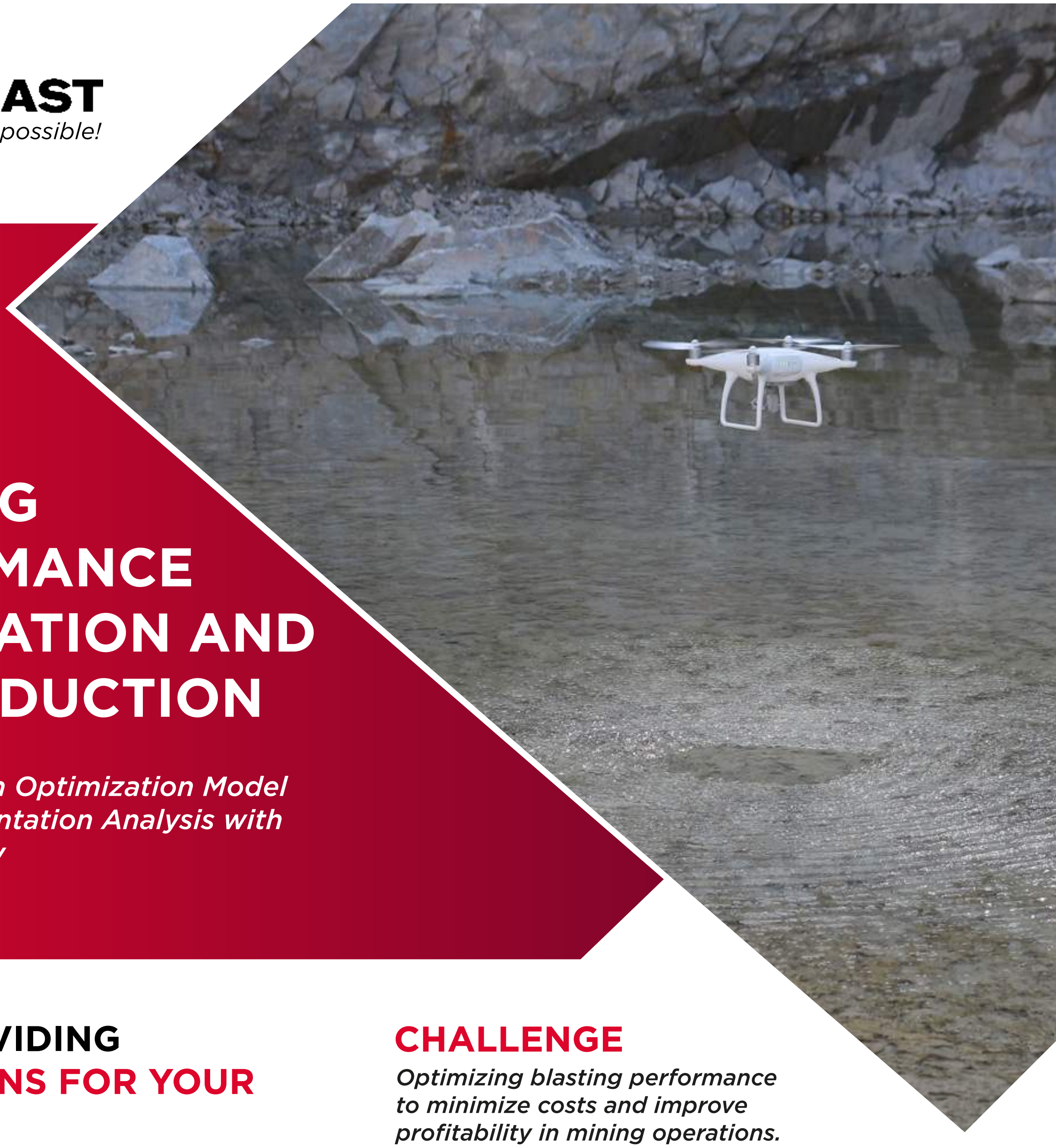

BLASTING PERFORMANCE OPTIMIZATION AND COST REDUCTION

Pattern Expansion Optimization Model based on Fragmentation Analysis with Drone Technology

WE ARE PROVIDING THE SOLUTIONS FOR YOUR BUSINESS

As the mining industry faces growing pressure to find efficiencies, mining operations seek continuous improvement tools to validate their blasting procedures. Combining various technologies and solutions that consider terrain parameters, rock quality, and explosive strength to propose a practical method for pattern expansion that improves blasting processes has become a necessity.

