Strategic long term planning in mining

by G.L. Smith*

Synopsis

The fundamental challenge facing mineral and metal companies is how to create sustainable value while operating within mandated strategic bounds, identified constraints, and variable market and economic conditions.

This can be achieved by allowing the fixed physical nature of the mineral asset to drive definition of the optimal technical solution to mining and processing activities, and developing and resourcing a strategically aligned portfolio of production entities that creates flexibility to near- and longer-term business environment shifts, i.e. a production mix that allows variation of output to respond to short term market variation, within a long term context.

The practical achievement of this outcome is enabled by the concept of strategic long term planning. The core elements of strategic long term planning in the metals and minerals industry, and the relationship between them, are expanded. The strategic long term planning framework is a logic construct that enables delivery of an optimized, strategically-aligned business plan from the mineral asset portfolio using a set of tools and techniques with a common language, standards, systems and processes to align decisions and actions on a cyclical basis.

Introduction

For a minerals and metal company to create sustainable value from mineral assets, it is necessary to:

- Optimize the composition of the mineral asset portfolio to align with strategic and business objectives
- Create and operate long term assets within an anticipated long term business environment
- Create and retain flexibility of short term tactical response that allows effective response to short term shifts in the business environment.

To achieve this, it is necessary to:

- Allow the fixed physical nature of the mineral asset(s) to drive definition of the optimal (lowest capital cost, lowest operating cost, highest efficiency, maximized cash flow) technical solution to mining and recovery activities
- Define and apply different business environment perspectives, world views, or scenarios, to determine possible economic viability under the different perspectives, i.e. define the value proposition under different scenarios – what are the options?
- Develop and resource a portfolio of production entities from the mineral asset portfolio that creates flexibility to near- and longer-term business environment shifts, i.e. create a production mix that allows variation of output (minerals/metals, operating cost, capital intensity) to respond to market demand and pricing.

These activities require a structured, integrated approach across all elements of the business value chain from exploration through to product sales. The solution lies in systematic application of a series of tools and techniques, within a conceptual framework or philosophy, that aligns decisions and actions across the company, using a common language, standards, systems and processes, and defines the concept of strategic long term planning.

Strategic long term planning

Minerals and metal companies require mineral assets to generate value and attract investment (financial and social). Value generation from the mineral asset(s) is achieved through the application of a suitable business model. Mineral resources are the underlying value construct of the mineral asset. The physical characteristics of a mineral resource such as type and nature of mineralization, and physical structure (depth below surface, shape, extent, dip, surface topography, etc.) are fixed and do not change over time. However mineral assets exist at a place (a specific fixed location) so defining a context (e.g.

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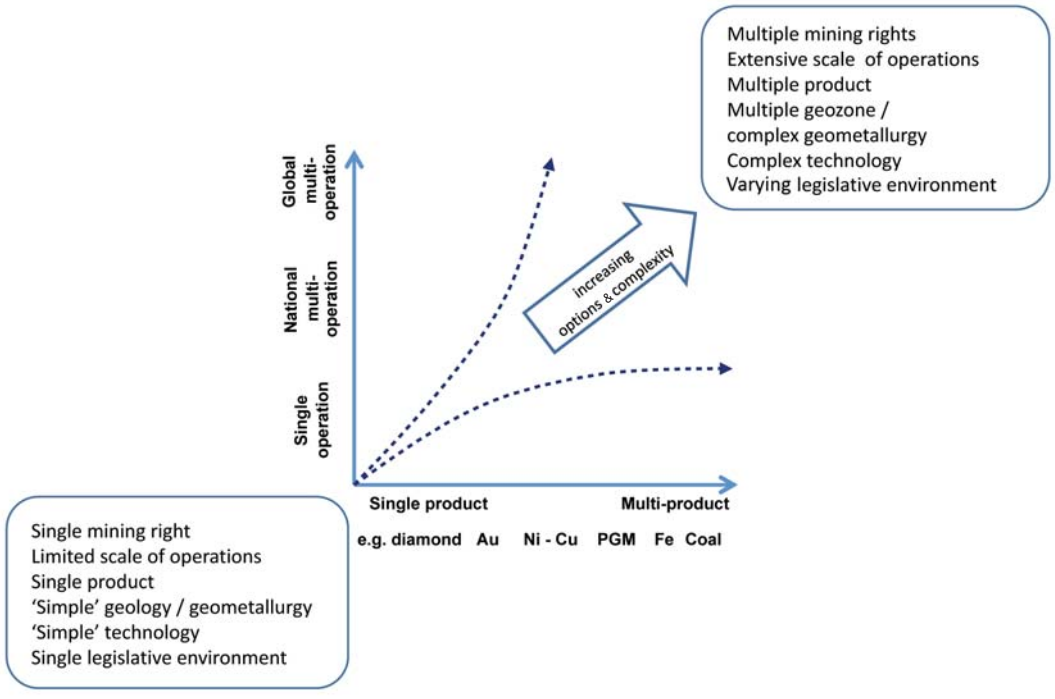

Figure 1—Strategic long term planning—complexity and options relative to nature of operations

stakeholders, legal, social, environmental, infrastructural) that may change over time according to social and political evolution. This is the spatial context that encompasses location and associated operating environment. The selection of a mineral asset portfolio is affected, in the business context, primarily by the perceived financial value (investment quantum, returns, and duration), arising from the mineral asset(s). This value construct is driven primarily by the physical nature of the mineral resource (size, content, and depth, which drive exploitation technology selection), the anticipated market demand for products arising from the mineral asset(s), and an accepted level of business risk in realizing the perceived value. All of these, except the physical characteristics, are influenced by near term and forecast long term, economic and market variables.

