Professional Development Courses

Online Course – Remotely Delivered Going Online Due to COVID-19

ROBUST STRATEGIC MINE PLANNING OPTIMIZATION

Location - Australia

YOUR HOME-OFFICE

Dates

May 11th- May 15th, 2020

Time

Perth, Australia 8:00AM-5:00PM
Brisbane, Australia 10:00AM-7:00PM

Early Registration Deadline - 10% discount

Friday, April 17th, 2020

Registration Deadline

Friday, May 1st, 2020

Course Fee

~~**AUD $4500**~~ **AUD $3600 (excluding taxes)**

Instructor

Hooman Askari is a professor of mining engineering in the School of Mining and Petroleum Engineering at the University of Alberta, Canada. He teaches and conducts research into mine planning & design and simulation of mining systems. Hooman is a registered professional mining engineer with more than two decades of operational, consulting, research, and teaching experience in the area of open pit mine planning and design. He consults as the Principal Engineer through OptiTek Mining Consulting Ltd.

Registration

Send the completed registration form to: registration@optitek.ca

For more information contact Hooman Askari at:
hooman@optitek.ca
Phone: +1 (780) 893-9365

ROBUST STRATEGIC MINE PLANNING OPTIMIZATION

Who Should Attend

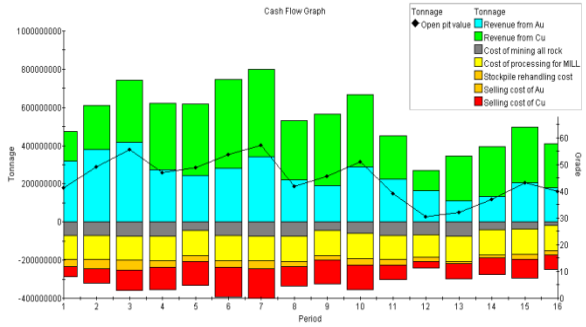
The Robust Strategic Mine Planning Optimization course is a comprehensive five-day course designed for mining and resource industry professionals including directors, project managers, mine planners, mining engineers, geoscientists, geologists, managers, metallurgists, financial analyst, and decision makers from exploration to operations. It is ideally suited to those from industry who wish to gain a more in depth and hands-on knowledge of modern strategic mine planning and optimization software tools and theory.

Cancellation Policy

Notification of cancellation received in writing by **Friday, May 1st, 2020** will incur a 20% cancellation fee. No refund will be made after this time.

Course Delivery

- Participants need to have GEOVIA Whittle software and license on their machines.
- We will provide SIMULIA Isight 2017 software and license for the duration of the course.
- Web conferencing using ADOBE Connect.
- Fully interactive audio and visual environment to deliver the course online.
- Lectures on theoretical concepts – 250 pages PDF file
- Step-by-step computer labs instructions – 280 pages PDF file
- Participants require two monitors or a laptop and a monitor. One monitor to be used for the Adobe Connect web conferencing and the other for Whittle/Isight
- Participants can share their computer screens and control with the instructor for model debugging and feedback.
- Incremental exercises and project work



