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Building an efficient mine planning process

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Benefits of building
an efficient mine planning process

by W.A. Wilkinson

The use of plow systems fell out of favor in the U.S. in the 1970s, but recent advancements have made the technology safer and more efficent. ©iStockphoto.com/pamspix.

Mine planners are under pressure to evaluate the impact of changing economic times and newly acquired data on their mine plans. Incorporating changes such as commodity prices, customer sales, fluctuating cost assumptions and newly acquired geologic data requires quick turnaround for model building and planning to keep mine plans on pace with changes as they occur. Because of the length of time required to perform some of the geologic modeling and mine planning tasks, planning frequency may not be keeping pace with the frequency of change.

To meet these challenges, one leading North American mining company successfully increased the frequency rate and accuracy of its mine plans to stay current with incoming data, ensuring its mine plans reflect the latest information, thereby minimizing or eliminating production cost variance.

This case study features a truck and shovel surface coal mine in the western United States that produces approximately 23 Mt/a (25 million stpy) of coal. The mine employs two geologists and seven mining engineers to gather new data, build geologic models and produce short-, medium- and long-range mine plans. The mine was acquired by another company, which had implemented Mincom MineScape software to replace its existing mine planning systems. The majority of the company's existing engineering staff was retained and trained in the use of Mincom MineScape software.

The mine planning process

The production of mining plans follows a fairly linear workflow. Drillhole and mine survey information is gathered to measure the structure and sample the chemical analysis of the deposit. The collected data is then used to create a geologic model of the structure and chemistry and define the resource based on mining constraints.

Mine planning uses geologic modeling information to design three-dimensional mining blocks that reflect the ground control plan and are sized to provide sufficient resolution for mine scheduling. The resource quantity and quality contained in the mining blocks are estimated, and then the data is used to produce a planned production schedule based on mining constraints.

Optimizing the plan typically requires completing multiple plan 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 geologic information becomes available to ensure mining plan assumptions will reasonably reflect actual field conditions. Inaccurate geologic models will introduce error into the downstream mining plans, which can result in surprise cost increases and revenue reductions to the operation.

Opportunity for improvement

At this particular North American coal mine, the mine planning process was reviewed after the mine was purchased. Planners obtained new geologic data during a planned drilling season. Drillhole information was accumulated, but planners would only update the geologic model at the end of exploration drilling. Therefore, continuous updates were not performed due to the time required to generate the geologic model.

The geologic model consisted of two areas. One included the

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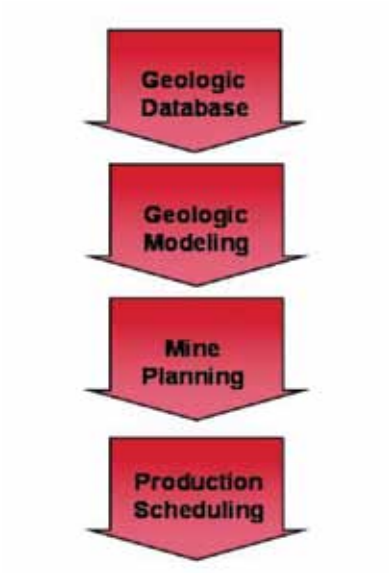

Mine planning workflow.

site planned for the next two years of mining. The other covered the remaining mine area. The model covering the next two years of mining was built on a 30.5-m (100-ft) grid cell size, while the longer-term area was built on a 122-m (400-ft) grid cell size.

The amount of time required to update these two models was approximately 18 hours. The time required to complete the workflow limited the availability of new data to the mine planning system, so engineers were not working with the latest information.

Mine plans were completed with multiple software systems. Mine layout and design was performed in one system, while mine scheduling was performed using Microsoft Excel. Long-range mine plans on average took five weeks to complete. The majority of time was spent generating economic pitshells, which were then estimated for volume and quality. Resource estimates from the pit shells were then exported to Excel for scheduling. Plan-progress maps were constructed manually in CAD by color-coding the scheduled blocks in Excel by planned periods.

Optimizing the mine planning process

Drawing from experience gained at its other mines, the company began improving processes to reduce geologic modeling and mine planning turnaround times, thus providing an opportunity to develop more accurate and optimized mine plans. A significant part of the plan to improve the process was replacing the multiple existing mine planning systems with a single, integrated mine planning system — the Mincom MineScape geologic modeling and mine planning system.

A major improvement in geologic modeling process flow was made by combining both short- and long-range model areas into one model with a 30.5-m (100-ft) grid cell size, eliminating the need to build more than one geologic model. Eliminating the necessity of building a second model, and the increased automation provided by the Mincom MineScape geologic modeling system process, reduced model building time by 75 percent.