The complexity and extent of possible options that arise under these circumstances increases with movement from a single commodity, single operation in one country business through to a multi-commodity, multi-operation, multi-national enterprise as represented schematically in Figure 1.

The combination of the spatial context, economic, market, and technical variables can be defined in a range of possible strategic scenarios or world views in which the value from the mineral asset(s) could be realized. The world view attempts to capture the interdependence and uncertainty associated with key elements of the spatial and business contexts across the long lead times associated with financial returns from mining activities.

Strategic long term planning of mineral and metal companies must therefore incorporate elements of:

- Optimization of the mineral asset portfolio composition
- A long term perspective of a possible business environment
- Flexibility of exploitation options in the short term.

Within this context, strategic long term planning therefore requires a cyclical reassessment of exploitation options (and the composition of the mineral asset portfolio), in the context of anticipated changes in the near- and long-term business operating environment. This results in a near term tactical response (typically in a budget period) and a longer-term strategic response (the long term plan), both of which are encapsulated in the company business plan.

The philosophy of strategic long term planning is simple—it is an integration of logic, process, and methodologies to facilitate long term planning of mineral asset exploitation, within a strategic and market context. Simply put, it creates the link between the market requirements, business strategy, and tactical planning activities. Strategic long term planning creates the basis for the development of a portfolio of operations, current and future, that ensures optimal resource exploitation and creates the flexibility to respond to changing economic and market conditions while operating within legislative and mandated strategic constraints. The nature of these components, and their interrelationship in the strategic long term planning process, is schematically represented in Figure 2.

Interpreting Figure 2 from the bottom upwards:

- The global and national business environments, in conjunction with the characteristics of the market for mining product(s), create the context in which world views or scenarios are developed for application in planning. Critically, this creates the understanding of the business environment in which the mining company operates but also understanding of the key drivers of change from one economic state to the next
- World views or scenarios (the centre link part of the diagram) are developed and used to develop long term planning parameters (global assumptions) that

represent the relevant underlying assumptions for each scenario, e.g. metal prices, exchange rates, escalation, etc. These planning parameters inform the financial analysis and optimization of the business plan, and create the link between mineral asset portfolio utilization and the market

- The annual cyclical business planning process is conducted utilizing the planning parameters (global assumptions) associated with the preferred or most likely world view.

The physical characteristics of the individual mineral assets within the portfolio determine the development of a mine extraction strategy, the mining right plan, the budget, and long term plan per asset and collectively for a multi-asset business. Concurrently value is optimized through application of value-based management principles during the development of the strategic long term plan—at mineral asset level and company level for a multi-asset organization.

The business plan then forms the basis upon which the organization is structured and resourced. Supporting, aligned execution plans are developed for the necessary supporting activities in finance, human resources, projects, engineering and infrastructure, and sustainable development, all of which take place in an annual planning cycle.

- The composition of the mineral asset portfolio is then reviewed and optimized relative to the most likely scenario, the current state of execution of projects, and company strategic intent.
- The business plan, which is the core output of the strategic long term planning process, is then reassessed for a possible shift to the next most likely world view. Real options arising from evolving alternate trajectories are evaluated and a contingency plan is developed, based on planning parameters associated with the alternate scenario.

The operating context

The global and national business environments, in conjunction with the characteristics of the market for minerals and metals (and products) create the context in which a mining and metals company operates.

Key elements of this context are

Characteristics of the mineral resource

The mineral resource is the primary asset underlying value creation through the mining, recovery, and sale of metals or minerals. The objective is to facilitate understanding of the nature of the mineral resource(s) and the geological context in which the business would be operating.