GEOVIA WHITTLE AND SIMULIA ISIGHT

First Name: _____

Last Name: _____

Company Name: _____

Job Title: _____

Address: _____

_____

City: _____

Prov/ State: _____

Country: _____

Email: _____

Phone: _____

Visa ☐ Master Card ☐

Invoice ☐ By Phone ☐

Card # _____

Expiry _____/_____

CVV: _____

(Fee + 10% GST) AUD$ _____

Name on Card: _____

Signature: _____

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ROBUST STRATEGIC MINE PLANNING OPTIMIZATION

GEOVIA WHITTLE AND SIMULIA ISIGHT

COURSE DESCRIPTION

GEOVIA WHITTLE AND SIMULIA ISIGHT

Strategic mine planning optimization process is the backbone of mining operations. In mining projects, deviations from optimal mine plans will result in significant financial losses, future financial liabilities, delayed reclamation, and resource sterilization. The life-of-mine production schedule determines the order of extraction of materials and their destination over the mine-life. In this course, principles and fundamental concepts involved in strategic mine planning and optimization are presented. Subjects covered are block value calculations; mining revenues and costs; open pit limit optimization using manual method, floating cone, and 2D & 3D Lerchs and Grossmann algorithms; Pseudo Flow algorithm, life-of-mine production planning; mine-life estimation; cut-off grade optimization and Lane's theory; simultaneous optimization; multi-mine multi-process production scheduling, and an approach to managing grade uncertainty. Mathematical optimization models and case studies for long-term open pit mine planning will be presented. Blending problem formulations are setup and solved in Excel Solver. The course complements theory with comprehensive instructions and hands-on experience completing a project using GEOVIA Whittle strategic mine planning software. Comparative analysis of different production scenarios, stockpiling, cutoff optimization, SIMO, multi-mine and their impacts on the bottom line of the mining business is illustrated.

Outcomes of the course include:

- Understand concepts of strategic mine planning
- How optimization improves economic performance
- Complete a strategic mine planning study in Whittle
- Robust strategic mine planning optimization
- Integrate SIMULIA ISIGHT and GEOVIA WHITTLE
- What costs should be included in pit optimization
- How to deal with sustaining capital and sunk costs
- Principles of Lerchs & Grossmann 3D algorithm
- Principles of Pseudo Flow algorithm
- Resources and Reserves classification in Whittle
- Pit limits optimization with practical push-backs
- Generate optimal shells, reports and schedules
- Push-back design with a minimum mining width
- Cut-offs and cut-overs and cut-off scaling
- Nonlinear processing recoveries
- Production scheduling – using contractors
- Advanced techniques with mining direction control
- Buffer stockpiles, blending and strategic stockpiles
- Extractive blending and bulk blending
- Understand cut-off optimization & Lane's Theory
- Advanced simultaneous optimization (SIMO)
- Calculate sensitivities to develop risk reduction strategy
- New feature of CAPEX optimization
- Robust strategic mine planning using SIMULIA ISIGHT
- Integrate Whittle's SIMO with SIMULIA's optimization
- How to control highly variable input project parameters
- Multi-mine production scheduling
- Feeding multi-process processing plant
- Managing the risk associated with grade uncertainty
- Understand the potential value of the deposit.
- Target areas for future drilling
- Quantify the Impact of grade uncertainty on scheduling
- Allowing for underground mining
- Surface and underground transition
- Real Cases – Iron Ore, Gold-Copper, and Oil Sands

Day 1

Pit Limits Optimization

- Introduction to Strategic Mine Planning & Optimization
- Pit Limits- Floating Cone, 2D Lerchs & Grossmann
- Optimal Pit Limit- 3D Lerchs & Grossmann
- Optimal Pit Limit - Pseudo Flow algorithm
- Concept of parcels and undefined waste
- Block Value Calculations
  - Revenue calculation assumptions
  - Dilution and mining recovery
  - Extra cost of mining material as ore
  - Mining and rocessing costs adjustments
- What Costs to Include in Pit Optimization?
  - Fixed costs
  - General and administrative costs
  - Time costs
  - Overhead costs
  - Mill limited or mining limited operations
- Geotechnical consideration and overall safe pit slopes
  - Rectangular slope regions
  - Slopes within rock-types
  - Slopes with zone numbers
  - Slope with profile numbers
- Block Model File Format (*.MOD, *.RES, *.MSQ)
- Concept of Revenue Factor (RF)
- Nested pit shells and RF parameterization
- Fixed and geometric RF
- Ore Selection by Cut-off and Cut-off Calculation
  - By marginal cut-off
  - By breakeven cut-off
  - By cash-flow
  - Formula for a cut-over
- Cut-offs with multiple elements
- Display of cut-offs and cut-overs and cut-off Scaling
- Ore selection by cash flow
- How cut-offs are affected by minima and maxima
- The effects of raised and lowered cut-offs
- Ore selection by Value Mode and Profit Mode
- Modeling nonlinear processing recoveries
- Resources and Reserves classification in Whittle

Whittle Lab01 - Open Pit Limit Optimization Iron Ore

- Project data exploration history and field campaign
  - Rock-types and elements
- Project costs calculation
  - Waste and ore mining costs
  - Ore processing costs and recoveries
  - General and administrative costs
  - Mining or mill limited operation
- Open Pit Limit Optimization
  - Grade-tonnage curve

