

# Devising the best plan

Bill Wilkinson of Ventyx examines how mines can improve speed and accuracy to achieve operational excellence

**A** building is only as strong as its foundations; this is true for mining as well. As the foundation of all mining activity, a plan that most accurately reflects the real-time state of the geological structure in the ground, along with the process capabilities of the mine and the economic variability of demand as well as commodity markets, results in a more productive, predictable and profitable operation.

To maximise profitability, planners and schedulers are under constant pressure to create mine plans that are as accurate as possible and optimise production at all stages, from mine to market.

Wasted time, due to surprises in the changing geological structure or lack of the right equipment required to meet production, are both costly and unacceptable.

To ensure accuracy, planners and schedulers must account for a staggering array of variables, including:

- Geological samples and data from the mine;
- Production capacity of each stage of the process;
- Available equipment, machinery and manpower;
- Sales demand and commodity prices;
- Production cost assumptions; and
- Health and safety of workers.

Traditionally, the time and resources required to continually collect this data, model and remodel scenarios, build and adjust mine plans, and work out the effects on scheduling has meant that no one could keep pace with the reality of what is happening in the ground.

Even the best mine plans were still full of inaccuracies and best guesses that were based on past experience rather than quantifiable data. This resulting gap between the actual plan and reality is where costly surprises creep in to have a negative affect on production schedules, output and, ultimately, profitability.

The goal of mine planning and scheduling is to: fully understand the planning process; account for all significant variables as accurately as possible; decrease the time between geological sampling and mine plan remodelling; minimise production costs; optimise output to take into account demand and commodity prices; and free mine engineers to focus on more strategic objectives such as continual improvement and operational excellence.

## UNDERSTAND MINE PLANNING

It may seem obvious, but to implement best practices you first need to understand the mine-planning process. Each mine is different, but, in general, plan production follows a fairly linear workflow:

- Gather drill hole and mine survey information to measure the geological structure. Sample the chemical analysis of the deposit.
- Create a geological model of the structure and chemistry from the data. Define the resource based on mining constraints.
- Design 3D mining blocks that reflect the ground control plan and are the right size to provide sufficient resolution for mine scheduling.
- Estimate the resource quantity and quality contained in the mining blocks, and use the data to produce a planned production schedule, based on mining constraints.

Optimising the plan typically requires completing multiple scenarios. Having an efficient, integrated and streamlined process will reduce the amount of time required to complete a mine-planning scenario. Additionally, the process should be repeated as new geological information becomes available to ensure any mine plan assumptions reasonably reflect actual field conditions. Inaccurate geological models will introduce errors into the downstream mining plans, which can result in surprise cost increases and revenue reductions. ▶

**“To implement best practices you first need to understand the mine-planning process”**



### ► IDENTIFY BOTTLENECKS

All stages of the mine-planning process, and technologies used to plan and schedule should be analysed, paying close attention to where potential bottlenecks can form. Quick wins may be realised by focusing on the process first. A good place to start is looking upstream to areas in the process that are constrained by input.

For example, short-term engineers can experience long wait times while interrogating the most current geological model. Geological models are usually very large and an interrogation process that evaluates the entire model, rather than the small short-term plan area, can be very inefficient. Through a simple process change, engineers can interrogate smaller portions of the larger model and prioritise the analysis, speeding up the time to production.

Bottlenecks are common when data must be shared between two processes that use different, stand-alone applications. Transferring data in and out of these disparate applications adds complexity to the process. For example, some mine managers export mining blocks to Microsoft Excel to perform mine scheduling. Once that is complete, they manually create plan progress maps in their CAD system.

Through the use of an integrated system, the construction of a graphical plan progress map could be automated, eliminating many hours of manual CAD work.

Of course, there are always instances where data needs to be transferred to other systems, but selecting a system with modern, plug-in architecture and open data will streamline the process.

Some bottlenecks may require a change in technology. Many miners are continually bumping up against constraints in some mine-planning solutions.

Some mines may maintain two geological models primarily because of a constraint on model size, set by the planning application. They create a short-term model at a higher grid resolution to meet the accuracy requirements for short-term planning, and then create and maintain another lower-resolution model for longer range plans.

Maintaining two identical models adds significant time and complexity to the modelling and interrogation process. Implementing a solution that would allow the creation of a geological model of sufficient resolution for the short-term model, but applied to the long-term area, would greatly streamline the process and reduce the time to model.



### IMPROVE ACCURACY

Streamlining the process cannot come at the expense of accuracy as that remains the primary goal of all of the planning, scheduling and production process.

To highlight this importance, take this example: underestimating coal thickness by 15.2cm over an area as small as 4.45ha will result in a planned production shortfall of one unit train. If coal is selling at US\$50/short ton, this would result in US\$500,000 of revenue that the mine will never realise. Accuracy has implications across the entire production stream. Improving the accuracy of geological modelling increases the confidence in the mine plans to meet quality and quantity specifications on upcoming shipments.