CHALLENGE

Optimizing blasting performance to minimize costs and improve profitability in mining operations.

Mining operation costs are defined by crushing and milling, load and haul, and drilling and blasting charges. As drilling and blasting is the initial phase of mining operations, it dramatically affects the overall cost. Consequently, one primary challenge is optimizing blasting performance to achieve desired outcomes at the lowest possible price.

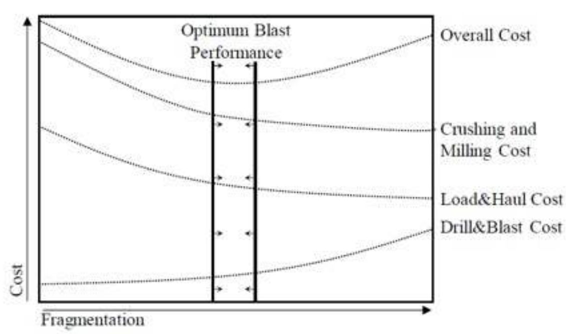

Figure 1. Mining cost relation (adapted from Efficient Blasting Techniques, Floyd, 2000)

KEY FEATURES

- O-PitSurface: fragmentation prediction model
- Drone technology for obtaining fragmentation data.
- Calibration Rock Factor
- Building Optimization Module

SOLUTION

Improving safety and reducing mining costs via technology-driven blast fragmentation analysis and optimization.

Pattern expansion was vital for reducing drill blast costs for the client we applied this solution. First, predicting conditions in a blast simulator to avoid on-site issues. We used O-PitSurface, a blast design software, to support the fragmentation prediction model calibration and estimate optimal design parameters.

To accomplish the best results, we used a drone flight to define the area to be analyzed, including ground sampling distance and height, photo overlay, and camera angle. The resulting photos were processed using photogrammetry analysis software to produce a scaled orthophoto. We then analyzed the orthophoto in WipFrag resulting in a geographically referenced particle size distribution data.

Before simulating any change in design parameters, it was essential to have an accurate prediction model, such as the Kuz-Ram's Rock Factor. We used the GRG non-linear programming optimization methodology in calibration to obtain a perfect match between predicted and measured fragmentations.

Figure 2. Fragmentation Analysis using WipFrag w/GIS

ROCK FACTOR CALIBRATION PROCESS				
	Initial Parameter	Rock Factor Cal. STG1	Rock Factor Cal. STG2	Rock Factor Cal. STG3
Diameter	102 mm	102 mm	102 mm	102 mm
Bench Height	10 mm	10 mm	10 mm	10 mm
Burden	3,0 m	3,0 m	3,0 m	3,0 m
Spacing	3,5 m	3,5 m	3,5 m	3,5 m
Subdrilling	1,2 m	1,2 m	1,2 m	1,2 m
Stemming	2,8 m	2,8 m	2,8 m	2,8 m
(KR Adjustes) X20	91 mm	97 mm	102 mm	106 mm
(KR Adjustes) X50	190 mm	204 mm	213 mm	224 mm
(KR Adjustes) X80	330 mm	353 mm	369 mm	390 mm
(KR Adjustes) X90	416 mm	446 mm	446 mm	493 mm
(Photo-Analysis) X20	190,9 mm	114 mm	117,8 mm	115,3 mm
(Photo-Analysis) X50	209,6 mm	220,7 mm	225,8 mm	235,9 mm
(Photo-Analysis) X80	347,7 mm	364,5 mm	384,1 mm	399,5 mm
(Photo-Analysis) X90	433,7 mm	457,1 mm	480,7 mm	506,1 mm
Rock Factor Cal.	7	7,5	7,83	8,14

To obtain optimum blast design parameters, we defined a non-linear problem, including dependent variables, empirical restrictions, and fragmentation demands. We applied controllable changes at each improvement stage in the pattern expansion field to avoid excessive deviations.
We implemented a detailed fragmentation analysis to control blast results and expanded the pattern until the fragmentation limit was reached.