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ROBUST STRATEGIC MINE PLANNING OPTIMIZATION

GEOVIA WHITTLE AND SIMULIA ISIGHT

- Re-Blocking node
- Slope Set node and Pit Shells node
- Choose 3D LG or Pseudo Flow algorithm
- Operational scenario node and revenue factors
- Ore selection discussion
- Non-linear recoveries
- Pit Shells node running an optimization
- Compressed revenue factors
- Schedule graph and bench schedules
- Block size and selective mining unit (SMU)
- Pit by Pit Graph – Nested Pit Shells
- Choosing push-back manual, auto, semi-auto
- Practical push-back selection criteria
- Skin analysis

Day 2

Life-of-Mine Production Scheduling

- Production Scheduling Concepts
  - Benchmark schedules
  - Choose the ultimate pit
  - Choose push-backs
  - Sensitivity analysis
  - Taylor's rule
- Benchmark Production Schedules
  - Worst case scenario
  - Best case scenario
  - Concepts of lags and leads
  - Fixed lead schedules
  - Milawa NPV algorithm
  - Milawa balanced algorithm
  - How Milawa algorithm works
- Effect of Scheduling
  - Discounting and time value of money
  - Sensitivity analysis
  - Cost positioning
  - NPV vs Reserves
  - Payback period
  - Internal rate of return
  - Inclusion of costs of not using the full mining capacity

Whittle Lab02 – Open Pit Production Scheduling

- Schedule graph and bench schedules
- Mine-life estimation and sharing time related costs
- Push back chooser
- Milawa NPV and Milawa Balanced algorithms
- Push-backs with minimum mining width
  - Mining width node with/without the outer pit expansion
  - How the minimum mining width works
- Benchmark schedules and optimized schedules
- Sensitivity analysis using spider graph
- Hiring Contractors
  - Decide on contractors hiring strategy and costs
  - Transfer the schedule to excel
- Bench-mark schedule meeting tonnes and grade constraints
- Improve schedules using NPV as a metric
  - Understand impact of operational constraints on NPV
  - Trade-off between operational mine plans and NPV
  - Trade-off between mine plan flexibility vs. NPV
- Document comparative analysis of new scenarios

Whittle Lab03 - NPV Practical Pushbacks

- How NPV Practical Pushbacks works
  - Integrating mining with and scheduling
- Fixed and variable lead and lag
- Hiring contractors improving the schedule
- Compare NPV Practical Pushbacks vs Min Mining Width
- Interim push-back design
- The impact of geo-metallurgy/ore hardness
- Truck-hours constraint
- Heavy blocks and and pit optimization
- Exclusion polygons and pit optimization
- Whittle Exercise 1 – Gold-Copper – Pit Optimization

Day 3

Whittle Lab04 – Control Mining Direction & Pre-stripping

- Constrain the direction and growth of pit shells
- Producing directional shells using expressions
- Defining Mining Distance Factor (MDF) as expression
- Specify directional shells on the Optimization tab
- Implementing and evaluating mining direction
- Mining Direction Control
- Oils Sands deposit exercise
- Pre-stripping without stockpiles
- Pre-stripping with stockpiles
- Controlling waste reject
- Impact of directional constraints on NPV
- How to compound mining directions

Whittle Lab05 - Buffer Stockpiles

- Store economic ore in stockpiles
- Supply ore to the mill in periods that the mill is not fully fed
- Supply ore to the defined processes once mining has stopped
- Allow pre-stripping and stockpiling of economic ore
- Use buffer stockpile to balance mining and processing limits
- Grade-tonnage curve analysis for stockpiles grade ranges
- Legacy stockpiles - tonnage and grade
- Cost associated with stockpiles
- Treatment and re-handling costs
- Stockpile cut-off calculation
- Stockpile input-output grade and tonnes analysis
- Multi-element stockpiles, low, medium, and high grade
- Use data selector to plot customized charts and graphs

Whittle Lab06 – Blending Stockpiles – Extractive Blend

- Bulk blend vs Extractive blend
- Blending stockpiles
- Blend targets and definitions
- Blend bins concept
- Fixed blend bin size
- Automatically adjust bin size
- Control the head-grade by blending constraints
- Improve process throughput or metallurgical performance
- Variable penalties on contaminant thresholds
- Blending desired ratio of rock types into processes
- Using CPLEX engine
- Rehabilitation cost for stockpiles

