

# Mining Optimization Laboratory Professional Development Courses

# STRATEGIC MINE PLANNING & OPTIMIZATION

# SOFTWARES: GEOVIA WHITTLE & EXCEL SOLVER

## Location

**Porto Alegre, Rio Grande do Sul, Brazil.**

Universidade Federal do Rio Grande do Sul.  
Laboratório de Planejamento Mineiro – LPM. Avenida  
Bento Gonçalves, 9500. Prédio 75. CEP 91501-970.  
Porto Alegre, RS, Brasil.

## Dates

**October 15 to 19, 2018 – 5 days from 8:30am-5:00pm**

## Registration Deadline

**Friday, October 1<sup>st</sup>, 2018**

## Course Fee

**R\$ 3.000,00**

## 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 18 years of operational, consulting, research, and teaching experience in the area of open pit mine planning and design. He has a strong track record of success in leading the Mining Optimization Laboratory (MOL) research team sponsored by BHP Billiton, Newmont, Suncor, Shell, Maptek, and Mintec into development, testing, and delivering mine planning optimization prototype software and mine simulation models to major mining companies. He consults as the Principal Engineer on long-term to short-term open pit production scheduling optimization and simulation of mining-systems through OptiTek Mining Consulting Ltd.

## Who Should Attend

The Strategic Mine Planning and Optimization course is a comprehensive four-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.

## Course Delivery

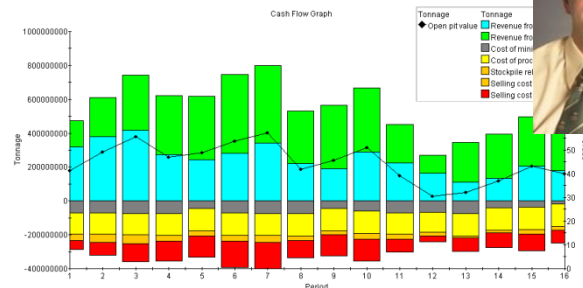
- Lectures on theoretical concepts
- Documented step by step computer labs instructions
- Incremental exercises and project work
- Presentation of real mining case studies

## Mining Optimization Laboratory (MOL)

MOL research focuses on using operations research and advanced analytical methods such as mathematical modeling, optimization, discrete event/continuous simulation, and intelligent agents to arrive optimal or near-optimal solutions to complex, large-scale mine planning/operations decision-making problems.

University: [hooman@ualberta.ca](mailto:hooman@ualberta.ca)

<http://www.ualberta.ca/MOL/>



## Participants are Required to Bring a Laptop Software will be Provided for the Course

First Name: \_\_\_\_\_

Last Name: \_\_\_\_\_

Company Name: \_\_\_\_\_

Job Title: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

City: \_\_\_\_\_

Prov/ State: \_\_\_\_\_

Country: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_

Fax: \_\_\_\_\_

## Information about registration:

Ricardo Rodrigues da Silva

Laboratório de Planejamento Mineiro – LPM.

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Site: [www.lapes.ufrgs.br/lpm/](http://www.lapes.ufrgs.br/lpm/)

## Cancellation Policy

Notification of cancellation received in writing by Friday, **October 1<sup>st</sup>, 2018** will incur a 20% cancellation fee. No refund will be made after this time.

# Mining Optimization Laboratory Professional Development Courses

## STRATEGIC MINE PLANNING & OPTIMIZATION

## SOFTWARES: GEOVIA WHITTLE & EXCEL SOLVER

### COURSE DESCRIPTION

#### Software: GEOVIA Whittle & Excel Solver

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; 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. The course also covers an introduction to mathematical programming using Excel Solver. Mathematical optimization models and case studies for long-term open pit mine planning are 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 (version 4.5) and Excel Solver. Comparative analysis of different production scenarios, stockpiling, cutoff optimization 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
- What costs should be included in pit optimization

- Principles of Lerchs Grossman 3D algorithm
- Pit limits optimization with practical push-backs
- Generate optimal shells, reports and schedules
- Push-back design with a minimum mining width
- Production scheduling – using contractors
- Advanced techniques with mining direction control
- Buffer Stockpiles and Extractive Blending
- Understand cut-off optimization & Lane's Theory
- Advanced simultaneous optimization
- Multi-mine scheduling, feeding multi-process processing plant
- Managing the risk associated with grade uncertainty
- Use Excel LP Solver to solve practical mining problems
- Use Excel LP Solver to solve bench scheduling problem
- Use Excel LP Solver to solve grade blending problem
- Quantify the Impact of grade uncertainty on scheduling
- Case studies – Iron Ore and Gold, Silver, and Copper

