feasibility Study (FFS). The PFS often lays the foundation for project success or failure, and should perhaps be regarded as the key step in the whole development program, rather than the FFS. Unfortunately, it is not uncommon to see "cut price" pre-feasibility studies leading to costly disasters later on. The PFS is the time to fix the process flowsheet and conceptual plant design to provide a firm foundation for the FFS.
- Final (FFS), or Bankable (BFS) Feasibility Study– this is the final study prior to pressing the green (or indeed red) light for the project. It involves the finalization of every element of the project. It should be confirmatory in nature, based on the flowsheet fixed during the PFS. Whether there is any difference between a Final Feasibility Study and a Bankable Feasibility Study is a debatable point. However, one can say that a bankable study is generally subjected to a full independent audit, while a FFS may or may not if the project is to be funded in-house. Preparing for a full independent audit may affect the amount of detail presented in the study, and possibly the degree to which various risks have been addressed.

Each level of feasibility study should address all aspects of the project, identify potential risks, and include a risk analysis.

Any aspect of a project could represent a key advantage or possible fatal flaw, and needs to be identified as early as possible. A few non-technical examples include:

- The political situation could mean that a major economic incentive is available, or that the project is desirable for national strategic reasons. Conversely, there may be serious hurdles such as instability or adverse government policy.
- Environmental regulations under consideration could reduce the profitability, affect the selection of technology or location, or even rule out the project altogether.
- Social conditions could lead to the availability of skilled personnel, or perhaps favourable labour rates. On the other hand, there may be a potentially powerful community opposition to the project.
- Possible future trends in market conditions could affect the marketability and/or value of the product favourably or unfavourably.
- Climatic conditions could be favourable or unfavourable. For example, a dry mild climate could be highly beneficial for a heap leaching project, whereas a very wet or extremely cold climate may render such an operation unworkable.
- The location could make or break the project. The proximity of cheap power or a ready market could be decisive. On the other hand, the costs and logistics dictated by a remote location could render the project uneconomic.

All of these types of issues, as well as the more obvious technical factors such as the potential size, grade, and potential mining and processing characteristics of the resource, need to be subjected to a risk analysis to ensure nothing has been missed and to highlight issues for more detailed study.

The cost estimates for each level of study should be carried out at an appropriate level of detail.

Typical accuracies specified for the various study levels are:

- Scoping Study: Capex +/- 25-30%, Opex +/- 15%
- Pre-Feasibility Study: Capex +/- 20-25%, Opex +/- 10%
- Final Feasibility Study: Capex +/- 10-15%, Opex +/- 5%

The magnitude of the contingency is a more difficult figure to set. Typical figures are around 25%, 15%, and 10%, for the above three study levels. However, the use of a large contingency as well as a wide range of accuracy at the scoping stage could lead to the project being unnecessarily ruled out. An alternative approach is to study the potential economics over a range of capital and operating costs, in order to gain a feel for the effect of capital cost.

It is often possible to estimate potential operating costs with a greater degree of accuracy than capital costs. Again, it may be preferable to assess operating costs using sensitivities rather than applying accuracy limits and a fixed contingency.

If metallurgical testwork is needed, the appropriate level should be specified at each stage.

This is a very broad topic, as the type of testwork varies enormously. However, a few key points are:

- Testwork should always include appropriate mineralogical analyses.
- Samples should be very carefully selected to be as representative as the phase of drilling or exposure of the resource allows. The selection should be a team effort, involving the metallurgical, geological, and mining staff as appropriate.
- Testwork should be systematic, increasing in detail as the project develops.
- The PFS testwork should be in sufficient depth to develop project design criteria, performance predictions and product analyses.

- The FFS testwork should be confirmatory in nature, and should be carried out using samples representative of the final mine plan, with most emphasis on the first few years of operation. The need for, and type of, pilot scale testwork is a project by project decision. It will be affected by factors such as the size of the project, the availability of sufficient suitable sample material, process complexity and/or novelty, corporate policy, and the requirements of the finance providers.

Alan Taylor
Metallurgical Consultant/Managing Director
ALTA Metallurgical Services
www.altamet.com.au/MetBytes

MetBytes are metallurgical commentary and insights written by Alan Taylor who has 40+ years' experience in the metallurgical, mineral and chemical processing industries. He has worked in metallurgical consulting, project development, engineering/construction, plant operations, plant start-up and technology development. Projects and studies have involved copper, gold/silver, nickel/cobalt, uranium, base metals, phosphates and alumina.

The ALTA Free Library includes proceedings from the ALTA 1995-2014 Nickel-Cobalt-Copper, Uranium-REE and Gold-PM conferences for free download (1150+ papers). The library will be expanded regularly, providing a valuable ongoing resource to the industry. A selection of papers from recent conferences are also available.