THE ROLE OF OPEN PIT OPTIMIZATION IN PROJECT FINANCING

Andrew Little[1]

INTRODUCTION

One of the most important aspects of project financing, from a lenders' point of view, is the technical due diligence. This due diligence, or audit, is generally carried out on the feasibility study which has been prepared either in-house by the project sponsors or by consultants on their behalf. It is usually performed by the Lender's specialist mining staff or by technical consultants appointed by the Lender. The due diligence will generally cover all aspects of the project and in particular investigate areas which are considered critical to the success of the project and the ability of the project cash flow to repay the loan.

BankWest Project Financing Department have a Mining Engineer and a Geologist on staff who provide technical advice to the Bank. Their role entails carrying out the due diligence on resource projects which have been presented for funding as well as monitoring of existing mines with which the Bank has gold or other commodity hedging facilities. This latter role is equally as important as the project due diligence as any increase in the hedging facility relies on a re-evaluation of ore reserves.

To assist Technical staff in carrying out the due diligence, BankWest have a Sun Sparc 10 workstation on which Datamine and Whittle Four-D pit optimization are operated. Direct access to this software enables BankWest to carry out a more detailed audit of feasibility study data, when required.

RISK ANALYSIS

One of the important aspects of a due diligence is the estimation of project risk.

Hence the more detail provided in a feasibility study, the quicker the Bank can come to grips with the project and in most instances the more comfortable they can become with it. The more comfortable a Bank becomes with the project the lower they will perceive the project risk as being.

Risk is associated with fees and lending margins, and generally the lower the perceived risk of a project, the lower the fees and margins.

Most Project Finance lending in Australia is limited recourse finance, where the Lenders have access (which may be restricted) to the project Sponsors and/or third party guarantors for loan repayment

1. ANDREW LITTLE
Qualifications: Associate Diploma in Mining Engineering, RMIT, Australia. Graduate Diploma, Management Studies, Edith Cowan University.
Membership: AusIMM.
Experience: Pioneer Concrete; Utah Development Co; Capricorn Coal Management Pty Ltd; Alcoa; Minproc Engineers Pty Ltd (Australia).
Currently: Senior Manager Project Evaluation, Bank of Western Australia Pty Ltd, Australia.

and collateral support before completion of the project. This is the period during development up to when the project becomes fully operational.

Once completion has been achieved and verified by the Lenders' technical advisers, the Lenders only have recourse to the project cash flow and assets. However project Sponsors, in most instances, will remain liable for breaches of representations, warranties and undertakings relating to the project which remain in place for the term of the finance.

The requirements of the completion test are formalised in the loan facility agreement and this basically confirms that parameters, both operating and financial, set out in the feasibility study or project development plan, have been met. Banks then have to rely solely on the project for loan repayment. Thus risk analysis is an extremely important aspect of the due diligence.

One of the most important risks is reserve risk. Banks generally require a specified ore reserve "tail", which means that at the proposed completion of loan repayment there is a set percentage of reserve left. This is essentially a safety buffer should reserve estimation prove to be significantly incorrect. However despite this form of "insurance", projects have, in the past, failed through the reserve estimate not being realised in actual production.

A detailed pit optimization is viewed by most financiers as being an essential component of a feasibility study as it assists in assessing the projects' reserve risk. In particular, a detailed pit optimization study which includes sensitivity analysis is a vital element in this assessment.

ORE RESERVES

The examination of ore reserve determination is one of the most important areas in any due diligence. The four stages normally associated with ore reserve estimation examined are:

- resource block model construction
- mining dilution incorporation
- pit optimization
- pit design and tabulation of ore reserve estimates.

The ore reserve estimate is dependent on the reliability of the data base including:

- data density and location
- drilling, sampling and assaying technique
- sample recovery
- bulk density determination
- accuracy of topography, particularly in undulating areas.
- other logged details specifically relating to other geological, mining and metallurgical factors.

The other vital area of resource estimation lies in mineralisation interpretation which, whilst relying on drill hole density and spatiality, also relies considerably on the geologist carrying out the interpretation.

Mineralisation interpretation should be conservative by nature to ensure that an achievable resource estimate is produced.

Other important factors in resource estimation include:

- statistical analysis of data in determining top cuts etc
- estimation method (ID, kriging, etc.)

Once the resource block model has been constructed, there remains the next step of incorporating mining dilution into the model to produce a "mineable" resource model. The method by which dilution is incorporated varies considerably, however, the industry standard method of constructing a "skin" around the mineralisation interpretation is used in many instances.

The reason that the building of the "mineable" resource model has been deliberated on, is that this data is the prime data on which pit optimization is based. If this stage is flawed, then any subsequent pit optimization will be a waste of time. The Four-D process and hence results are specifically reliant on the integrity of the block model.

At BankWest we have reviewed a few projects where the construction of the reserve model involved a considerable amount of optimism and to which we could not become comfortable. Hence any pit optimization results derived from this model could not, in our view, be relied upon. It is fair to say that most Banks would prefer to see a reserve model, which is to be ultimately used for pit optimization and reserve estimation, to have a degree of conservation built into it.

