

Maximizing underground project value with the application of Pseudoflow in Deswik's mine scheduling solution



Learn how Senior Mining Consultant, Jun Liang, from ORELOGY Mine Consulting applied Pseudoflow in Deswik's mine scheduling solution to increase project value for an underground mine.

The Challenge

In underground (UG) projects with complex operations and mining activities, a traditional Cut-off-Grade (COG) can be difficult to determine.

How do you ensure the economics of all mining excavations maximize your project's undiscounted cash flow?

How do you subsequently identify mining areas with higher profit margins and bring them forward in your Life-of-Mine (LOM) schedule to maximize the project's discounted cash flow?

The Solution

Using Pseudoflow in Deswik.Sched, an algorithm similar to the Lerchs-Grossmann model used in Open Pit optimization, ORELOGY helped an underground mine in their economic analysis and scheduling phases of a UG plan to overcome these challenges.

The Result

With the application of Pseudoflow, the overall undiscounted Cash Flow for the Project improved by 5% and, more importantly, the Discounted Cash Flow (DCF) for the LOM increased by 12% (Discount rate 8%). Further, the DCF increased by 38% and 31% in the first three and five years of LOM respectively.

Project Context and Challenges

The Operation:

- 1.6 Mtpa with > 10-year mine life.
- 15+ orebodies.
- Remnant mining areas at shallow depth.
- New mining areas at >2000m below the surface.

Complexity created cost estimation challenges:

- Some remnant stopes required longer rehab development.
- Some remnant stopes required additional rock-fill consolidation.
- Haulage costs varied greatly due to significant variation in elevation in each orebody.
- Due to these variations within and between mining areas, the traditional COG was difficult to determine.

Value-based scheduling challenges:

- Multiple areas could start mining concurrently – with limited resources, which areas should start first?
- Previous schedule sequencing was based on the ranking of individual orebodies with higher/lower priorities – how is priority determined when there is a large range of value within each orebody?

Pseudoflow Application

The Solution

- Apply Pseudoflow in the economic analysis of the mining areas to maximize the project's net undiscounted cash flow.
- Use the Pseudoflow results to identify and prioritize the high profit margin mining areas and improve the project's Net Present Value (NPV).

What is Pseudoflow?

- Pseudoflow is a type of network flow algorithm that is faster than the traditionally used Lerchs-Grossmann algorithm. It is a more efficient (processing time/power, and input parameter setup) method.
- It is used to find and select solutions in open pit and underground mine design and scheduling that prioritize profit improving NPV and cashflow.

When used for underground mine planning, it can:

- Evaluate all planned excavation economics to determine the "Ultimate UG Design".
- Generate a Free Cash Flow guidance using a revenue factor approach that can be used to identify the sequence priority for scheduling.

Key Outcome and Results

For the Project, an alternative outcome using a traditional COG methodology was generated to allow the results of the Pseudoflow approach to be assessed.

The key outcomes were:

- The overall Undiscounted Cash Flow improved by 5%.
- The Discounted Cash Flow (DCF) for the LOM increased by 12%.
- The DCF increased by 38% and 32% for the first three and five years for the LOM respectively.

SCENARIOS	LOM (M\$)	YEAR 1 - 3 (M\$)	YEAR 1 - 5 (M\$)
Undiscounted Cash Flow			
COG Approach - Auto Levelled Schedule	1,545	180	376
Pseudoflow Analysis - Auto Levelled Schedule	1,615	249	527
Final LOM Schedule with Pseudoflow Analysis - additional manual constraints	1615	250	492
% Variation from COG Approach	+5%	+39%	+31%
Discounted Cash Flow (8% Discount Rate)			
COG Approach - Auto Levelled Schedule	872	151	288
Pseudoflow Analysis - Auto Levelled Schedule	985	208	405
Final LOM Schedule with Pseudoflow Analysis - additional manual constraints	973	208	380
% Variation from COG Approach	+12%	+38%	+32%

**Note: Additional manual constraints were not applied to the COG scenario*

Other Applications

What mine planning activities benefit from the application of Pseudoflow?

- Quickly evaluating, comparing and selecting mine designs based on value.
- Enabling value as a scheduling parameter.
- Economic optimization in Life of Mine, ore reserve estimations and mine project studies.
- Sensitivity and scenario studies.
- Mine plans and schedules with large data sets and complex constraints.

Interested in learning more about Pseudoflow? Contact Deswik at deswik.com.