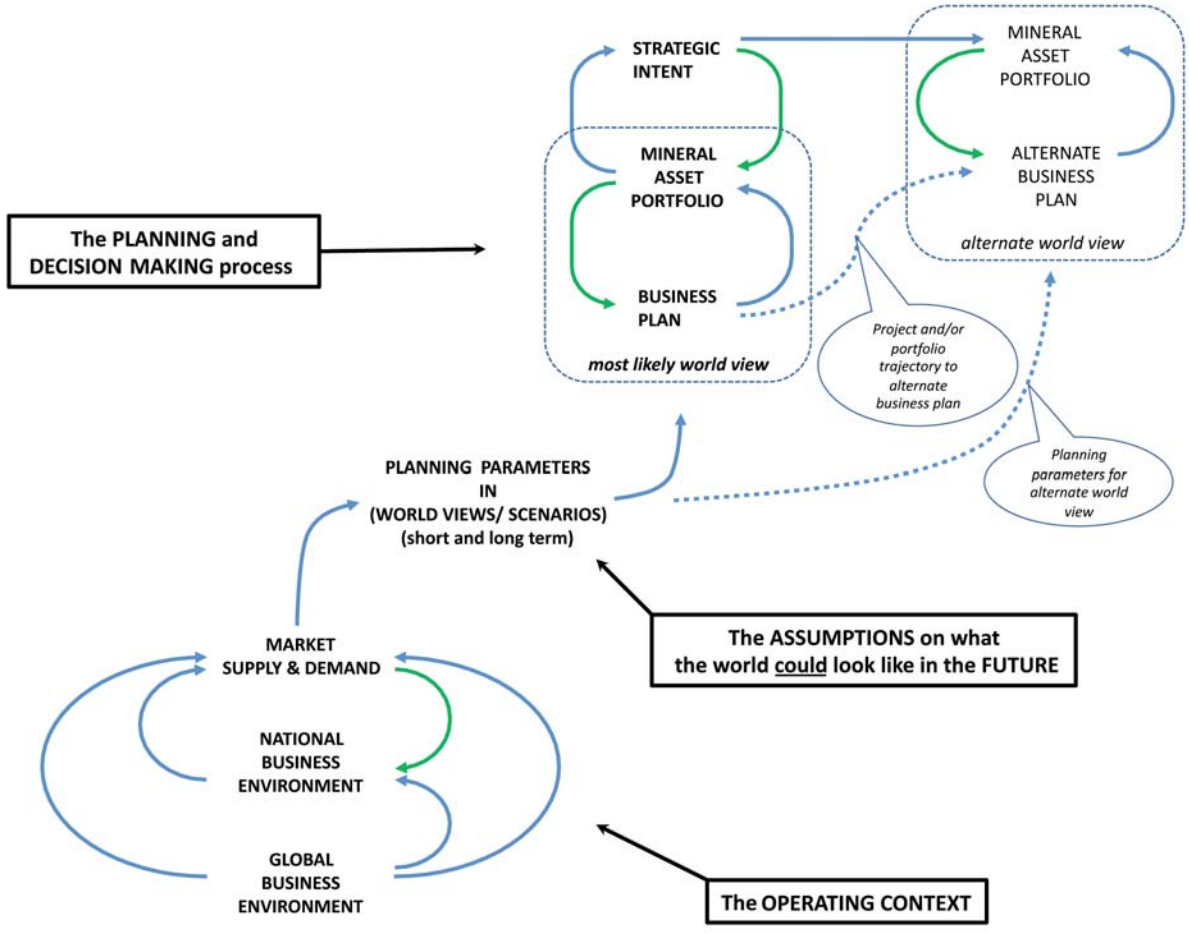

Figure 2—Schematic representation of the relationship of key strategic long term planning elements

Characteristics of the metals/minerals market

Understanding of the market and participants informs value-based decisions and influences strategic actions. The key tools to facilitate market understanding and intelligence are:

- Porter's 1980 'five forces' analysis
- Market information and understanding in the form of a 'fact base'
- An annual industry and competitor analysis
- Industry cost curve analysis
- Supply/demand/pricing analysis and modelling.

Critically, the interpretation of market understanding and intelligence manifests in the strategic long term planning framework through world view or scenario development and the associated global assumptions that are applied throughout the business planning process. Understanding of the market and the environment in which the business functions informs the building of world views or scenarios and the associated global assumptions that are used to develop and optimize the investment centres that comprise the business plan.

The industry value chain

The objective is to describe the major elements within the value chain and highlight areas of strategic planning flexibility. The nature of the value chain is integral to the understanding of the characteristics of the market.

Global business environment

The global business environment can be defined as the global environment that influences local decisionmaking on resource use and capabilities. This includes the social, political, economic, regulatory, tax, cultural, legal, and technological environments. As businesses have no control over the external environment, their success depends upon how well they adapt to the external environment. The ability of a business to design and adjust its internal variables to take advantage of opportunities offered by the external environment, and its ability to control threats posed by the same environment, determine its success. The nature of the global business environment will have an effect on the nature of demand and resultant selection of orebodies for mining. Global economic activity is the driver of consumption of product from the minerals and metal industry. Changes in economic activity have a direct and immediate impact on the industry as they impact demand and ultimately pricing. Anticipating possible scenarios is thus crucial. The critical aspects of the global business environment must be incorporated into the strategic planning framework in order to align long term investment with probable market demand scenarios. This is done through integration of world views that adequately encapsulate the key global dimensions into the planning process.

National business environment

Similar to the global business environment, the national business environment considers the social, political, economic, regulatory, tax, cultural, legal, and technological environments of the country in which the business is operating. Typically this tends to be focused on legislative and socio-political components. In South Africa, the national business environment is dominated by a legislative environment that has been created to move South Africa from a racially biased society to a true, majority-based democracy. The legislative environment is a key enabler of mining and business activities. Acquisition and effective exploitation of mineral assets is predicated on a well-defined and effective system of legal tenure that will allow investment in long life assets. The exploration for and subsequent exploitation of minerals in South Africa is subject to a wide range of legislation and regulation; however, mineral asset acquisition and exploitation is governed primarily by the Minerals and Petroleum Resources Development Act (MPRDA) and associated regulation. The social licence to operate is further impacted by the Mining Charter. Understanding and operating within the context of the legislation applicable to the minerals industry is thus a requisite for effective business functioning and strategic long term planning.

Each of these contextual elements contributes to, and influences, the world views or scenarios that create the context in which business planning takes place.

Assumptions on the future—world views and planning parameters

The reality of the business environment is that it is increasingly complex and dynamic. Developing an understanding of the uncertainty inherent in the external and future environments, and testing the robustness of strategic plans against a set of possible futures, is a critical component of strategic long term planning. Analysing key global trends and seeking to influence the possible business future(s) requires a widening of perspective to a range of possibilities.