#### **Day 1 – Monday, October 15, 2018**

##### **Module 1: Pit Limits Optimization**

- Introduction to Strategic Mine Planning & Optimization
- Pit Limits- Floating Cone, 2D & 3D Lerchs & Grossman
- Block Value Calculations
- What Costs to Include in Pit Optimization?
- Project data exploration history and field campaign
- Project cost calculation
  - Waste and ore mining costs
  - Ore processing costs and recoveries
  - General and administrative costs
- Whittle Lab01 - Open Pit Limit Optimization
  - Grade-tonnage curve
  - Reblocking node
  - Slope set node
  - Pit Shells node
  - Operational scenario node
  - Revenue factors
  - Ore selection discussion
  - Pit by pit graph

- Compressed revenue factors
- Schedule graph and bench schedules
- Block size and SMU
- Skin analysis

#### **Day 2 – Tuesday, October 16, 2018**

##### **Module 2: Life-of-Mine Production Scheduling**

- Production Scheduling Concepts
- Whittle Lab02 - Long-Term Production Scheduling
  - Schedule graph and bench schedules
  - Mine-life estimation
  - Sharing time related costs
  - Push back chooser
  - Milawa NPV and Milawa Balanced algorithms
  - Push-backs with minimum mining width
  - Benchmark schedules and optimized schedules
  - Implementing and evaluating mining direction
  - Sensitivity analysis using spider graph
  - Generating reports in Whittle
- Whittle Lab03 - Practical Push Backs – NPV
  - Mining with contractors
  - Fixed and variable lead and lag
  - Mining direction control
  - Interim push-back design
  - The impact of Geo-metallurgy/ore hardness

#### **Day 3 – Wednesday, October 17, 2018**

- Whittle Lab04 - Pre-stripping and Buffer Stockpiles.
  - Pre-stripping
  - Multi-element stockpiles
  - Rehandling cost calculations
  - Stockpile cut-offs

##### **Module 3: Introduction to Mathematical Optimization**

- Introduction to mathematical programming for engineers
- Lab05 - Blending using Excel Solver
- Lab05-Bench Scheduling using Excel Solver
- Whittle Lab06 – Extractive and Bulk Blending
  - Blending stockpiles
  - Blending bins (manual and automatic)

# Mining Optimization Laboratory Professional

## Development Courses

- Blending to control head-grade
- Concept of blend bins
- Control the head-grade by blending constraints

### **Module 4: Cut-off Grade Optimization & Stockpiling**

- Cut-off Optimization - Lane's Theory
  - Cut-off Optimization – Maximizing Profit
  - Cut-off Optimization – Maximizing NPV
- Whittle Lab07 - Cutoff Grade Optimization Step by Step

### **Day 4 – Thursday, October 18, 2018**

#### **Module 5: Simultaneous Optimization (SIMO)**

- Introduction to simultaneous optimization
- 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
- Whittle Lab08 – Simultaneous Optimization

#### **Module 6: Multi-Mine Multi-Process Optimization**

- Introduction multi-mine multi-process optimization
- Whittle Lab09 – Iron Ore Multi-Mine Project
  - Merging multiple block models in one project
  - Mining limits applied to multiple mines
  - Mining limits on individual mines
  - Multi-process dry and wet separation
  - Multiple/alternative processing streams
  - Multiple/alternative products
  - A complex mine logistics example
  - Lessons learnt from optimizing multi-mine

# STRATEGIC MINE PLANNING & OPTIMIZATION

### **Day 5 – Friday, October 19, 2018**

#### **Module 7: Managing Risk and Grade Uncertainty**

- Establishing a final pit-shell under grade uncertainty
- Equi-probable realizations of grade within the orebody
- Optimal pit for Krig, E-type models and P90 & P10 realizations
- Impact of grade uncertainty on the final pit limit
- Quantifying the Impact of grade uncertainty on scheduling
- Whittle Lab10 – Final pit in the presence of grade uncertainty.

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### Technical information:

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