“Accuracy has implications across the entire production stream”

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Accurate mine plans enable engineers to accurately predict when a significant multi-million-dollar capital investment in new equipment would be required due to upcoming increased overburden and sales volumes. Getting this wrong can be catastrophic. If equipment is undersized, the company will have invested millions of dollars on equipment that cannot meet sales targets and perhaps lose millions more in penalties for not meeting customer demand in contracts.

Options to make up lost production could force the company to buy on the commodities market, and perhaps sell at a loss and/or purchase and commission additional unplanned equipment. Both solutions will at best reduce profits and may make the operation unprofitable.

Improving accuracy in mine planning requires continuous improvement to the geological model, the foundation of the mine plan. Incorporating new mine data into the geological model will help decrease the variance between planning and actual production. What is planned will more closely reflect what is actually being produced. Excellence at this stage is critical to the viability of the mine, particularly in difficult economic times.

### DATA FROM FIELD TO PLAN

Planners may receive new geological models after a planned drilling season. Drill hole information is accumulated throughout the drilling season, and as the mine advances more data is gathered either through production drilling just ahead of operations or survey data collected by GPS systems.

Planners cannot use new data if it is not reflected in the geological model. If the modelling process is complex and labour-intensive, geologists may only update the geological model at the end of exploration drilling. Decreasing the time between the collection of the most current geological sample data and its reflection in the mine plan improves accuracy and ensures plans have the least amount of variance from reality.

Reducing the time between field sampling and model development allows multiple models to be created on the fly as new drill hole and quality data is received.

Geologists can quickly analyse the effect of the additional drilling on the model and continually keep the geological model updated for mine planning. Accuracy is increased through a higher resolution model, which reflects measured data more closely.

Because geologists have more accurate models in less time, they can spend more time optimising the exploration drilling plan. Through this exercise companies can reduce the number of planned exploration holes for the next drilling season.

Increasing the accuracy and resolution of geological modelling can also eliminate the cost of drilling pilot holes in areas where infill drilling is performed to get supplemental coal-quality data.

Savings in drilling costs alone have been shown to more than offset the expense of mine-planning software. With savings of about US\$1,650 per hole, that can add up to a significant reduction in drilling costs.

### CREATE & ANALYSE SCENARIOS

Optimising the mine plan can require completing multiple plan layouts and schedules, examining the results and choosing the most cost-effective scenario. Having an efficient, integrated and streamlined process will reduce the amount of time required to complete multiple mine-planning scenarios.

This process should be repeated as new geological information becomes available to ensure mining plan assumptions still reasonably reflect actual field conditions. The reduction in time to develop the plans results in better decision making through the ability to compare multiple scenarios simultaneously.

### COMBINE SHORT & LONG RANGE

A major improvement in geological modelling process flow can be made by combining short- and long-range model areas into one, with a standard grid cell size. Eliminating the need to build more than one geological model and increasing automation can reduce its building time by 50-75%.

### INTEGRATE SOLUTIONS

If an organisation is running multiple software solutions for mine planning and scheduling, best practice would be to implement a single, integrated solution, built with efficiency in mind. Integration will enable process improvements and shorten geological modelling and mine-planning turnaround times, thus providing the ability to develop more accurate plans.

Using an integrated mine-planning and geological-modelling system will also improve process flow. Rather than exporting block resource estimates to another scheduling package or Excel, scheduling can be completed in a single mine-planning system. Plan progress map generation can be automated when a scheduling system is integrated with the CAD system. By implementing this change, the time to complete long-range mine plans can be reduced by 40-60%.

### ADDRESS COMPLEX GEOLOGY

Often, the inability to model geologically complex areas can result in reduced equipment productivity, lost resources and reduced mine life. Make sure your modelling and planning technology can handle geologically complex areas. This should include the ability to define interval relationships, pinching and washout controls, and the incorporation of field-survey information. Models should be able to handle complex interval splitting and faulting, while honouring drill-hole information.

### FOCUS ON EXCELLENCE

Improvements in the process flow result in direct and indirect benefits for the operation. Faster geological modelling and mine planning provide significant direct benefits in the form of cost savings and increased productivity. Also to be considered is the time freed up for skilled engineering staff to focus on important, organisation-wide initiatives.

With greater efficiency achieved through process improvements, mining companies can reap significant benefits by focusing freed resources on continuous improvement and operational excellence. Freeing up engineering resources from this cumbersome process can result in exponential payback as they re-energise their focus on other areas throughout the mine.

### CONCLUSION

By deploying best-practice planning, scheduling and process improvements, mines can achieve direct and indirect cost savings, and become more productive, predictable and profitable.

Each mine is different, but key to deploying best practices is the use of a modern, integrated mine-planning and scheduling solution that can keep pace with incoming mine data, ensure accuracy, accelerate mine modelling and plan output, facilitate information sharing, enable the mining of complex geographic areas, and free up human resources to focus on continual improvement and operational excellence. ▼

**“Accurate mine plans enable engineers to predict when a significant capital investment in new equipment would be required”**

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