Strategic Decision Making in Mining – Optimisation

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Project Evaluation 2016
Optimisation
– one word, many meanings!

&

Business optimisation
– modelling options

Daniel Kahler and Brian Hall
Optimising – everyone wants it!

Sam Walsh, Rio Tinto, 11/8/15

We’re seeing a strong focus on improving that business in terms of its cost, in terms of its throughput. [Rio Tinto are moving key people to site to ensure that]… every step possible to optimise that business.

Andrew Mackenzie, BHP Billiton, 26/8/15

…..we will continue to monitor market conditions to optimise value

Spokesperson, South32, 14/1/16

Our primary focus is on optimising the performance of our existing operations and maximising the value of those assets,

Nev Power, Fortescue Metals Group 15/10/15

Our team is continuing to deliver sustainable cost reductions through an unwavering focus on optimising every aspect of Fortescue’s operations

Spokesperson, Rio Tinto, 11/2/16,

offset the bear market in metals by optimizing their portfolio, cost reductions, and improvements in productivity
Optimisation – one word, many meanings!

In common usage:

IMPROVEMENT = OPTIMISATION

Probably a lost cause to argue against this
Optimisation – one word, many meanings!

### Activity or Item
- Enterprise optimisation
- Business optimisation
- Pit shell optimisation
- Truck haulage optimisation
- Mine-to-mill optimisation
- Asset optimisation
- Pit-to-port optimisation
- Schedule optimisation
- Fragmentation optimisation
- Financial optimisation
- Mill recovery optimisation
- Implementation optimisation
- Supply chain optimisation

### Software
- Comet
- Prober
- XPAC
- Flowsim
- FlexSim
- Whittle
- XACT
- SOT
- HoV
- MSO
- Express
- Blasor
- MineMax
- NPS Scheduler
- Stope Optimizer
- BlendOpt
- River Logic
- Enterprise Optimizer
- Simio
- DumpSolver
- Lobos
- Stope Optimizer
- Simio
- DumpSolver

### Approach
- Real options
- Management flexibility
- Heuristics
- Evolutionary algorithms
- Dynamic programming
- CPlex
- Mixed integer linear programming (MILP)
- Constraint programming

**Tools that help**
Optimisation – one word, many meanings!

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### Activity or Item

**Enterprise optimisation**

**Business optimisation**

**Pit shell**

**Stope design**

**Truck haulage**

**Mine-to-mill optimisation**

**Decline design**

**Asset optimisation**

**Pit-to-port optimisation**

**Schedule optimisation**

**Fragmentation optimisation**

**Financial optimisation**

**Mill recovery optimisation**

**Implementation optimisation**

**Supply chain optimisation**

Optimisation – one word, many meanings!

Scope!

Component

Optimisation

Business

Optimisation
Where does my “optimisation” fit?

Outcome in $ (or NPV) ≠ Business Optimisation

Component A Optim + Component B Optim ≠ The Optimum
Optimisation – one word, many meanings!

1. Design
2. Schedule
3. Asset
4. Implementation
5. Financial and risk
Optimisation – one word, many meanings!

Scope!

Component Optimisation

Business Optimisation

Business optimisation

**Strategy selection**
The traditional approach

**Strategy optimisation**
The flexible approach


Image courtesy: [http://sanatiostuff.blog.fc2.com/blog-entry-73.html](http://sanatiostuff.blog.fc2.com/blog-entry-73.html)
Business optimisation

Modelling techniques

Mathematical programming

Fully-flexible models

Strategy optimisation

The flexible approach

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Business optimisation

Mathematical programming will be likely to identify superior solutions to well defined problems…

BUT…
**Business optimisation**

*Caution needs to be used in assuming away all the variability for the purpose of finding an “optimum result” that can be calculated by a mathematical solver* (Rieck, 2015)

…off-the-shelf software solutions might not meet the needs of the business and customised models might be required (De Kock, 2007)

…there are perhaps fewer problems in mining that are suited to solution by these techniques than some would like to believe (Poniewierski, 2003)
Business optimisation - the challenge
Business optimisation

A Wicked Problem To solve:

- The orientation of a solution concept
- The solution is likely to change as you approach it. So...


Agreement??
Business optimisation

What should be the outcome?

- Information to make decisions
- Improved understanding of the project
Business optimisation

Modelling techniques

Mathematical programming

Strategy optimisation

The flexible approach

or

Fully-flexible models

Image courtesy: http://sanatiostuff.blog.fc2.com/blog-entry-73.html
Business optimisation

Modelling techniques

• Interactive for single cases

• Not constrained by mathematical formulations

Strategy optimisation
The flexible approach

Fully-flexible models

Image courtesy: http://sanatostuff.blog.fc2.com/blog-entry-73.html
Case Studies
Thank you

Component optimisation

- Design optimisation
- Schedule optimisation
- Asset optimisation
- Implementation optimisation
- Financial and risk optimisation

Business optimisation

- Strategy Selection
  - Traditional approach

Strategy Optimisation

- Fully-flexible models
- Mathematical programming

Wicked Problem

Consultation &