In the strategic evaluation of mineral asset exploitation options, a view must be taken of possible future(s) and associated parameters that will influence investment decisions. This view, which is encapsulated in a set of common long term planning parameters (the global assumptions), can and does change in line with macro-economic drivers. While a project development and execution team correctly focuses on ways to mitigate risks associated with local assumptions (project-specific, technical uncertainties), it is imperative that strategic decisionmakers are aware of, and understand, the significance of global assumptions that have a bearing not only on specific project investments, but rather the entire portfolio of mineral assets held by the business.

The complexity of long term planning parameters (typically forecasts of exchange rates, inflation rates, metal prices, cost escalations, capital escalations, working capital, etc.) and the relationships between them and events that occur in the global economy requires that inherent uncertainty in investment decisionmaking and portfolio planning is communicated through scenario planning.

The link between the operating context and the planning of exploitation of the mineral asset is that of world views or scenarios. These are constructed and used to develop long term planning parameters (global assumptions) that represent the relevant underlying assumptions for each scenario, e.g. metal prices, exchange rates, escalation, etc. These planning parameters inform the financial analysis and optimization of the strategic long term plan and the business plan.

Importantly, world views and the development of associated long term planning parameters do not change normal, accepted processes and techniques of business strategy definition. The application of these tools inside the strategic long term planning process provides critical input into the initial stages of information gathering (via the world views or scenario process) and in the identification of critical issues/options facing the business (via the real option analysis process when considering possible trajectories to alternative world views and associated asset extraction plans).

The key processes and tools to develop world views and the associated planning parameters are:

- Scenario planning or world view development
- The development of the long term planning parameters.

Scenario planning (world views)

The scenarios or world views that are developed as part of the strategic long term planning process are integral to the optimization of the mineral asset portfolio; they inform the development of long term planning parameters (the global assumptions) and impact strongly on contingency planning and real options assessment. Critically, the world views or scenarios create the link between the market, the global and national business environments, and the utilization of the mineral asset portfolio.

Developing an understanding of the uncertainty inherent in the external and future environments, and testing the robustness of any strategic plans against a set of possible futures, is a critical component of long term and strategic planning. Analysing key global trends and seeking to influence the future(s) requires opening our minds to a range of possibilities and discontinuities. The complexity of strategic problems and the need to find acceptable solutions requires using methodologies that are innovative, rigorous, and participatory. The development, socialization, and adoption of common world views can be facilitated through a workshop process where scenarios are created as a way of presenting alternative future world views, and from which critical long term planning parameters can be developed.

Key elements of this workshop process comprise

- Learning: developing shared understanding of the methodology and theory, and setting the context
- Scope definition: clearly defining the scope to ensure focus
- Determination of the key variables and drivers specific to the industry e.g. demographics; innovation, science and technology; geopolitical relations and the role of China; the global economy and globalization; natural resources and the environment
- Exploring key themes (e.g. metal/mineral demand, society issues such as the social licence to operate, government issues, environmental issues, technology and alternative applications, capital and operating cost escalators, competitor actions, etc.) aimed at raising key drivers, key questions, and setting the context
- Developing scenario themes and storylines
- Writing up the synthesis and scenarios
- Reviewing the outputs.

Typically, outputs are visually presented relative to two orthogonal axes representing primary drivers of change e.g. global economic activity and metal/mineral dependency, with descriptors of the world views in each quadrant. Dependent on the number of scenarios developed (typically three, maximum four), alternative business options can then be developed with identification of suitable trajectories between scenarios, dependent on changing circumstances or progression between scenarios over time.

The critical difference in this approach is rational movement towards an identified and agreed world view (previously introduced through the scenario development process), rather than an ad-hoc crisis-driven response. The organization knows what trajectory to follow as the contingency positions have been previously defined.

Long term planning parameters (global assumptions)

Cash flow estimates used in discounted cash flow analyses are fundamentally derived from estimates of revenue, operating cost, and capital cost. Extensive effort is directed at estimating costs (both operating and capital) to accuracy levels of less than 10 per cent error during the feasibility studies. Similarly production, grade, and metallurgical recoveries are estimated at comparable levels of accuracy to drive the revenue line. However, an area that is often not subject to the same rigour is the impact on plan viability of assumptions regarding metal (commodity) prices, exchange rates, inflation rates (domestic and foreign), and escalation factors (capital expenditure and operating expenditure).

On the assumption that these global parameters are usually rigorously determined for a five-year period and then maintained at long term trend estimates, the adoption of an optimistic or pessimistic long term perspective can have a significant effect on projects with 15–30 year life spans. The risk of not undertaking viable projects because of a pessimistic long term view, or conversely undertaking marginal projects because of an optimistic long term view, is mitigated through the use of scenarios or world views plus real option valuations. Estimation of these long term planning parameters in the context of anticipated business world views or scenarios is therefore critical.

A critical step in understanding the future is an understanding of the key drivers that determine future developments. These so-called driving forces or causal factors are many and are often complex in their relationships. The relationship of these key drivers can be mapped using causal loop diagrams from which a simplified view of the interrelationship of these driving forces or casual factors can be derived. In this approach the less predictable factors (unknowns/uncertainties) are used to infer the parameters, which are more predictable, which in turn influence the parameters which are utilized in the planning parameters. The logic being that once a view of the outermost parameters has been established (from a scenario), the parameters of the inner shells can be progressively inferred, creating a consistency in the parameter logic that is driven by the possible future world view.

