



AN OVERVIEW OF USING REAL OPTIONS TO VALUE AND MANAGE MINING PROJECTS

Pre-conference workshop • April 21, 2004

Presenters: Dr. Michael Samis, *P.Eng., Kuiseb Minerals Consulting* and Dr. Graham A. Davis, *Colorado School of Mines*

WORKSHOP OVERVIEW:

Advances in finance theory and risk management have had an important influence on investment decision-making in the finance and insurance industries. This influence has now spread to non-financial industries, such as mining, power generation and petrochemicals. These new ideas about valuation and risk management provide additional decision tools and insights for valuing projects and exploring advanced risk modelling.

This one-day workshop provides a practical overview of using the real option method to value and manage mining projects.

The workshop covers three main topics:

- A review of some of the most important project characteristics of the mining industry that influence value — project duration, output price uncertainty, operating leverage, and management flexibility — and which should therefore be reflected in a valuation calculation;
- A demonstration of how financial market information and project specifics are used in the real option method to guide operating strategy and calculate a project value that is directly linked to a project's risk profile;
- A review of investment decision situations in the mining industry for which the real options technique can provide new insights. These applications include trade-offs between high-cost and low-cost projects, early project closure, selective zone closure, capacity expansion, and deferring the development of a mineral lease.

Participants will acquire:

- A conceptual understanding of how real option valuation can provide a consistent valuation approach that differentiates projects by their unique cash flow risk characteristics;
- Insight into how important aspects of project structure, such as management flexibility and operating costs, influence optimal management strategy, project risk, and value;
- A demonstration of the wide range of projects to which real option methods apply through the use of practical examples.

PARTICIPANT FOCUS AND EXPERIENCE

The workshop is designed for mining professionals and analysts who are involved in evaluating or managing projects or who may be responsible for assessing investment risk.

Participants do not require advanced mathematical skills to understand the workshop material. However, they should be familiar with:

- Basic statistical concepts such as expected value, variance, and standard deviation;
- Constructing a discounted cash flow calculation;
- Introductory financial concepts such as the time value of money and risk-adjusted discount rates.

REAL OPTIONS WORKSHOP OUTLINE:

8:30 to 10:00 am: Valuation fundamentals

Introductory comments. The role of project valuation. Extending the idea of a valuation model: Project structure, project uncertainty, and valuation methods. *Example:* Demonstrating a realistic mine valuation model with Monte Carlo.

10:00 to 10:15 am: Coffee break

10:15 to 11:00 am: Market information and its use in valuation

Comparative valuation methods in the mining industry. Financial contracts. Forward contracts and forward prices. The relationship between mine revenues and forward contracts. *Example:* Valuing a one-period mine as a portfolio of forward contracts and bonds.

11 am to 12 noon: Valuing cash flows with no flexibility

Introduction to real options. A simple example of discounting differences between real options and DCF. Demonstrating differential discounting and its recognition of project structure. *Example:* Valuing a satellite reserve development versus a stockpile heap leach.

12 noon to 1 pm: Lunch

1:00 to 2:00 pm: Introduction to flexibility and early real options

Early models of management flexibility: The Black-Scholes model and Operating Profit uncertainty models. Representing mineral price uncertainty with binomial trees. Integrating binomial trees into a valuation model.

2:00 to 2:30 pm: Practical examples of valuing project flexibility

Early closure at marginal resource project. *Example:* A marginal mine closure decision.

2:30 to 3:00 pm: Coffee break

3:00 to 4:45 pm: More practical examples of mining flexibility

Restructuring a project in low commodity price environments. *Example:* Selective zone closure. Restructuring a project in high commodity price environments. *Example:* Sequential or parallel development. Deferring project development at a resource lease. *Example:* Valuing a mineral lease.

4:45 to 5:00 pm: New frontiers and concluding comments

New frontiers in the valuation of natural resource projects. Workshop summary.

PRESENTER BIOGRAPHIES:

Dr. Michael R. Samis began his mining career in South Africa where he worked in production, planning and valuation positions at several gold and coal mines. While in South Africa, he completed a M.Sc. degree in mineral economics that focused on using real options to analyze project financing proposals for marginal gold mines. In 2000, he completed his Ph.D. at the University of British Columbia where his research considered the interaction between geological structure, capital and operating costs, management flexibility and project uncertainty. His professional experience includes valuing major capital investment projects with complex forms of management flexibility, producing and leading professional development workshops discussing the use of real options to value and manage natural resource projects, and providing expert witness affidavits for business litigation involving natural resource valuation problems. Dr. Samis is registered as a Professional Engineer in Ontario, Canada.

Dr. Graham A. Davis is an Associate Professor of Economic and Business at the Colorado School of Mines. Dr. Davis has a Bachelor's degree in engineering, an MBA, and a Ph.D. in mineral economics. He is recognized as an expert in applying real options to real world problems, and has undertaken real options valuation projects for government and private organizations worldwide. He teaches a 15-week graduate-level course on real options applications in the mining and petroleum industries.