Whittle Integrated Strategic Planning

Optimising open pit & underground mining businesses

Service Offering

- Improve cash flow profile
- Increase NPV
- Guide investment decisions
- Raise finance
- Harness innovation
- Achieve sustainable operations

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Whittle Consulting - the specialists in Integrated Strategic Planning for the mining industry

The Integrated Strategic Planning Process
Whittle Integrated Strategic Planning is a long-term planning methodology which considers all parts of the value chain, across all periods and includes all stakeholders. As a decision made at any point in the system potentially affects the optimal decision for other parts of the system, the key is to optimise all decisions simultaneously. Only Whittle Consulting has the unique combination of the Whittle Integrated Strategic Planning process, the Whittle Consulting team and the Whittle Consulting proprietary software (Prober-E).

The team
Whittle Consulting is a team of highly experienced industry specialists, who are passionate about adding value to mining businesses.

The software
Whittle Consulting combines this expertise with the power of our proprietary software, Prober-E. Prober-E is the most advanced optimisation software available for the mining industry. With over 30 years of development, Prober-E is a multi-thread, cloud-enabled, non-linear, multi variable, simultaneous optimiser. Prober-E has the power to resolve the largest and most complex Enterprise Optimisation mining models.

The results
Since 1999, Whittle Consulting has conducted over 150 Whittle Enterprise Optimisation studies for mining companies around the world. These studies have repeatedly demonstrated our ability to improve the economics of a mining project or operation from 5% - 35%, and in many cases substantially more. These results are achieved even after conventional mining optimisation techniques have already been applied.

The services
Whittle Consulting offers a comprehensive range of services, specifically designed to the needs of the mining industry. Over the next few pages we list our service offering and invite you to contact us to discuss how we can best be of assistance to your operation or project.

“The results have stunned us. They are far better than we thought they would be.”

Mark Child, CEO and Executive Chairman, Condor Gold, La India Project, Nicaragua

PROBER-E
by Whittle Consulting

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Integrated Strategic Planning Seminar (2 Days)
(Formerly known as the Money Mining Seminar)

The 2-day Integrated Strategic Planning Seminar comprehensively explains the philosophy and methodology of Whittle Integrated Strategic Planning. It includes an explanation of the process involved and the benefits derived from developing a Whittle Enterprise Optimisation model. This seminar presents a framework for cross-functional business collaboration which can be extended to all stakeholders. The ideal approach is for senior managers from all business disciplines to attend the seminar together. Participation in the seminar is either a final step in deciding whether to embark on an Enterprise Optimisation study, or the first step in doing it.

Integrated Strategic Planning seminars have been attended by over 3,000 participants worldwide. You can find the dates and book for upcoming public seminars on our website. In-house seminars can also be arranged, upon request.

Seminar Outline Day One

1. INTRODUCTION
   • Introductions/Objectives/Participation/Workbooks
   • Creating Value
   • What is Optimisation?
   • Integrated Strategic Planning

2. OPTIMISATION Steps 1 – 6
   • Open Pit Case Study: Introduction
     0. Base Case life of mine plan
     1. Pit optimisation: Lerchs-Grossman
     2. Phase/pushback selection
     3. Mine schedule
     4. Cut-off grade: Ken Lane
     5. Blending
     6. Stockpiles

3. OPTIMISATION Steps 7 – 10
   • Process plant calibration (grind/throughput/recovery)
   • Product specification
   • Logistics
   • Capital scaling implications

4. UNDERGROUND CASE STUDY
   • Grade tonnage curves
   • Stope design criteria
   • Mine scheduling
   • Variable cut-off strategies
   • Maximising value

“**A unique approach to optimising project value and cash flow returns...this is well worth attendance & highly recommended.**”

**John Meyer, SP Angel, London.**

Seminar Outline Day Two

RECAP DAY 1

5. ACTIVITY BASED COSTING (ABC)
   • Types of cost accounting
   • Traditional fixed/variable/capital costs
   • Activity Based Costing (ABC)
   • Identifying attributable, period, capital costs
   • Frontline, support, backline activities
   • Examples

6. THEORY OF CONSTRAINTS (TOC)
   • The production line, impact of bottlenecks
   • Theory of Constraints (TOC): Eli Goldratt
   • Mining case study
   • Recommendation 1: Defining constraints
   • Recommendation 2: Treatment of period costs
   • Recommendation 3: Grade control methodology/Grade Bins

7. SUSTAINABILITY
   • The “Five Capitals” – Sustainable Development Balance Sheet
   • SUSOP – Sustainable Operations
   • Integrating EO/SUSOP

8. RISK & UNCERTAINTY
   • Sources of uncertainty
   • Modelling uncertainty
   • Measuring the impact of uncertainty
   • Monte Carlo and Optimisation
   • Real Options
   • Hedging

9. IMPLEMENTATION & CONCLUSION
   • Technical barriers – data, software
   • Organisational/human barriers – “it’s a Minefield”
   • Strategic to Tactical operational considerations
   • The ideal planning process – when and how?
   • Where to next?
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**Strategic Assessment (3-5 days)**

A **Strategic Assessment** is a short exercise to discuss and explore the potential of Whittle Integrated Strategic Planning for your business. Conducted over several days, this involves:

- Examining the current practice for all the key components of Whittle Integrated Strategic Planning.
- Comparing this to best practice.
- Estimating what the scale of benefit (to production, cash flow, or NPV) might be in applying best practice. (e.g. 10-20%, 15-25%, 30-50%, etc.)
- Determining what it would take to apply best practice. (i.e. time, cost, information availability, organisational readiness, etc.)