Photo analysis vs. Prediction | Fragmentation Calibration | Rock Factor adjustments - Prediction Calibration

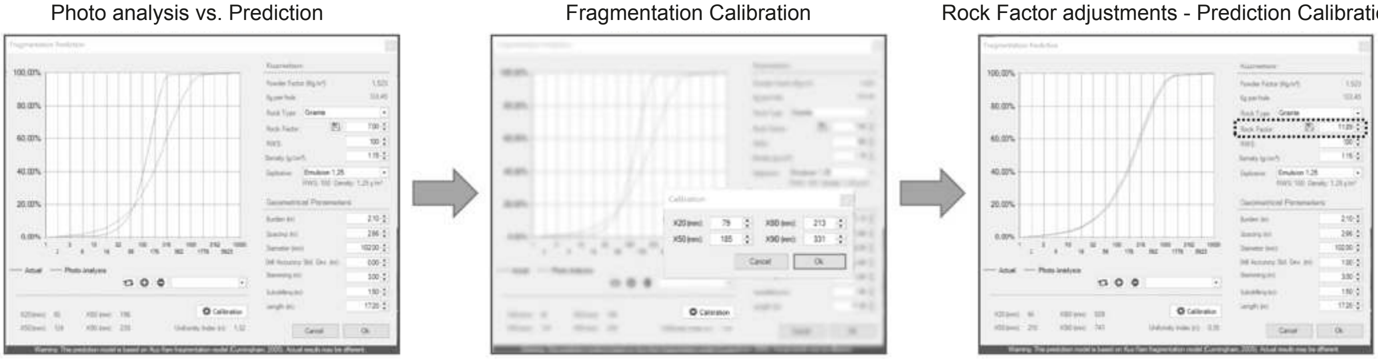

Figure 3. Rock Factor Calibration Process (O-Pitblast system)

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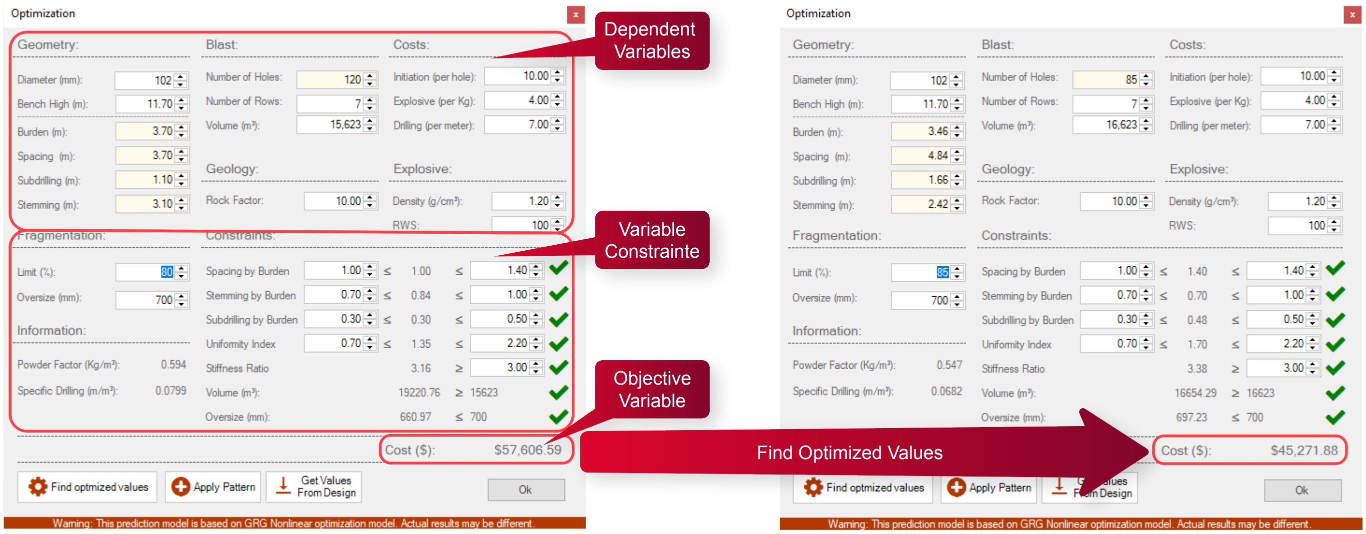
Initial Stage **Final Optimized Stage**



RESULTS

Integrating technology in daily mining tasks is crucial in enhancing safety and production efficiency. The initial design parameters are presented in the Table below for the present study.

