RPMGLOBAL

PERSPECTIVES

#133 *November* 2016

FATAL FLAWS

IN PROCESSING DUE DILLIGENCES

Dr. Andrew Newell
Executive Processing Consultant

Introduction

A Due Diligence is typically required when funds are sought to develop a new project or expand an existing operation or when there is a proposed merger or acquisition.There are two types of Due Diligence, namely Legal/Financial and Technical, both equally as important and both need to be found satisfactory before an acquisition or merger would progress.This article discusses Processing Fatal Flaws found in Technical Due Diligences.

Historically, most Technical Due Diligences conducted by RPMGlobalGlobal have been for financial institutions. Today, there are more potential operators (i.e. mining companies) in the mix.

Importance of Processing

Processing is important because it is often the major component of upfront capital costs, as well as operating costs, and thus a critical path to revenue. Also projects can be 'sensitive' to processing recoveries and product type/quantities. For projects, it should be recognized that it is difficult and expensive to

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correct processing plant problems during the 'payback period' where there is no production or revenue and just on-going operating and capital costs, Consequently it is important to have the processing completely 'sorted' before construction commences.

Finally, processing has a major impact on infrastructure requirements such as power and water.

Technical Due Dilligence

A Technical Due Diligence assesses the reasonableness of the technical and economic aspects of a project in terms of practicality, viability and risks (RPMGlobal Perspectives No.111). It examines the methodologies, supporting data and underlying assumptions used for evaluating or managing a project based on supplied information, technical and operating data from similar projects ('benchmarking'), site visits and interviews with key project or operating personnel.

The main purpose of a Technical Due Diligence is to identify 'Show-Stoppers'- aspects of the project that make it impractical or unviable - and thus protect the investor from potentially losing money by investing in the project. The Technical Due Diligence sometimes uncovers faulty assumptions or unusual methodologies - 'Devils That You Don't Know' - that can seriously undermine the project. This does not necessarily mean that the investor would not become involved in the project, particularly when the underlying asset has significant potential (e.g. good ore body); it usually encourages a re-development of the project by the new investors/owners.

A successful and timely Technical Due Diligence relies on experienced personnel with a background in project development as well as operations and an overlap with other disciplines. For a metallurgist, besides being competent in the processing technology associated with that commodity as well as typical metallurgical responses and costs, a knowledge of the geology (the geo-metallurgical aspects such as ore types as applied in the resource model, etc.) and the mining (mine scheduling – dilution, blending, tonnage and feed grade variations) is essential to deliver an accurate and timely assessment. Metallurgists are often involved in assessing site infrastructure and logistics, however power stations, tailings storage facilities and rail remain the domain of infrastructure specialists. In addition, a metallurgist often reviews the marketing arrangements and the nature of the smelter/buyer contracts.

Two types of assets are the target of a Technical Due Diligence. Most assets that are investigated in Technical Due Diligences are projects supported by a Feasibility Study. Consequently, the main Technical Due Diligence activities are based around examining the reasonableness of the study, approach/methodologies, supporting data and assumptions and thus the likelihood of the project being technically and economically feasible. In addition, attention is paid to the nature of the project's potential/upside as well as whether risks and potential mitigations have been adequately considered. The quality of a Feasibility Study has thus a significant bearing on the outcome of a Technical Due Diligence.

A Feasibility Study has typically progressed through the Scoping Study and Pre-feasibility Study stages. When a study stage has been bypassed, it is often quickly revealed in a Technical Due Diligence; there is a general lack of methodology in the study approach, only a focus on selected areas, various options remain open and unresolved, marketing studies may not be as advanced as they should be, insufficient test work to support the study level may be captured in a document that is incomplete, contains gaps and is difficult to follow.

The other asset types considered in a Technical Due Diligence are an existing operation or operations, often becoming available for either merger or acquisition at either the top or the bottom of the mining cycle. These types of Technical Due Diligences are in some ways easier to conduct, since the asset has passed the Feasibility Study stage and a body of industrial data and actual costs is available for review.

