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SIMULATING THE FEASIBILITY OF THE SOUTH CROFTY MINE RESTART PLAN

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ABSTRACT

This study uses discrete-event simulation in MineTwin to evaluate the feasibility of the strategic restart plan for South Crofty, a historic underground tin mine in Cornwall, UK, in partnership. The original plan, developed with a static scheduling tool, did not capture equipment interactions, queuing delays, or operational variability. To overcome these limitations, we built a simulation model incorporating detailed mine layouts, production schedules, equipment specifications, and equipment coordination rules. The simulation revealed several constraints not identified in the static plan, including the need for additional loaders and insufficient surface haulage capacity. The simulation also enabled level-specific equipment allocation, which proved critical in pre-production phases with limited level connectivity. Overall, simulation complemented static planning by revealing dynamic bottlenecks and improving confidence in the operational feasibility of the restart plan.

1 INTRODUCTION

This case study focuses on South Crofty, a historic underground tin mine in Cornwall, UK, currently undergoing redevelopment (Cornish Metals 2025). As part of strategic planning, management had to ensure the mine plan was feasible with the proposed equipment fleet and infrastructure upgrades. The mine plan outlined the annual tonnage to be mined, the number of equipment units required each year, and estimates of overall mining profitability.

Traditionally, such plans are developed using static scheduling tools such as Deswik, which do not explicitly model queuing, mutual equipment waiting, or variability in task durations (Deswik 2025). Instead, these tools rely on expert judgment to estimate the inefficiencies resulting from these dynamic interactions. As a result, these plans may lack reliability, particularly under resource-constrained conditions.

In contrast, simulation captures interactive constraints, non-linear dependencies, and inherent variability in mining operations. For this reason, the management of the South Crofty mine used simulation to evaluate the mine plan's feasibility and identify potential bottlenecks before operations began. This study addressed the following key questions:

- Can production and development targets be met during pre-production (P-2, P-1) and steady-state years (Y1 to Y5)?
- What equipment allocation strategies best support these targets?
- Is the surface material handling capacity—bunkers, loaders, trucks, hoppers, crushers—sufficient?

2 SIMULATION MODEL DEVELOPMENT

We developed the model in MineTwin, a discrete-event simulation-based decision support tool for mining operations (Amalgama Software Design 2025). Model inputs included the detailed mine layout—covering all stopes and roads—planned production schedules, equipment specifications (e.g., loaders, trucks, drills, chargers), as well as shift and blasting schedules. We imported the mine layout from Deswik into MineTwin, using its built-in checks and validation tools to ensure data consistency.

We verified the model using simplified scenarios representing typical production and development activities through discussions with key mining personnel. This was done in collaboration with our project partners and mining consulting experts, Tomahee Consulting. In the absence of historical data, we could not explicitly validate the model. However, we compared the simulation results against the values from the static mine plan and investigated any discrepancies. Key comparisons included:

- Tonnage output (split by ore and waste): 0% deviation from the annual ore plan; –5% to +1% deviation for waste.
- Meters advanced (by profile and mining operation type): deviations ranged from –31% to +21%.
- Haulage distances (by trucks and loaders, for production and development): deviations ranged from –41% to +21%.
- Vertical meters drilled: deviations ranged from +7% to +27%.

We simulated the entire timeline from development through ramp-up to peak production. Years P-2 and P-1 focused on lateral development and infrastructure setup, with limited ore production. During steady-state production years, Y1 to Y5, the model incorporated longhole open stoping operations for ore extraction.

3 RESULTS AND ANALYSIS

The simulation revealed the following key insights into mine plan feasibility and operational performance:

Three additional loaders are required to meet the plan in the P-2 period. Managing waste rock during early development proved challenging, as the hoist system was not yet in place. Without sufficient tunnel width for trucks, loaders must transport waste from stopes to underground dumping areas on their own, significantly increasing their workload.

An additional loader is needed in Y5 to meet tonnage targets. High loader utilization and truck wait times revealed a bottleneck not captured in the static mine plan.

The planned surface material handling capacity is insufficient. Simulation results showed that the existing truck–loader–hopper configuration could not meet the required material movement targets. A key shortcoming of the static plan was its failure to capture the dynamic interplay between loader and truck availability, leading to frequent idle time caused by mismatched equipment timing and limited coordination.

MineTwin showed how loaders and trucks should be assigned to specific mining levels for year P-1, complementing the static plan, which only provided total equipment numbers without indicating their distribution. This added detail is especially important in pre-production phases, where limited level connectivity makes equipment placement critical to meeting performance targets.

4 CONCLUSION

This study illustrates how discrete-event simulation can enhance strategic planning in underground mining, complementing traditional static tools. While traditional static mine planning tools offer high-level scheduling and resource estimation, they often fail to capture the complex interactions, equipment dependencies, and variability inherent in underground environments. By applying simulation to the South Crofty restart plan, we identified key operational risks — such as insufficient loader capacity and haulage bottlenecks — that were not evident in the static plan. This study demonstrates the potential value of simulation and specifically MineTwin in improving the reliability, robustness, and operational readiness of strategic mine plans. The MineTwin platform is highly scalable and adaptable, supporting a wide range of underground and open-pit mines through its data-driven architecture and configurable simulation logic.

REFERENCES

Amalgama Software Design. *MineTwin*. https://mine-twin.com/, accessed 31 July 2025.

Cornish Metals. *South Crofty Tin Project*. https://cornishmetals.com/projects/uk/south-crofty/, accessed 31 July 2025.

Deswik. *Deswik*. https://www.deswik.com/, accessed 31 July 2025.