Integrated Extraction Simulator (IES)

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Integrated Extraction Simulator (IES)
1. Characterisation
- Measure & quantify the Grade Engineering® responses of the orebody
- Conducted through combination of physical testing & data analytics

2. Geometallurgy & Spatial Analysis
- Understand geological controls on Grade Engineering® responses
- Spatially map responses defining Grade Engineering® domains

3. Process Design & Simulation
- Define Grade Engineering® “circuit”, equipment design & specifications
- Quantify process simulation responses across mining value chain

4. Strategic Mine Planning
- Develop strategic mine plan incorporating Grade Engineering®
- Define impact on equipment, layout, material movement, mine development

5. Project Evaluation
- Quantify the economic impact utilising Scenario Analysis
- Define implementation options and viability

6. Pilot/Production Trials
- Technical validation at production scale of Grade Engineering® technology
- Detailed testing, validation, reconciliation process
Integrated Extraction Simulator (IES)

Why build a new simulator?

What is IES?

Process Modelling

Model Landscape

Building Flowsheets

Calibrating Models

Opportunity Assessments

Scope of Assessment

Understanding variability and uncertainty
WHY BUILD A NEW SIMULATOR?

Current state of industry

Gross misalignment in terms of *process modelling and simulation tools*

Experts only use technical workstation based systems requiring a dongle

- Flowsheets are a snapshot of a point in time (one ore type, one operating setting)

Expensive surveys

- Delay in the results (often 3 months)

Limited and complicated models

- New models take too long from research to commercial availability

Limited to a single domain (blasting or comminution or flotation)

- Requiring proprietary lab test work

Limited predictability for different ore types and operating settings

Use spreadsheet models for flexible and rapid opportunity assessments

- Use of Geometric models for forecasting KPIs

Models incorporate local knowledge and procedures
WHY BUILD A NEW SIMULATOR?

Current state of industry

Gross misalignment in terms of **process optimisation**

Ad-hoc studies performed by Consultants

- Limited in scope to 1 or 2 value chain domains
- Consultant keeps the model
- Little to no retained knowledge at site
- Little to no leverage from past studies (unless from the same consultant)

Site gets a report and sits on someone's desk / inbox and some recommendations are tried

- Site performs own ad-hoc optimisation studies and trials
WHY BUILD A NEW SIMULATOR?

Way forward with IES

Alignment in terms of process modelling, simulation and optimisation

IES

Site Reality

Reliable platform for modelling and simulation on the cloud

Flexible addition of most appropriate models for a site that includes local knowledge and procedures

Manage use of available data in a structured manner

Integrity of simulation results

Integrated and updated

Accessible system for site and consultants

Powerful simulation and optimisation platform for decision support

Retention of site knowledge

Foundation for continual improvement
WHAT IS THE INTEGRATED EXTRACTION SIMULATOR?

- Cloud based multi-component simulation platform
- iPhone Analogy – IES is the iOS, Models are Apps
- Currently has JKSimMet and JKSimFloat models plus custom models for blasting, etc, etc
- P9Q model updates will be deployed regularly throughout project on IES (1 week turnaround)
- Multiple Simulation Capability - Mass Simulation, Sensitivity Analysis and Optimiser
Equipment Process Models linked to Ore properties from universal and/or proprietary tests

- Laboratory Services Models
- Equipment Manufacturer Models
- Site / Local Models
- Researcher Models
- Consultant Models

Symbols:
- BBMWi
- Ci
- SPI
- DWi
- Axb
- Etot
Likely to have multiple Flowsheets for a Site for different purposes

- Increased Data and Applied Knowledge
- Order of magnitude opportunity assessments for circuit alterations
- Focussed troubleshooting
- Operational control and improvement support
USE OF EQUIPMENT PROCESS MODELS

Ore

Primary Crusher

Grinding Circuit

Flotation

Concentrate

Tailings

Add equipment based on circuit

Select appropriate Process Model for Equipment. Several may exist with different input parameters and process logic
Great resolution of the circuit equipment but ....

“It’s worth remembering that good simulation models combined with poor data or poor model parameter estimates can produce highly plausible looking nonsense.”

Wills Mineral Processing Technology 2006
Integrated circuit – Blasting to Flotation

1) Models

2) Simulations

3) Results
1. **Optimise current circuit settings for ore characteristics**

   a. Condition the mill feed and set the mill for max throughput
      
      XXXX Mine to Mill 2007

   b. Set the mill for max throughput
      
      Grinding Circuit Optimisation (XXXX 2009)
      Debottlenecking and Optimisation of SAG Grinding Circuit (XXXX 2015)

1. **Invest capital to change circuit to improve value**

   a. Changes to operations or circuit configuration to reduce throughput reduction for harder ores
      
      Evaluation of Comminution Alternatives (XXXX 2013)

   b. Set the mill to condition the rougher feed for max recovery
      
      Increase Recovery from Grind (XXXX 2015)
Current modelling and simulation study context

IES enables ....

- extend context downstream to monitor effects on flotation
- extend context upstream to vary feed conditioning
- extend for every block in the block model
Mass Simulation – each day, each block in the block model – write distributions not single “average”

Combine Mass Simulation with Optimization – write maximum KPIs and associated mill settings

Optimise KPIs during partial outages, i.e. a Ball Mill offline

Opportunity Assessment of Grinding
Inform further Testwork and/or Site Trials

Performance risk profile across entire concentrator for each option

IES

JKSimMet
Excel

10s of iterations performed manually

1000s of iterations on workstation

10,000s to 1,000,000s of iterations on Scalable Cloud

Extend Dimensionality

Extend Solution Space
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