This framework provides guidance as to which parameters ought to constitute the global assumptions, keeping in mind that the purpose of the global assumptions is to create a link between the vagaries of a possible future world and actual parameters that are quantified for investment analysis. In this context the development of alternative global assumptions to align with alternative

future world views is not so much a forecasting exercise, but more a means of understanding the implications of uncertainty and facilitating the testing of investment decisions in the context of future uncertainties. Consistency in the logic of generation of parameters associated with alternate future world views is therefore paramount.

Derivation of the specific global assumptions associated with each scenario is normally conducted separately to the scenario development process. Various technical experts are identified (internal and external to the organization) from different disciplines (economics, marketing, finance, supply chain, capital projects, estimators, etc.) and presented with the scenarios with a request for relevant inputs. In some instances, certain parameters become inputs to other parameters. For example, the view on GDP and inflation is used as input into the expert opinion regarding cost escalation. On collation, the global assumptions are circulated within the same expert group for final comment and alignment as necessary. This approach creates better understanding of parameter interdependency and clarity on the scenario structure, while testing internal consistencies.

Within this approach the following logic applies:

- The cost escalations and demand environment will be driven by descriptors within each scenario
- The metal price forecast is triangulated using cost margins, incentive prices, and analysts' views
- There will be a trend to flat, real-money terms, long term prices when supply and demand are in balance.

The global assumptions are a set of long term planning and economic parameters that best encapsulate the external drivers of value associated with a scenario or world view to be applied in business planning. The aggregated parameters provide a descriptor of a current and future world view and transition between the two. Crucially, the global assumptions provide the link between the agreed world views or scenarios and the associated economic parameters for business planning purposes. The global assumptions create discipline and uniformity of assumptions, as they are the only economic planning parameters permitted to be applied across the organization for planning and valuation purposes. This facilitates comparison and ranking of options.

The planning and decision making process—business planning

The annual cyclical business planning process is executed using the planning parameters or global assumptions associated with the preferred or most likely scenario/world view. The composition of the mineral asset portfolio is reviewed relative to the most likely scenario, the current state of execution of projects, and company strategic intent. The physical characteristics of the individual mineral assets within the portfolio determine the development of a mine extraction strategy, the mining right plan, the budget and long term plan per asset and collectively for a multi-asset business. Concurrently, value is optimized through application of value-based management principles during the development of the strategic long term plan—at mineral asset level and company level for a multi-asset organization.

The business plan, which is the core output of the strategic long term planning process, is then reassessed for a possible shift to the next most likely world view. Real options arising from evolving alternative trajectories are evaluated and a contingency plan is developed, based on planning parameters associated with the alternative scenario. The business plan then forms the basis upon which the organization is structured and resourced. Supporting, aligned execution plans are developed for the necessary supporting activities in finance, human resources, projects, engineering and infrastructure, and sustainable development. All of these activities take place in an annual planning cycle.

Execution of this process, in a planning cycle, requires attention to:

- Business strategic definition
- Business value optimization (value-based management for identification and choice of business model options)
- Long term planning procedures (planning cycle, mine extraction strategies, mining right plans, long term plans)
- Capital investment prioritization, real option analysis and project value tracking
- Portfolio optimization
- Definition of the long term plan and business plan
- Definition of upside or downside responses (contingency plan)
- Execution plans for supporting capability:
  - Project portfolio execution
  - Metallurgical process capacity (smelting, refining, effluent)
  - Infrastructure (water, electricity, roads, rail, housing)
  - People (skills, motivation, organisational culture)
  - Community (stakeholder alignment and participation).

These activities are not necessarily sequential, as feedback loops occur between different activities at different points in the planning cycle. This process is schematically represented in Figure 3.

Business strategy definition

Overall company strategy, as defined and communicated by the Board, directs the execution of the business objectives and provides the framework for decision making. This is the starting point for strategic long term planning for metals and minerals entities.

Typically, company strategic planning follows elements of:

- Information gathering and analysis (internal, external, market)
- Identification of critical issues facing the organization
- Development of a strategic vision statement that sets future direction
- Mission statement review/revision
- Development of strategic goals
- Formulation of strategies for each goal
- Preparation for operational planning based on the strategic plan.

In the strategic long term planning approach, the company strategy directs the objectives of value-based management and defines prioritization logic in the long term planning process, i.e. the overall mineral asset portfolio optimization process is directed by the company's strategic intent.