COST AND OTHER INPUT PARAMETERS

Generally, during the feasibility study, pit optimization is completed very early in the study period, and often well before final operating costs are established. Thus in most instances, preliminary costs are used, such as budget contract mining costs, and first pass processing costs, etc.

Whilst it is acceptable to use these costs, in very few cases is the pit optimization rerun, after the final feasibility costs have been determined, as a final confirmation of the original costs and parameters. In many cases, mining contract tenders have been received prior to project finance negotiation, as well as processing costs and metallurgical recoveries having been firmed up. If there is any significant variance between the costs used in the pit optimization and those used in the final financial model, then the pit optimization should be rerun.

The other important input parameter to the pit optimization process is the overall wall slope. The general practice is to allow for haul roads and safety berms in this overall angle. Whilst it is relatively simple to allow for safety berms, it is more difficult to correctly predict the final design location of ramps, particularly if there are any 'flats' to be incorporated in this design. The final design should, in most cases, have similar ore and waste quantities to that of the optimal pit shell being used as the basis for design. If this is not the case, then a rerun is necessary, with modified slopes, which better allow for haulroads and berms.

From a Banking perspective, it is important to rerun FDOP if any of the overall slopes have changed in any of the segments as a result of design, particularly if the deposit is in any way sensitive to wall slopes.

Pit optimization should be viewed as an iterative process with the impact of updated metallurgical recoveries, costs, and other parameters being determined by additional runs.

SENSITIVITY ANALYSIS

Most feasibility studies comment only on the sensitivity analysis carried out on the financial model. Very few studies include pit optimization sensitivity analysis. Whilst the financial model analysis can provide a very good indication as the robustness or otherwise of the project, it cannot provide the impact of cost or other parameter variations (particularly downside) on the reserve. This can only be done by carrying out additional pit optimization sensitivity runs. Banks, in carrying out their due diligence, would prefer to see sensitivity results tabled in the study document and include:

- commodity price
- operating cost
- pit slope
- grade reduction

RESULTS PRESENTATION

Many feasibility studies fail to present the results of pit optimization studies satisfactorily, with only brief details on what is a very important step in reserve estimation.

In order for those carrying out a due diligence to quickly understand the pit optimization study, all information relevant to the study should be presented in the feasibility study document either in the mining sector or if room doesn't permit as an appendix. All costs (including their derivation) the various costs ratios and other parameters should be clearly presented in table format including:

- block size
- COSTM values by vertical interval
- COSTP values by vertical interval
- gold price used in FDAN
- throughput limits for mining, processing and product, together with period lengths, if variable.
- discount used.
- etc.

The results should also be presented in a table with the pushback pit(s) (if any) and the optimum pit highlighted. This should also be displayed in a graphical form for clarity.

A print out of the parameters file could also be included for additional information. The more details presented, the easier it is for those carrying out the due diligence to come up to speed.

It is important that all stages of the optimization study be well documented to provide a detailed audit trail. This will enable every aspect of the study to be reviewed in the future, if necessary.

DETERMINATION OF OPTIMUM PIT

Whilst it is easy to determine the optimum pit using the highest NPV as the criteria, many projects particularly those with small resources, are tending to use reserve life as the criteria for the "optimum" pit.

If this "sub optimal" pit contains significantly more ore for a marginal decrease in NPV, then it could be considered preferable to base the pit design on this pit. This has the effect of increasing project life which is beneficial, particularly when more time is required to prove up additional reserves in the area.

Some Four-D users are now evaluating the FDAN results on an incremental commodity unit cost basis, particularly for non-precious metal projects, where the project life is between ten and twenty years. They have found that the effect of discounting after ten years produces a smaller pit.

Whatever criteria the "optimum" pit is based on, the reasons for the choice should be fully explained.

CONCLUSION

Pit optimization has provided the mining industry and the Banks with a very valuable tool that, if used correctly, provides additional confidence in reserve estimates.

Having said that, the results from this software are only as good as the input parameters, in particular the "mineable" resource model. The old adage of "garbage in - garbage out" is particularly applicable to this situation.

Pit optimization should not be treated as "black box" software where a series of numbers are "fed in" and the answer "pops" out. All data used in the optimization run needs to be thoroughly vetted, and similarly all results should be examined closely to ensure that they make sense. Unfortunately, in most instances those carrying out the feasibility study are usually under very tight time constraints which generally precludes these detailed checks being applied.

Pit optimization assists the Banking industry in evaluating the potential reserve risk, which in our view is one of the greatest risks in Project Financing. It must be remembered that most Banks are not equity risk takers. They get no return for taking equity risk and therefore are looking to project cash flows, sponsors and guarantors, to be repaid. If the reserve, on which the financing has been based, fails to be realised, then there is a good chance that the project will also fail.

It is in the project sponsor's interest to present as much detail as possible on pit optimization in the feasibility study document in order for Financiers to become more comfortable with the reserve

estimation. This in turn will reduce the time required for the due diligence process and may also assist in reducing fees and margins offered on project finance.

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