The Strategic Assessment can be undertaken as a site visit or as a desk-top analysis. The deliverable of a Strategic Assessment is a 20+ page report which identifies the key value drivers for the site. It also provides an educated estimate of the potential benefit of undertaking a full Whittle Enterprise Optimisation study. The Strategic Assessment is written using concepts and terminology explained in the Integrated Strategic Planning Seminar.

**Activity Based Costing & Theory of Constraints Analysis & Design (2-5 days)**

**Activity Based Costing (ABC)**

Cost modelling based on activities performed and their relevant cost drivers, plus a distinction between period/fixed and attributable/variable costs.

**Theory of Constraints (TOC)**

A concept that views any manageable system as being limited in achieving its goals by a very small number of constraints.

Two core elements to be undertaken before building a Whittle Enterprise Optimisation model are the design of an integrated **Activity Based Costing (ABC)** and **Theory of Constraints (TOC)** model. This involves:

- Conducting a series of workshops with management and operational staff.
- The review of the financial and operational information systems.
- The design of a model that identifies:
  - key activities
  - their respective cost drivers
  - the proportion of period versus fixed costs, and
  - the location and nature of the main constraints/bottlenecks in the system.

The population and reconciliation of the resulting model is to be completed by local staff. The conduct of ABC and TOC modelling are worthwhile exercises. They are also the first step in building a complete Whittle Enterprise Optimisation model. In addition, the output provides the template for the design of cost, operational and management reporting systems.

“It is no exaggeration to say that the Enterprise Optimisation techniques, namely the integration of activity based costing and theory of constraints, constitute the most significant innovations that I have seen in almost 30 years of experience in the mining industry.”

Peter Knights, Professor of Mining, Queensland University.

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Enterprise Optimisation (typical duration 12-20 weeks)

Enterprise Optimisation (EO): A single integrated model that consolidates existing knowledge and data from disparate systems.

Whittle Consulting can work with you to construct and operate an Enterprise Optimisation (EO) model. This involves a comprehensive 12-20 week study comprising data collection, modelling, optimisation and analysis. Typically, this would be structured as follows:

MONTH 1: BASE CASE

Build a Base Case optimisation model, replicating and reconciling to the current plan. This uses existing pit, phase or underground mine designs, the current mine schedule, cut-off and stockpiling policy, existing processing and production/commercial assumptions. This phase is intended to match the business’s existing plans in Prober-E, and to check the calibration and accuracy of all the settings through to the current financial model. A base line should be set on social, political and environmental impacts of the operation. The original case is re-valued for the application of ABC/TOC and any other change in assumptions to produce an updated version of the base case. A by-product of this phase is an audit and confirmation of the integrity of the current strategic plan.

MONTH 2: OPTIMISED CASE

Develop an Optimised Case. Allow the optimiser to control the variables that are flexible, whilst observing appropriate constraints. This will revise the pits/phase/schedule/cut-off/stockpiling/blending/processing/production/logistics/capital (i.e. the 10 Steps of a Whittle Enterprise Optimisation model). These 10 Steps are applied consecutively for validation and interpretation purposes, but ultimately simultaneously, to see what the ore body and system is capable of in terms of generating stakeholder value.

MONTH 3: SCENARIOS

With a powerful Whittle Enterprise Optimisation model in place, a variety of scenarios can be explored with this sophisticated optimisation model of the business. The scenarios can reflect different future market conditions, or alternative business strategies. Alternative plans can be developed, evaluated and maintained as options. This prepares the business for future changes to market conditions and business context.

The selected scenario(s) from the Whittle Enterprise Optimisation study become the new strategic plan for the business. In turn, the study becomes the foundation for the objectives, KPIs and performance targets for the whole organisation.

Services timeframe:
Enterprise Optimisation (typical duration 12-20 weeks)

The 10 Steps of a Whittle Enterprise Optimisation Model

There are 10 distinct steps in a Whittle Enterprise Optimisation model. As they are interrelated, they are ultimately considered simultaneously.

"The Whittle Enterprise Optimisation model is tailored for each site. It determines how much capital is worth spending on each constraint, simultaneously rebalancing the pit, phase, schedule, cut-off, blending, stockpile, processing, product mix and logistics to suit the specifics of each mining project or operation."

