

Metals & Mining Practice

How artificial intelligence can improve resilience in mineral processing

Even before the COVID-19 pandemic, mineral processing companies were grappling with profound uncertainty. Those that took steps to harness the power of AI improved agility and operational resilience.

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As COVID-19 continues to affect millions of lives and livelihoods, it is delivering perhaps the most significant shock to industries—from education to healthcare to food supply—in almost a century.

Mineral processing companies also have to grapple with profound uncertainty and volatility. Before COVID-19, some were already taking steps to build their capabilities to cope with fluctuations inherent in commodities markets. But recent events triggering challenges in workforce availability, supply chains, and demand created a need for higher levels of operational resilience in a short period of time.

Here is where recent advances in artificial intelligence (AI) helped. Typically, processing plants have terabytes of data stored over several years that can be combined with financial and market data to gain unique insight into profitability under different scenarios. Several pioneering operators are starting to harness AI to not only resolve the short-term challenges but also enhance operational resilience as a long-term competitive advantage. The following case studies shed light on the approaches taken by two players in employing these new capabilities.

Integrated fertilizer producer: Creating operational agility

In recent years, frequent changes in market prices have buffeted fertilizer companies, requiring new ore-processing strategies in order to maximize long-term profitability. This integrated player had already started building AI tools and agile-operations capabilities in its processing. When COVID-19 struck, the company expanded these capabilities to weather the crisis.

The first step was using AI to understand correlations between market prices and profitability in different operating models. In particular, it

compared the effects of maximizing production (immediate profits) or yield (long-term profits) with the economic life of the mine. It also looked at the effects of maximizing grade of beneficiated ore and the impact of different ore characteristics on downstream costs.

By building AI models to better understand these drivers, the company was able to identify more profitable strategies—and it gleaned some surprising insights.

For instance, maximizing production was not always the most profitable operating model. Mine planning and manpower deployment were the least resilient—and hardest to adapt—amid changes in market dynamics. In addition, beneficiation plant decisions could lead to more than 20 percent variability in downstream processing costs.

With a deep understanding of profit drivers across the company's complex value chain, it realized the intricate correlations among hundreds of variables involved required more than just "operator experience."

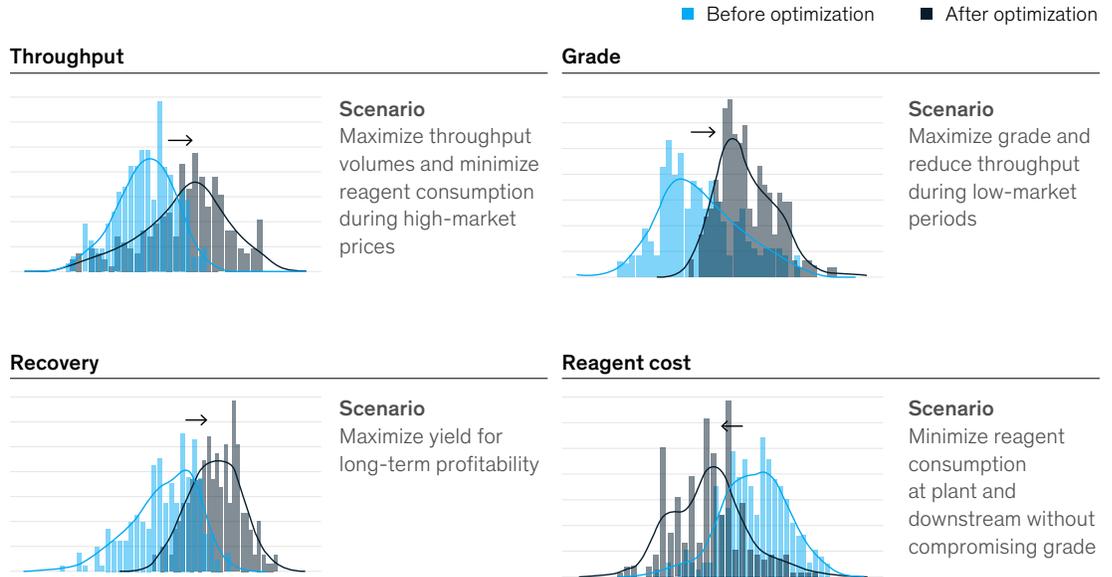
Instead, it built an AI tool on many historical data layers, allowing plant leadership, including operators, to understand the financial implications of several operational decisions (exhibit). This helped operators to do the following:

- Pinpoint optimal ore characteristics instead of processing whichever ore the mine was currently producing, leading to dynamic changes in mine plans.
- Change plant parameters to optimize throughput, grade, and yield to maximize profit per hour for the plant.
- Increase agility of sales and operations planning process, bringing operators closer to market realities.

Exhibit

Using machine learning to respond to market scenarios helped mitigate the financial trade-offs.

