

Case Study: How Jaguar Mining Modernized Their Underground Workflow with MOSS

Case Study

NSS
CANADA

Customer Background

The customer, Jaguar Mining is a gold producing, development, and exploration company operating in the Iron Quadrangle, a prolific greenstone belt located near the city of Belo Horizonte in the state of Minas Gerais, Brazil.

The Iron Quadrangle has been an area of mineral exploration for centuries, dating back to the 16th century and contains world-class multi-million ounce gold deposits such as Morro Velho, Cuiabá and São Bento.

Jaguar's gold operating assets include the MTL Complex (Turmalina mine and plant) and Caeté Complex (Pilar mine, Roça Grande mine and Caeté plant).

In February 2023, NSS Canada's team completed a successful implementation of their MOSS (Miner Operated Survey System) at Jaguar's Pilar and Turmalina mine sites.



Challenges

Jaguar Mining chose to implement MOSS at their Pilar and Turmalina mine sites to improve the quality, control and efficiency of the processes involved in the development of galleries, sleepers, and ramp. In addition, the implementation of MOSS also aimed to have faster information and decision-making of field execution.

Challenges revolving around geo-controlled drifts were due to the banded gold ore body which caused an unpredictable face. Due to this unpredictability, advancement needed to be marked up by geology for the azimuth, dip, and dimensions.

Attributable to the banded ore body, Jaguar Mining aimed to decrease their overbreak and underbreak by slating the drill pattern to the corresponding angle of the vein.



Customer Requirements

Receive Training Support for Technology Implementation -

In order to implement MOSS in their underground daily operations, NSS Canada's Global Field Technicians were required to train Jaguar Mining's workers on how to use the technology at their mine sites. This required two Canadian staff members to perform step-by-step demonstrations for the team to make adjustments in their daily processes.

Streamline Operational Efficiency with New Technology -

Jaguar Mining management chose to modernize their mining methods to streamline their underground operations. The addition of MOSS allows miners to follow mine plans accurately which increased overall efficiency. When it comes to having a competitive edge in the mining industry, integrating technology, automating, and optimizing workflows are key to a total mine solution. Operations, engineering, and geology departments at a mine are consistently kept up to date on the progress of all active headings. Mishaps at the face can be addressed the day-of, instead of in days or weeks which prevents expensive rework.

Reduce Underground Costs & Increase Safety -

Today's modern mining industry is safer, more efficient, and more cost-effective, due to innovation and the adoption of new technologies. MOSS checks off all these categories. MOSS speeds up cycle time by providing the ability for one miner to perform tasks previously completed only by the survey crew in 10-20 minutes that would have previously taken up to two hours. In addition, MOSS eliminates the serious hazard of workers being exposed to open cavities with its cavity monitor survey feature.

Solution

Underground Surveying Software -

The Miner Operated Survey System (MOSS) is an underground surveying software that supports a wide range of Leica robotic total stations, including the latest state-of-the-art MS60 3D face-mapping technology. MOSS integrates mine design specifications and drawings when completing mark-ups, and provides real-time information to miners, engineers, and geologists. The software is fully matured and packed with decades of input.

Reduction in Overbreak & Underbreak -

The system has been proven to reduce overbreak by 10-15%, promoting best practices among miners. MOSS provides miners with all required information, allowing for refinement in drilling techniques, maintaining consistency, and adhering closely to design specifications. This immediate feedback system not only enhances the quality of work but fosters greater accountability among miners.



Solution



UG Survey at Every Face -

With MOSS implemented in active headings, we see a direct result of improved workflows and faster cycle times. MOSS is able to capture and provide solutions for: comparison between mine design and actual blast, setting of line and grade, collar drill hole location, 3D drill pattern generator, face scanning/photos, and cavity monitoring. The entire seven-step process takes on average 10-20 minutes which is dependant on the experience level of the user.

In addition, the NSS Canada team added a new feature to the MOSS software that allows the design of slanted drill patterns which determines the best angle for the least amount of waste possible allowing full geological control for the Jaguar Mining team.

Mine to Design with Real-Time Information Capabilities -

With MOSS, the engineer's plan for the mine is followed accurately, measuring each face with real-time results, ensuring that the miners can get to the mineral resource as efficiently and accurately as possible. MOSS has proven direct cost savings due to the real-time data provided to the miner at the face.

Each time the MOSS process is completed, the mine plans are updated which results in newly updated plans every day. After the tablet is synced, surface workers can quickly see overbreak or underbreak, deviation from mine design, topes, and volumetric data. MOSS users can see an immediate return on investment in relation to more accurate metrics to month-end reconciliations and financials.

Implementation

The implementation of MOSS at Jaguar Mining's Pilar and Turmalina mine sites was a process of mutual learning. In the beginning, it was necessary for the Jaguar Mining team to make several adjustments in their mining methods and additional time was needed to complete a successful implementation at both sites.

The training and demonstration process took longer than anticipated due to the language barrier between the Canadian and Brazilian team which necessitated a translator on site during training.

Thanks to this cooperative process and the responsiveness and readiness to learn from both teams, the language barrier and increased training time were the only hurdles needed to overcome during the implementation.

“Training with a language barrier can be challenging; however, the translators and team at Jaguar made it easy to communicate and train everyone successfully. At the end of the implementation, the team felt confident using MOSS underground in their daily operations.”

-Maxime Graveline, NSS Canada Global Field Technician



Results

Through our implementation of MOSS with Jaguar Mining, we were able to adapt and overcome some interesting geology on site. With the banded ore structure that Pilar's mine deals with, our team designed a way to follow geological control and provide their surveyors with a more efficient way to markup inclined drifts with a secure hanging wall and effective hole pattern. This in turn saves money and time for the mine to markup what used to be a difficult face. Lastly, the implementation of MOSS allows the surveyors to quickly and accurately follow geological control to carry out other tasks.

- **MOSS allowed the workers to maintain a safe distance from the mining face.**
- **With Jaguar's old method, it was not possible to get a true overbreak and underbreak profile in the field. The implementation of MOSS provides real-time visualizations and immediate intervention when needed which was not possible prior to MOSS.**
- **Adaptions using the MOSS was necessary to meet the particularities of the Pilar mine deposit.**
- **MOSS provides the ability to make corrections if a section is not following the plan with the overbreak and underbreak software feature.**
- **MOSS provided immediate results in the field and on-surface with the real-time information feature.**
- **Improvement of mining advancement.**
- **MOSS allows workers to visualize the project within the mine which has aided them in avoiding collisions and tire losses in LHDs and trucks.**

Results

Jaguar Mining's trained staff reported the following after the implementation of MOSS:

50%

INCREASE IN POSITIVE
CULTURE CHANGE
AFTER MOSS

75%

INCREASE IN
OPERATIONAL
IMPROVEMENTS

50%

IMPROVED RESOURCE
UTILIZATION &
EFFICIENCY

Results

“The introduction of MOSS at Jaguar Mining is another step towards our commitment to quality, by increasing safety, operational efficiency and cost effectiveness in our underground operations.”

**-Eric Duarte, Jaguar Mining Inc.
Vice President of Operations**



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