Lewis Tota, Technical Services Manager, Whittle Consulting.

"I recognised that Whittle had a great process but importantly, the right tool to do the job. Prober-E is that tool. Without it, Integrated Strategic Planning and the optimisation of the entire enterprise simply would not be possible."

Tim Duffy, President Director & Managing Director, Agincourt Resources
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Enterprise Optimisation (typical duration 12-20 weeks)

Recent Examples

Whittle Consulting has developed over 150 Enterprise Optimisation models for mining businesses across all continents and commodities. These have consistently proven to significantly enhance the economics of mining projects and operations. The full effects of a Whittle Enterprise Optimisation study conducted using the Whittle Integrated Strategic Planning process can be extraordinary. Where an NPV uplift of 5% can sometimes be the difference between a project being financially viable or unviable, Whittle Consulting has regularly achieved NPV increases from 5%-35%, and in many cases substantially more. These results occur even when other conventional optimisation techniques have already been applied.

Increasing overall cash flow

![Gold Operation](image1)

![Copper Project](image2)

Bringing cash flow forward

![Underground Operation](image3)

![Precious Metals Operation](image4)

Whittle Consulting NPV uplift results

Typical Net Present Value (NPV) uplift of 15%-65%

“The results from Whittle’s enterprise optimisation across four production scenarios of Condor Gold’s La India Project in Nicaragua, resulted in an average increase of 51% in NPV, 20-25% increase in contained gold with pit shells and a 20% increase in the annual production ounces gold during the first 5 years of the mine life.”

Mark Child, Chairman and CEO of Condor Gold plc
KPI/Management Reporting/Information systems - Design & Advice

Key Performance Indicator (KPI): A set of quantifiable measures that a company or industry uses to gauge or compare performance over time.

A Whittle Enterprise Optimisation study identifies the key drivers of value within the business. It also sets a blueprint for the new operating strategy with a degree of clarity that cannot otherwise be achieved. It is important that cost and operational information systems, management reporting systems and processes, including targets and Key Performance Indicators (KPIs) are aligned with this strategy. If the strategy is to maximise “Net Value per Bottleneck Unit”, then it is important to have reports and targets which are consistent with this objective. Typical targets including, maximising utilisation, tonnes and recoveries allow for a new set of value-based objectives. (e.g. KPIs like “tonnes per hour” need to be replaced with “dollars per hour.”)

With everyone working the right plan and with the right measures in place, the business of mining becomes rewarding for all involved.

Following a Whittle Enterprise Optimisation study, the following can be reviewed and aligned as necessary:

- Operational data systems
- Cost accounting design
- Management reporting
- Key Performance Indicators (KPI’s)
- Targets and incentives

Whittle Consulting can participate and advise, or even lead this stage, or can engage implementation partners, as required.

Implementation Support

The Whittle Integrated Strategic Planning process will identify and prioritise the changes to operating policies that you need to implement. To assist, Whittle Consulting has a range of alliance partners who are experienced and aligned with Integrated Strategic Planning methodology and the Whittle Enterprise Optimisation model. This will ensure the effective realisation of the opportunities Whittle Integrated Strategic Planning has identified for your business.

This support can include:

- Detailed mine design
- Short term scheduling
- Resource & reserve sign-off (i.e. JORC or NI 43-101)
- Operational improvement programmes
- Mining & processing technical support
- A range of mining & processing technologies
- Assays, geo-metallurgical studies
- Mine to mill
- Engineering estimates
- Mining & software
- Management system software
- Sustainability programmes
- Change management

Our network of alliance partners includes:

Ongoing Review & Assessment

As time passes, more data becomes available, operating experience grows, new technologies emerge and the market changes. Strategic plans must also evolve, regularly adapting and evaluating new threats and opportunities as they arise. As a minimum, we recommend updating your Whittle Enterprise Optimisation model annually.

Depending on the size and complexity of the model, and the mechanisms that prove to be important, the Whittle Enterprise Optimisation model can often be maintained in commercially available software tools (Geovia Whittle/SIMO). Alternatively, Whittle Consulting can supply ongoing access to Prober-E through a simple Framework Agreement.
Whittle Consulting operates worldwide
Whittle
Integrated
Strategic
Planning

What are your objectives?

1. Improve cash flow profile
2. Increase Net Present Value (NPV) of a project or operation
3. Support Pre-feasibility Studies (PFS) and Feasibility Studies (FS)
4. Guide investment decisions
5. Raise finance
6. Achieve sustainable operations
7. Respond to market and contextual changes
8. Perform due diligence (DD) and/or validate current plans
9. Design management processes and systems
10. Focus Big Data
11. Identify bottlenecks and leverage points
12. Embrace complexity
13. Enable Business Improvement (BI)
14. Rescue distressed assets
15. Harness innovation

Whittle Consulting

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