Histograms of output parameter performance in different scenarios using artificial intelligence models



The COVID-19 crisis is only a few months old, so it is too soon to quantify the effects of this data-driven operations approach over a diverse-enough, meaningful interval. However, this player is already more resilient financially and well positioned to make the most out of the recovery phase.

Base-metals producer: Pivoting to manage through crisis

For some companies, the current crisis has offered a chance to test new skills. That was the case for an integrated base-metals producer. The company was already far along in its journey to build agile and AI capabilities when COVID-19 emerged. By using its new capabilities, the company was able to increase production and yield while debunking some long-held operational assumptions. The

results helped build greater confidence in AI and agile methods across the business.

The crisis has quickly affected market demand and pricing in end markets for the base-metals producer. It has also affected the company's ability to operate a number of its assets. As a first response, the operator considered a number of traditional crisis-response strategies, including reducing costs, curtailing operations, and revising its mine plan to target more profitable ores.

But it also had several new tools it could use. First, the company began retraining the AI models it had built from optimizing for metal production to optimizing for yield, cost, or both in this new environment. The company also used AI to complement traditional mine-planning efforts to determine the potential

Agile value, principles, and processes and AI tools have enhanced one company's resilience by helping it respond faster to the crisis.

profitability at different levels of production and to supplement scenario planning.

Second, the organization deployed its recently created agile teams in new ways once the crisis hit. Teams had already embraced radical new approaches to problem solving, working through two-week sprints and implementing minimal viable products to test, learn, and improve iteratively rather than laboring on perfect solutions.

Agile teams that were focused on reducing bottlenecks or optimizing production pivoted to support the COVID-19 response. In one instance, a cross-functional agile team focused on how it could dramatically reduce the exposure risk for its haul-truck operators. The team developed creative ways to change morning huddles to improve the safety of its crews and to support operational goals. Other agile teams have successfully turned their attention to how they can reduce costs.

At the enterprise level, both sites and functions are using blueprinting and objectives and key results¹ to develop plans to respond to their new operating reality. The company had already used blueprinting to align the organization around a clear, simple set of goals when the overall focus was on optimizing production. Now, teams are using the same process to help the company quickly adapt goals to the new environment and build realistic plans for achieving them.

Because of work it had already done, the company was more flexible and responsive to change when the crisis hit. Teams had already learned to trust the data, take risks, and adapt to situations on a real-time basis. Those skills have helped the company learn and adapt to radically changed conditions. The situation continues to evolve for this miner, but the agile value, principles, and processes, and the AI tools it developed over the past year, have enhanced its resilience by helping it respond faster to the crisis.

Takeaways for mineral processing companies

As companies work to protect their workforce and maintain profitability during and after the COVID-19 crisis, the need to embrace AI and agile methods has only become more acute. Here are key components of the journey to a nimbler and data-driven way of operating:

- Switching from using empirical models to AI in day-to-day management and operations decision making
- Moving from relatively rigid production planning using long-term budgets to short two-week-horizon planning and increased agility across the value chain
- Shifting from single-recipe, plug-and-play tools to multiple value-driven, built-for-purpose methods tailored to specific requirements

¹ For more on agile blueprinting, see Santiago Comella-Dorda, Christopher Handscomb, and Ahmad Zaidi, "Agility to action: Operationalizing an agile blueprint," June 16, 2020, McKinsey.com. Objectives and key results (OKR) is a popular management strategy for goal setting within organizations; the purpose is to connect company, team, and personal goals to measurable results while having all team members and leaders work together in one direction.

- Turning from rigid workforce planning to more agile models, with a multidimensional team focusing on the highest-priority areas

How to get started

Processing companies that are just beginning digital transformations have an even stronger incentive to move quickly to build their agility and AI muscle because doing so is essential to managing the crisis.

They can begin by setting up a team with new skill sets required for implementation. This team would include data scientists to build the machine-learning tool, data engineers to structure and clean the data, and an agile coach to accelerate agile deployment.

In addition, selected workforce members should be upskilled as product owners to ensure the final product addresses specific needs of the business and as translators to form the bridge between deep operations experts at the plant site and data scientists. In parallel, it is important to access historical data across operational, financial, and other fields, and then clean, structure, and combine the data for analytics.

An AI model can be built with this new team structure—and by adopting agile principles—starting with a prototype and then deploying it at scale and testing for multiple objective functions as required by the business.²

Another key step is to invest in change management: being willing to discard long-standing assumptions and processes and empower teams to take risks—within clear boundaries and in line with modeling insights. This element also includes establishing an agile cadence within operations teams and market analysts to assess market conditions and discuss business implications for using the model. For periods of significant uncertainty, a shorter frequency of assessments will be needed.

Given the advancements in computing power and data availability, AI is already top of mind for executives of leading mineral processing companies. The COVID-19 crisis provides an additional stimulus to accelerate its deployment—building capabilities to harness the power of AI is an imperative in this new economic reality.

² For an impact story, see Red Conger, Harry Robinson, and Richard Sellschop, "Inside a mining company's AI transformation," February 5, 2020, McKinsey.com.

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