When Technical Due Diligences are conducted on non-Western Feasibility Studies, projects need to be evaluated within the context of the local commercial, technical and political environment and not necessarily compared with the standard Western approach which addresses the risks raised by Western investors and developers.

It goes without saying that studies should be conducted by competent and experienced personnel with a proven track record, either within the company or outside (e.g. consulting companies or EPCMs [Engineering Procurement Construction Management]).

Processing Flaws

The most commonly encountered processing flaws are related to the flowsheet. The flowsheet attracts much attention because it is the basis for the processing plant design through the mass and water balance, design criteria, equipment sizing and selection as well as the determination of consumable and labour requirements and finally operating and capital costs.

A flowsheet is based on testwork samples, mineralogy and the testwork program. If any of these aspects are poorly executed, then the flowsheet may be fatally compromised and, as a consequence, the process design and associated costs. Some typical issues include:

Testwork sample issues:

- Representativity of samples or blends for separation testwork including dewatering (if 'dry stacking' of tailings is being considered)
- Testwork sample locations : bench scale, locked cycle and pilot plant testwork
- Limited range of samples used to conduct comminution testing

Limited mineralogical studies:

- Particularly for more complex ore and ore types
- Intermediate products and tailings

Limited comminution testwork:

- Insufficient number appropriate of samples tested
- Limited range of comminution variables tested
- Poor understanding of liberation requirements
- No pre-concentration testwork (potential not identified)
- Limited amount of materials handling studies
- Ore recovery from bins and stockpiles (e.g. TUNRA)
- Limited amount of separation testwork
- Insufficient amount of testwork to convincingly support flowsheet interpretation and metallurgical response
- Bench scale flotation testwork – no Locked Cycle Testwork (LCT) - not conducted with 'site' water
- No reproducibility studies, particularly when results are variables – testwork and thus flowsheet decisions being made on one result
- No establishment of feed grade-recovery relationships (important for production schedule and financial evaluation)
- Poor understanding of metallurgical losses
- Limited amount of dewatering test work
- Insufficient body of data to convincingly select dewatering flowsheet and size and select equipmentwhere concentrates are

Flowsheet:

- Not finalised
- Unresolved technical issues
- Insufficient testwork support flowsheet selection
- Not suitable for all ore types/blends that would be presented to the plant
- Insufficient flexibility
- 'Novel' flowsheets not been proven on a demonstration scale (cf. pilot plant and bench scale tests)

Other areas that require review include:

Metallurgical recoveries:

- Limited understanding of sample or testwork error (reproducibility)
- No establishment of feed grade-recovery relationships
- No allowance for scale-up.

Plant design:

- Design criteria that do not allow for the full range of processing requirements over the Life of Mine (LOM)(may require a later expansion)
- Equipment selection and sizing
- Unsatisfactory and not well supported
- Limited or lack of modelling particularly for milling circuits e.g. transfer sizing (SAB/Ball mill circuits)

Operating Costs:

- Consumable estimates not based on first principles (e.g. testwork or simulation results – however not always an issue - benchmarking may be acceptable
- No current consumable unit cost quotations including power
- Proposed levels of costing accuracy not achieved
- No personnel list (employees and on-site contractors).

Conclusion

Technical Due Diligences are often challenging experiences designed to reveal flaws, sometimes fatal. 'Forearmed is forewarned' and identifying fatal flaws or 'Show Stoppers' provides the investor or potential owner with the opportunity to either walk away from the project or become more deeply involved by applying a new approach to the project development or operation.

The primary source of fatal flaws in processing is most often associated with the development and interpretation of the flowsheet, which is in turn based on the nature of samples and the adequacy of the testwork program.

Process design including equipment selection and sizing as well as the development of capital and operating costs represent two other areas where fatal flaws often occur. These fatal flaws or 'Show Stoppers' arise from:

- insufficient or non-availability of supporting data
- optimistic, incorrect or poorly based interpretations of data
- poor costing methodologies
- proposed levels of study accuracy not being achieved

In the case of existing operations, fatal flaws may arise through current or potential bottlenecks, the quality of operational staff, the condition of the plant and the ability of the plant to handle future ore types.