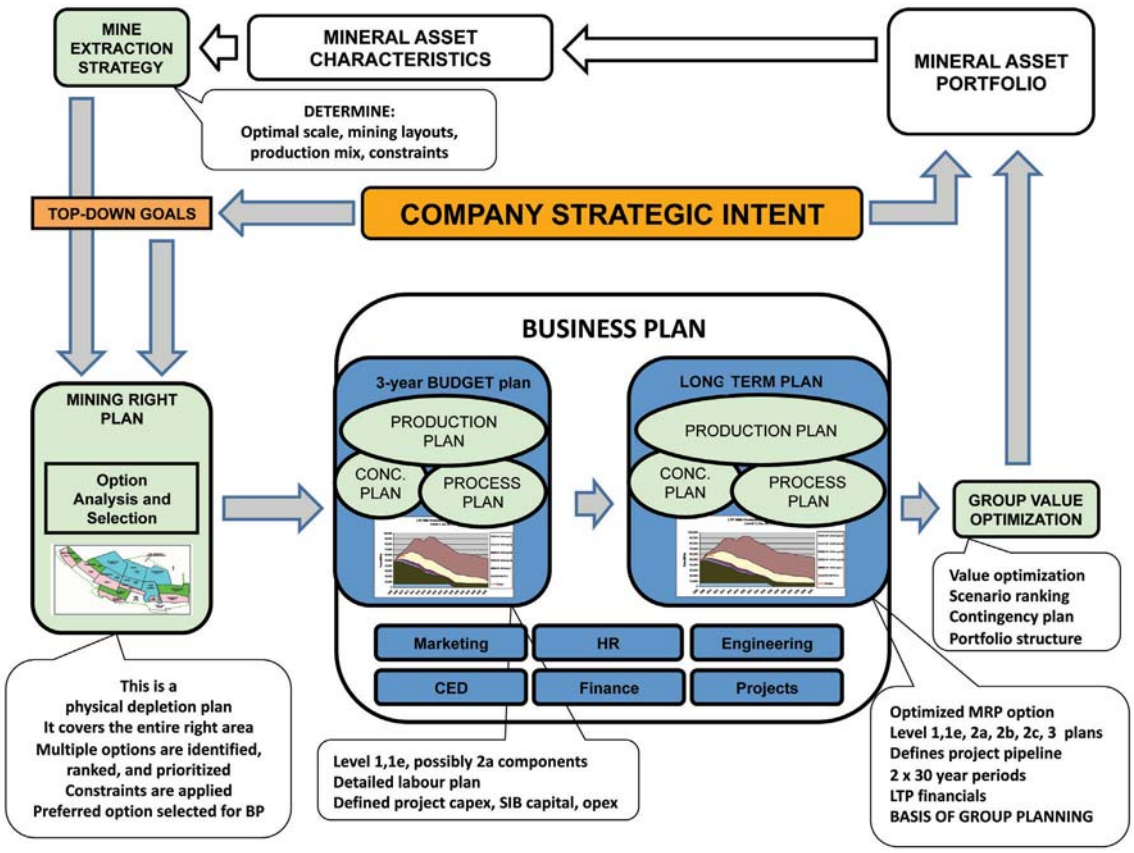

Figure 3—Business planning – key elements and interrelationship

Conversely, the global and local context, along with the developed world views, influence company strategy as part of the information gathering and analysis processes, in the overall strategic planning for the business. Similarly, the real option analysis of the value of possible trajectories/ exploitation choices for the business comprises inputs to the aspect of identification of critical issues facing the organization. The core outputs of the strategic long term planning process are thus also critical inputs into the overall company strategy.

Business value optimization (value-based management)

The logic inherent in value-based management (VBM) is not new to business or the mining industry and has been practised in a variety of forms for several years. Value-based management as a process, within the strategic long term planning framework:

- Provides a set of metrics and a logic framework for value and prioritization discussions
- Ensures alignment of objectives, establishes a common language, standards, and processes to align decisions and actions
- Provides a common approach to setting goals, identifying issues and opportunities, making decisions, allocating resources, and taking action
- Creates a common set of tools and approaches to understand sources and drivers of value, to prioritize issues and evaluate options.

What is different, however, is the adoption of the logic and its application to the strategic long term planning framework. The key question that VBM answers in this process is: What is profitable growth, now and in a possible future world view, and which of the options should be prioritized?

Long term planning process and procedures

The overall objectives of the long term planning process are to create alignment of activities to a common company planning calendar; to ensure utilization of common logic and tools that allow comparison between operations and options; and to generate a common business plan that drives execution of the company strategy. The business planning activity creates a central process around which the business organizes planning activities to meet the needs of the Executive and the Board. It creates an annual rhythm to activities, so that all parties are aware, through the ‘five Ps’ of the planning process (philosophy, programme, process, product, and people) of what must be done, by whom, by when, and to what standard to meet the company’s planning needs. Alignment with support activities is ensured through use of the long term plan as the base plan for resourcing, capability, and infrastructure establishment. The long term planning process ensures optimisation at mining right area level, with strategically aligned constraints, before consolidation and optimization at a mineral asset portfolio (company) level.

Each operation should develop and articulate a mine extraction strategy (MES), from which a mining right plan (MRP) can be developed and the budget and long term plan (LTP) extracted, to form the overall business plan (BP). Each step in the process is a path along a decision tree with choices being identified, rationalized, motivated, and implemented. The long term plan then informs all other disciplines within the business as to supporting requirements to create the business plan. For example, the LTP will inform the concentrator and processing strategies to ensure alignment with overall group strategic objectives. Similarly, in the human resource area it would provide the basis for staffing, skills development, and housing requirements. The business plan covers the life of the operation or the first 60 years (two periods of 30 years to align with the MPRDA,) whichever comes first. It comprises a combination of investment centres at different levels of confidence of estimate, viz. level 1, 1e, 2a, 2b, 2c, and 3 (see below). The business plan forms the basis of the production and cost (opex and capex) forecasting for the company and is used for capital prioritization and value optimization.

The mine extraction strategy is not the plan but a clear, motivated statement of the basic rules that will guide development of the mining right plan and the subsequent long term plan upon which investment decisions will be made. The mine extraction strategy thus informs the nature of the mining right plan specifically: optimal scale, relative production from different ore sources, basic infrastructure options, and critical constraints. The MES is an unconstrained view of the ultimate potential of the mineral asset.

