

Effective open pit mine planning and planning software

Over the past 10 years at Ukwazi we have seen and adapted to significant changes in mine planning software and mine planning service providers. Mine design and scheduling software applications has progressed with leaps and bounds since my first open pit mine planning assignment some 15 years ago. I remember having to manually modify parameters in text files and saving it to a specified directory structure before initialising the next run. Today, it still remains essential that you cannot separate the mine planning process from a thorough understanding of the practical mining cycle and how mine planning software really works. Mining software applications certainly looks very different today with most improvements over the last decade focussed on usability. It is only recently, based on the vast increase in competition among software providers, that the focus returned to functionality.

A great benefit of the ease of use of the colourful new generation general mine planning software, is that it made mine planning much more accessible to large and small scale mines. This is not only great for the transparent management and planning of operations and projects, but has greatly enhanced the visibility of mining engineering and mine planning as a skill set and is recognition of the critical role they could play. Great care should therefore be taken to ensure that the mine plan is achievable and based on valid mine planning principles. Effective and realistic mine plans are always crucial to the success of any mining operation.

A range of technical pitfalls and neglected mine planning principles were inevitably introduced as a result of the focus on apparent ease of use. Some of the available mine planning software solutions consider practicality better than others. In our experience there are some principles that are frequently understated in the mine plans that we come across and review. In some cases, these pitfalls could materially restrict the value of the mine plan.

- The three planning horizons for the short term, medium term and long term planning with objectives for each are usually not well defined specifically on some medium sized operations that tend to focus on medium term planning with a lack of focus on the short term and long term. Each of these plans should be set up with the end user and the objective of the plan in mind. Typically a general view could be that the short term is focussed on the production team, the management team for the medium term and budget plans and the investor and owner for the long term plan. Trying to satisfy all requirements in a single plan usually overcomplicates the strategic plan and oversimplifies the short term plan, rendering the first as inflexible and the last as irrelevant.
- End user buy-in is probably one of the most neglected but most critical aspects that could ultimately render any mine plan obsolete. It should be understood that a mine plan, that the end user does not understand or believe in, will not be implemented or used for its intended purpose.
- The application of the three modelling unit sizes for the geological model, SMU based mining model and lastly scheduling units, drives the level of selectivity and scheduling approach.
- The ultimate pit selection (size and shape of the final pit) should always consider the investment strategy of the owner combined with the understanding that the economics (such as the commodity price) might change in future. Planning a mine is to recommend investment decisions and alternatives to a specific audience. A single pit selection based on traditional measurements such as NPV or IRR alone is not always appropriate. An in-depth understanding of the investment criteria and strategic objectives is required. At Ukwazi, we investigate a range of at least four ultimate pit selection strategies with additional methodologies identified in collaboration with the client if required. The impact of each selection strategy should be clearly understood.
- A clear and concise basis of estimate is essential to allow the reader to easily understand the purpose and use of the plan and what the material parameters and modifying factors are on

which it is based. The degree of accuracy and how it slots into the mine planning cycle in terms of short term, medium term, budget and strategic life of mine scheduling, must be disclosed to allow for the appropriate interpretation of results.

- A clear understanding of how the blending algorithm and blending periods affect the in-pit mining sequence is critical as it affects the practical ability to execute the schedule. Some service providers handle this better than others. A practical mining sequence that facilitates blending should be the focus rather than relying on mathematical, non-transparent blending algorithms to dictate the mining sequence.
- A practical mining sequence should be enforced based on the physical conditions, pushback or cutback designs, available face length, equipment allocations, maximum mining width and vertical rate of advance and aspects such as temporary and permanent access.
- The production rate definition is a critical input to the mine plan and defines what can be expected from the pit. This should be based on the selected equipment and practical equipment fleet operational requirements and performance. Great care should be taken if global production rates are applied. Although the global rate might be achievable in principle, various practical constraints should be applied to plan production at achievable mining rates from appropriate areas. Pit space, available face length, level of selectivity, excavator size and minimum space provided for the complete mining cycle, loading configuration, access, haul routes and fleet size should all be considered. Newly introduced simulation products can add value as part of the process to define the production rate potential and constraints. A well-defined loader based schedule is generally preferred over a global production target based schedule.
- Destination scheduling with ore and waste definitions to include low and high grade stockpiles, finger stockpiles and direct crusher feed, can have a material effect on the products delivered and associated costs. Waste scheduling to defined permanent or temporary waste dumps and backfill or rollover scheduling does not only have a material effect on the operational cost profile but also on the environmental compliance, environmental exposure and rehabilitation costs.
- Compliance to the relevant reporting codes and the use of the word 'Reserve' is not always appropriate as implied by some software applications. The conversion of Measured, Indicated and Inferred Mineral Resources to the appropriate Mineral or Ore Reserve class should be based on solid technical principles, the level of accuracy and intended use of the plan.
- The use of a single software suite over the complete mine planning cycle and planning horizon is not necessarily the most efficient approach. It is more important to ensure that the appropriate mine planning principles are applied and that the plans fulfil the site specific requirements of the end user.

We believe that the best way to produce useful and appropriate mine plans is to use specialist mine planning teams led by competent persons with proven experience as a team for the specific mining method and commodity and has appropriate experience on the technical approach of the applied software solutions. Ukwazi has five specialist teams focussing on open pit mining, underground massive mining, underground narrow tabular mining, coal open cast and underground mining and mine planning maintenance over the three major planning horizons. Focus is everything.