Using a single, integrated mine planning and geologic modeling solution also improved the process flow. Rather than exporting block-resource estimates to Excel, scheduling was completed in one mine planning system. Plan progress map generation was automated as the scheduling system was integrated with the CAD system. By implementing this change, the time to complete long-range mine plans was reduced by 60 percent.

Better mine planning yields tangible results

Improvements in the process flow resulted in direct and indirect benefits to the operation. Faster geologic modeling and mine planning provided significant benefits and cost savings to the operation, and not through the reduction of engineering staff. Liberating technical staff from tasks to facilitate the process enabled them to spend more time investigating better design solutions, which increased minable reserves and reduced operation costs.

Improved geologic model and mine design accuracy

The significant time reduction in developing geologic models allowed multiple models to be created on the fly as new drillhole and quality data was received. Geologists were able to analyze the effect of the additional drilling on the model and continually keep the geologic model updated for mine planning. Accuracy was increased through a higher resolution model, which reflected measured data more closely. The model-publishing capabilities of the Mincom software enabled new model updates to be distributed to the mining engineers quickly and easily, so they were always designing with the latest information.

Incorporating the latest information into the geologic model improved the accuracy of the mining plans. The reduction in time to develop mine plans resulted in better decision making through the ability to compare multiple mine plan scenarios.

Enhanced operations

Operations staff encountered water-bearing sand zones, which impacted shovel production and ground control. Prior to modeling the sand units, the shovel would explore for the zones during operations. Exploring for problem zones with the shovel posed a significant risk of getting the shovel stuck in the sand or worse, a highwall slope failure resulting in an unproductive shovel. This would impact coal production and, more importantly, potentially result in injury or death.

Improving geology model turnaround and accuracy provided geologists time to model the noncoal, water-bearing sand zones. Once identified, shovel bench plans were developed to efficiently work in these difficult areas and communicated to operations. Planning for the sand zone improved shovel productivity and reduced highwall failure risk.

Streamlining the work flow gave the engineers more time to get out of the office and get experience in field management roles, where their analytical skills improved the operational work flow and daily decisions made in field operations.

Reduced exploration costs

Because geologists were provided more accurate models in less time, they were able to spend more time optimizing the exploration drilling plan. Through this exercise, they were able to reduce the number of planned exploration holes for the next drilling season compared to the previous method of planning holes.

The increased geologic model accuracy and resolution also eliminated the cost of drilling pilot holes in areas where infill drilling was performed to get supplemental coal quality data. The model's predict function was performed at the proposed drillhole locations, and the information was provided to the drilling crew. The predicted holes were found to correlate well with actual coal elevations and geology.

Increased minable reserves

Exploration drilling revealed a geologically complex area within the mine site. Typically, two coal intervals were being modeled and mined in the planned and active operations. The geologically complex area showed eight coal units, which were splits from the main two coal intervals. Adding to this complexity in the coal formation was the presence of a sand channel unit, which presented a significant ground control risk to the mining operation.

Prior to implementing the MineScape modeling system, this complex area was mined around, because the existing modeling system could not confidently model and, therefore, plan mining in this area. As a result of the improvements made in the geologic modeling and mine planning system, the area was modeled and multiple mining scenarios were developed to address the challenges of the area. Coal reserves that were previously avoided due to geologic anomalies are now part of the mining plan, increasing the available reserves and extending the mine life.

Greater confidence in purchasing decisions

Because coal sales drive the production for this mining operation, accurate geologic modeling using the latest data increased the confidence in the mine plans to meet coal quality specifications on upcoming shipments. Furthermore, optimizing the mining plan enabled engineers to accurately predict when a significant multi-million dollar capital investment in new equipment would be required due to upcoming increased overburden volumes and sales volume.

Summary

The mine planning process improvements described have resulted in direct and indirect cost savings for this mine. Streamlining the workflow has reduced the effort required and increased the quality of the mining plan.

Some may think that streamlining the mine planning process leads to cost savings by reducing staff. However, as experienced by this company, greater cost benefit and business value can be realized by maintaining existing staffing levels and reinvesting the newly available time and expertise of these skilled mining professionals back into the operation.

In the case of this mine, its staff had more time available in which to examine ways to make the operation more efficient, such as optimizing exploration drilling programs, building internal confidence in the accuracy of mining plans, increasing mine reserves by uncovering ways to mine in difficult geologic conditions, and helping execute the final plans with field operations.

Ultimately, improving the overall efficiency of the mine planning process with Mincom MineScape has allowed this mining company to reap more benefit by applying available staff time to efficiency programs that have boosted the performance of its mining operation. ■

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