The mining right plan is a physical depletion plan that covers the area over which mining rights have been granted in terms of the MPRDA. As such it is not time-limited and has a life, which is a result of the optimal scale of operations as identified in the mine extraction strategy. The MRP is driven by the mine extraction strategy (scale of operations, layouts, existing asset base, production sources, constraints). It is not necessary that the MRP options all be economically viable, but rather that the full extent of the mining right area be planned in a technically defensible manner at estimates that are current for capex, opex, and the global assumptions. Several options (normally extraction sequencing) should be developed in order to identify an optimized plan (maximized NPV) plan. The planning horizon of the MRP must cover the entire mining right area—viz. it is not time-constrained but spatially constrained (the mining right). A comprehensively scheduled mining right plan (MRP) will result in a view of the mineral resource potential and the mining and concentrating capacity and cash flow required to achieve it. The MRP forms the basis of annual reporting and updating of the mine works programme as required by the Minerals and Petroleum Resources Development Act. The MRP is reviewed and updated annually as part of the long term planning process.

The LTP is a plan (and associated economic analysis) indicating the optimized extraction option selected from the MRP. Cash flow estimates from the LTP are used to forecast estimates of value for a project, a mine, and the company. The LTP is constructed from investment centre models representing logical mining units (by reef type) and project area. It comprises a combination of investment centres at different levels of confidence of estimate, viz. level 1, 1e, 2a, 2b, 2c and 3.

The MRP and LTP leading to the business plan comprise a number of investment centre models representing planning at varying levels of estimate confidence. Logically, as study work is completed, investment centres progress from the lowest levels of confidence estimate through to execution.

Level 1 plans are effectively current operations (level 1) and approved projects in implementation/execution phase (level 1e) that have necessary project capital expenditure authorized and thus require only stay-in-business capital expenditure for the balance of planned life.

Level 2 plans are effectively proposed capital investments or projects and are divided into three sub-categories (a, b, and c), which are related to the confidence stage at which the respective proposed capital investment or project was last reviewed. These sub-categories are governed by a stage-gate review and approval process and comprise:

- Level 2a (feasibility study at ±10 per cent estimate confidence)
- Level 2b (pre-feasibility study at ±15 per cent to 20 per cent estimate confidence)
- Level 2c (conceptual study at ±25 per cent to 30 per cent estimate confidence).

Level 3 plans effectively cover the remaining extent of potentially exploitable resource within the area covered by the current mining authorization. The level 3 plans are at best scoping studies, may be based on inferred mineral resources, and generally not subjected to a rigorous stage-gate review process.

Two sub-categories exist in level 3; 3a and 3b:

- Level 3a (scoping study at > 30 per cent estimate confidence)
- Level 3b (scoping study at > 30 per cent estimate confidence based on pre-resource material, ‘blue sky’ opportunities).

Despite the best efforts to plan and find viable means of extraction, an investment centre (project) may not form part of the business plan for two reasons: economics or insufficiency of engineering work. This gives rise to two other categories:

- Not in business plan—NIB (eng)—these are uneconomic investment centres that may have been subject to extensive study work through to pre-feasibility level but are uneconomic for current long term planning parameters
- Not in business plan—NIB (nw)—these are investment centres that have not had any study work done on them to date or where exploitation is planned well in the future (>30 years).

The relationship of levels of planning to one another and to time is shown in Figure 4.

Contingency planning

Contingency planning identifies a controlled trajectory toward reduced or increased output relative to that originally planned in the long term plan and the business plan. Changes in output are likely to be necessitated through radical market