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ROBUST STRATEGIC MINE PLANNING OPTIMIZATION

GEOVIA WHITTLE AND SIMULIA ISIGHT

Day 4

Whittle Lab07 - Cut-off Grade Optimization

- Cut-off Optimization - Lane's Theory
- Cut-off Optimization – Maximizing Profit
  - Mining, mill, and market limited cut-offs
  - Cut-off optimization to balance mining and processing
  - Cut-off optimization to balance mining and market
  - Cut-off optimization to balance processing and market
- Cut-off Optimization – Maximizing NPV
  - Maximize the difference between present values of the remaining reserves
  - Concept of increments in Whittle
  - Compaction of grades, tonnage, and increments
  - Defining grade ranges for strategic stockpiles

Whittle Lab08 - Simultaneous Optimization (SIMO)

- Introduction to simultaneous optimization
- How SIMO works
- Integrating scheduling, blending, stockpiling, and cutoff
- Advanced optimization control
  - Optimization tab
  - Blend bins tab
  - Manual versus automatic bins
  - Stockpiles tab
  - Comparative analysis of value generated by SIMO
- Simultaneous Optimization
  - CAPEX Optimization process
  - Use additional capacity at a set cost per unit
  - Purchase additional mining and processing capacity
  - Use period validation to control additional limits
  - Simultaneous Reporting
  - Report CAPEX limits and costs
  - SIMO spreadsheet reports
- Whittle Exercise 2 – Gold-Copper – Production Scheduling
- Whittle Exercise 3 – Gold- Copper – Blending & Stockpiling
- Whittle Exercise 4 – Gold- Copper – Cut-off Optimization
- Whittle Exercise 5 – Gold- Copper – SIMO

Day 5

ISIGHT Lab09 - Robust Strategic Mine Planning (RSMP)

- What is Isight?
- The Design gateway
- The Runtime gateway
- Using post-processing tools
- Accessing the design gateway
- Adding an Excel component to the simulation process flow
- Adding a loop component to the model
- Configuring the executable
- Publishing a component
- Automate a series of functions to create a sim-flow
- Add components to a sim-flow
- Set up the core component
- Configure components to pass data to/from each other
- Execute a Sim-flow
- Visualize Sim-flow results
- Evaluate design alternatives
- Create a Sim-flow to capture a process
- Perform design optimization and gain design space understanding by using various techniques such as DOE, Optimization, Monte Carlo etc.
- How to control highly variable input parameters into projects
- Integrate GEOVIA's Whittle SIMO with SIMULIA's optimization toolbox
- Assure stability of results using controllable variables against uncertain environmental variables
- Controllable variables
  - Push-back selection
  - Mining direction
  - Mill capacity
  - Mining capacity
- Environmental variables
  - Commodity price
  - Mining costs
  - Recoveries
  - Processing costs
  - Slope stability
  - Resources
  - Grade and Geological uncertainty
- Determine robust & optimal values for numerous schedules
- Whittle SIMO – Final optimization of schedule using output of Isight Analysis
- Production scale that reacts well to changing input parameters

Whittle Lab10 - Managing Risk and Grade Uncertainty

- Use command line for process automation and simulation
- Reduce design cycle time through integrating workflow
- Establishing a final pit-shell under grade uncertainty
- Equi-probable realizations of grade within the orebody
- Optimal pit for Krig, E-type models
- Optimal pit for P90 & P10 realizations
- Impact of grade uncertainty on the final pit limit
- Quantifying the Impact of grade uncertainty on scheduling
- Final pit in the presence of grade uncertainty.

Whittle Lab11 - Multi-Mine Multi-Process Optimization

- Introduction multi-mine multi-process optimization
- Merging multiple block models in one project
- Mining limits applied to multiple mines
- Mining limits on individual mines
- Prioritize sequence of mining
- Multi-mine multi-process optimization
- Dry and wet separation processes
- Complex processing methods
  - Separation
  - Element extraction different stages
  - Different selling costs
- Redirect ore to processes that are not full
- Multiple/alternative processing streams
- Multiple/alternative products
- A complex mine logistics example
- Manipulate the multi-pit sequences
- Maximize NPV by multi-process profit mode
- Lessons learnt from optimizing multi-mine
- Wrap up and conclusion for the course