INITIAL BLAST DESIGN PARAMENTERS	
Burden	3,0 m
Spacing	3,5 m
Diameter	102 mm
Stemming	2,8 mm
Subdrill	1,2 m
Bench Height	10 m
Powder Factor	0,77 kg/m³

The idea behind the pattern expansion field is to avoid excessive deviations simultaneously. Controllable changes were applied at any improvement stage and detailed fragmentation analyses were performed to control the blast results. The pattern was expanded until the fragmentation limit was reached. In the Table below, it is possible to check the evolution of each stage in terms of changes and results.

PATTERN EXPANSION EVOLUTIONARY STAGES						
	Initial Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Diameter	102 mm	102 mm	102 mm	102 mm	102 mm	102 mm
Bench Height	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm
Burden	3,0 m	3,1 m	3,1 m	3,2 m	3,3 m	3,3 m
Spacing	3,5 m	3,6 m	3,7 m	3,8 m	3,9 m	4,0 m
Subdrilling	1,2 m	1,2 m	1,1 m	1,1 m	1,0 m	1,0 m
Stemming	2,8 m	2,9 m	3,0 m	3,1 m	3,2 m	3,3 m
(KR Adjustes) X20	105 mm	109 mm	113 mm	117 mm	121cmm	125 mm
(KR Adjustes) X50	221 mm	233 mm	245 mm	257 mm	270 mm	283 mm
(KR Adjustes) X80	383 mm	409 mm	433 mm	461 mm	488 mm	520 mm
(KR Adjustes) X90	484 mm	519 mm	552 mm	591 mm	629 mm	689 mm
(Photo-Analysis) X20	124,5 mm	134,7 mm	151,8 mm	171,2 mm	223,9 mm	N/A
(Photo-Analysis) X50	240,1 mm	275,8 mm	303,4 mm	327,1 mm	352,6 mm	N/A
(Photo-Analysis) X80	398,1 mm	449,9 mm	480,3 mm	517,8 mm	543,1mm	N/A
(Photo-Analysis) X90	501,5 mm	541,9 mm	604,4 mm	653,8 mm	714,8 mm	N/A

In summary, using O-Pitblast's blast optimization algorithm, the client reduced costs by $229,361 and blasted through 605,307 m^3/791,712 yd^3 of rock.

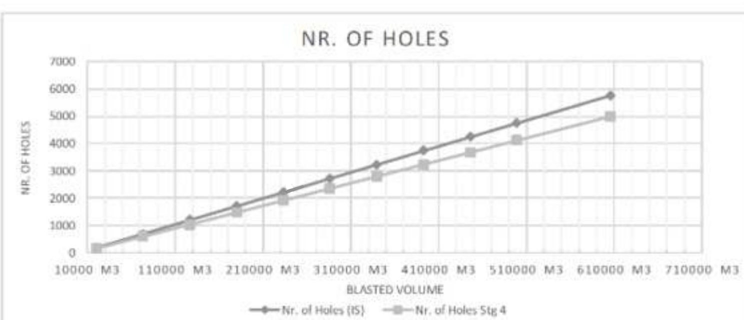


Figure 4. Drilled Holes

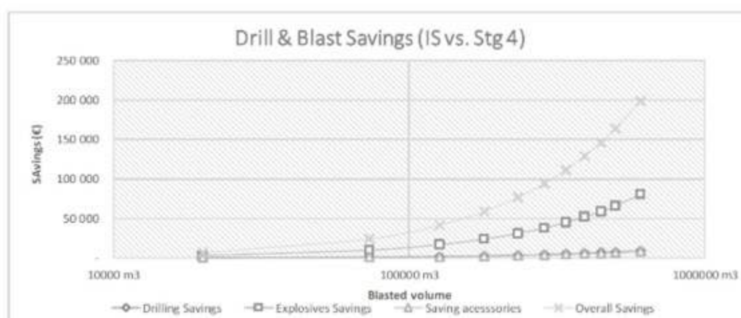


Figure 5. Drill and Blast Savings

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ABOUT US

At O-Pitblast, we aim to humanize mining by positively impacting every aspect of the blasting process.

As a leading provider of innovative blasting solutions, we prioritize people, ensuring the safety and well-being of our teams, communities, and the environment.

With a proven track record in providing tailored blasting solutions, O-Pitblast is the preferred partner for the global mining industry.

- Diverse expertise in multiples industry fields.
- Global reach with solutions on multiple continents.
- Cutting-edge software and hardware for blast design.
- Commitment to environmentally friendly practices
- Highly qualified and dedicated support team.
- Proven track record of successful projects worldwide.

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