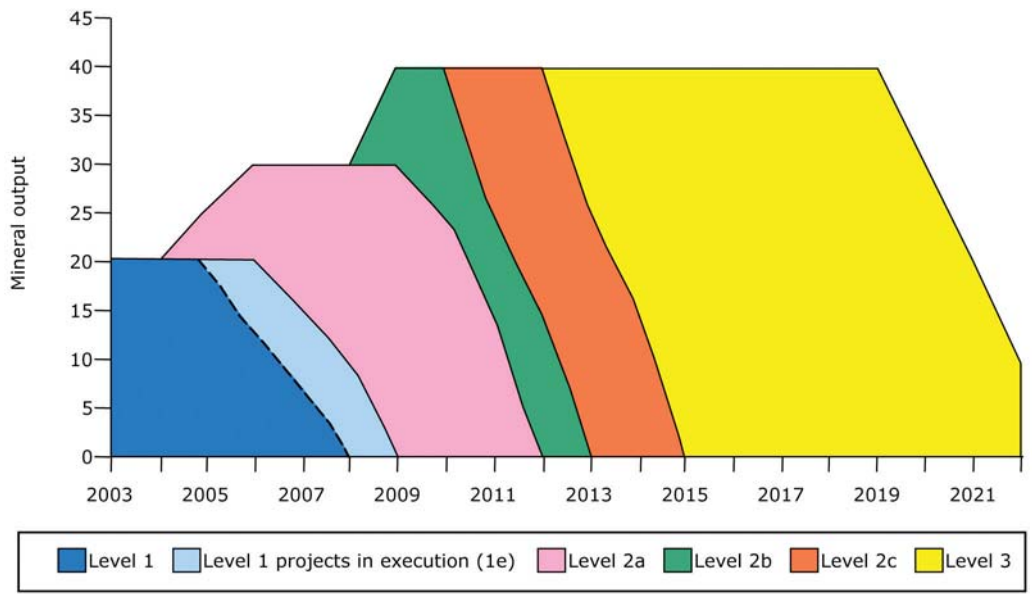

Figure 4—Schematic relationship of long term planning level categories

shifts, i.e. a shift to a different world view ahead of the expected timeline. Typically downside shifts are rapid and brought about by crisis, while upside shifts tend to be more gradual as markets tend to expand at a sustainable growth rate driven by capital cost and availability. Contingency planning is the preparation for an unexpected, rapid shift in industry dynamic. Despite development of world views or scenarios, the rate of change between anticipated world views is difficult to anticipate. Generation of contingency plans allows a rational, controlled shift between one operating state and the next based on earlier analysis. It is a means of reducing the scale of crisis through anticipation and prior sensitization. Contingency planning recreates the link between the business plan and the world views by creating an iterative loop based on a different set of global assumptions. This process is real option valuation and drives re-optimization of the long term plan and the mineral asset portfolio composition in the light of a possible alternative world view.

Contingency plan actions are a sequence of logical steps to move toward a lower future output profile from both current operations and future investments. These are evaluated by investment centre and downscaling options may include closure, delay, or mothballing. Three primary factors are used to drive the prioritisation of potential 'Plan B' actions:

- The market price for the product at which each investment centre becomes NPV break-even
- The working cost to revenue ratio for each investment centre as a measure of cost efficiency
- The potential mine output over the following five years.

In addition, a number of further factors are used to help identify 'Plan B' options:

- Dependencies between investment centres and any shared capital expenditure
- Strategic factors, including in South Africa potential impacts on mining rights or ability to meet BEE requirements
- Investments required to ensure that future mine economics are sustainable
- The ability to effectively mothball (place on care and maintenance) investment centres and restart operations should market outlook improve
- The potential to reduce fixed cost and the overall impact on the financials.

The development of these priorities requires input from multiple parties including the operations, projects, processing, and planning. Annually a contingency plan is developed as part of the long term planning process.

Valuation logic

Definition of a common approach to valuation modelling of capital investment decisions within the strategic long term planning framework is crucial and provides a basis for consistent valuation modelling practice. Discounted cash flow (DCF) methodology is applied, with emphasis on net present value (NPV) and internal rate of return (IRR). Distinction is made between the capital investment decision from which consideration of historic/sunk cash flows is excluded, as it has no bearing on the future viability of the investment, and assessment of overall business performance where it is necessary to include all past cash flows. Determination of project value (NPV) is based on the philosophy of a differential value obtained from the difference between the base plan at level 1e (the agreed and financed production, cost, and capital profile associated with all investment centres at level 1e and 1 with economic tail management applied) and the base plan plus the project (with its associated combined production, cost, and capital profile plus economic tail management), i.e. mine plus project less mine without project.

Valuations are conducted with and without tax shield benefits. Excluding tax shield benefits (stand-alone

assessment) allows ranking of projects, while inclusion of tax shield benefits indicates the likely return from the project once included into the overall business plan portfolio.

Inclusion of real option logic into the strategic long term planning process is achieved through:

- Defining world views/scenarios to quantify uncertainty (economic uncertainty)
- Investment centre categorization by confidence of estimate (technical uncertainty)
- Defining minimum DCF investment criteria (e.g. cost of capital and risk-adjusted discount rates) to allow inclusion in the plan
- Having a defined contingency plan that highlights the relative priority of options (maintain, expand, delay, close, dispose) available for consideration
- Cyclically evaluating all options within a mining right area (the mine extraction strategy) with the intention that the best option, the option that meets a strategic intent (the business plan constraints) be selected
- Continuous transparency within the mining right plan portfolio of investment centres.

Despite categorizing projects that form the mine extraction strategy and mining right plan on the basis of engineering confidence of estimate (levels 2a, 2b, 2c and 3), it is still necessary to prioritize projects on the basis of value-add to the overall business plan. The primary measure of value, in the overall strategic long term planning process, is that of net present value (NPV) coupled with internal rate of return (IRR) relative to an agreed minimum rate of return (an investment hurdle rate, either weighted average cost of capital or a risk-adjusted discount rate). This is done on an incremental basis for each project. However, given that the business plan is a combination of a short term budget period plus a long term plan, it is necessary to bring into consideration the effect of short term cash flow. The long term objective of the organization is to maximize value, but this has to be tempered with the need for balance sheet management and near term cash flows.

Project value tracking

The ability to develop a continuous feedback loop of business investment performance relative to original investment criteria (technical, capital, and otherwise) is essential if investment decisionmaking and value maximization is to be continuously improved. Value tracking of capital investment decisions is thus critical for mineral asset value optimization and capital prioritization in large multi-investment organizations. The use of common investment centre models, as developed and applied in the overall short- and long-term planning process, allows integration into existing reporting and governance cycles, and ensures alignment with the overall business planning process.

Project value tracking (PVT) analysis takes the form of a waterfall chart, which illustrates the relative importance of various external (environmental variables) and internal (management levers) factors that have caused the NPV to change since the original view baseline model. Figure 5 indicates a typical PVT analysis for a South African platinum producer.

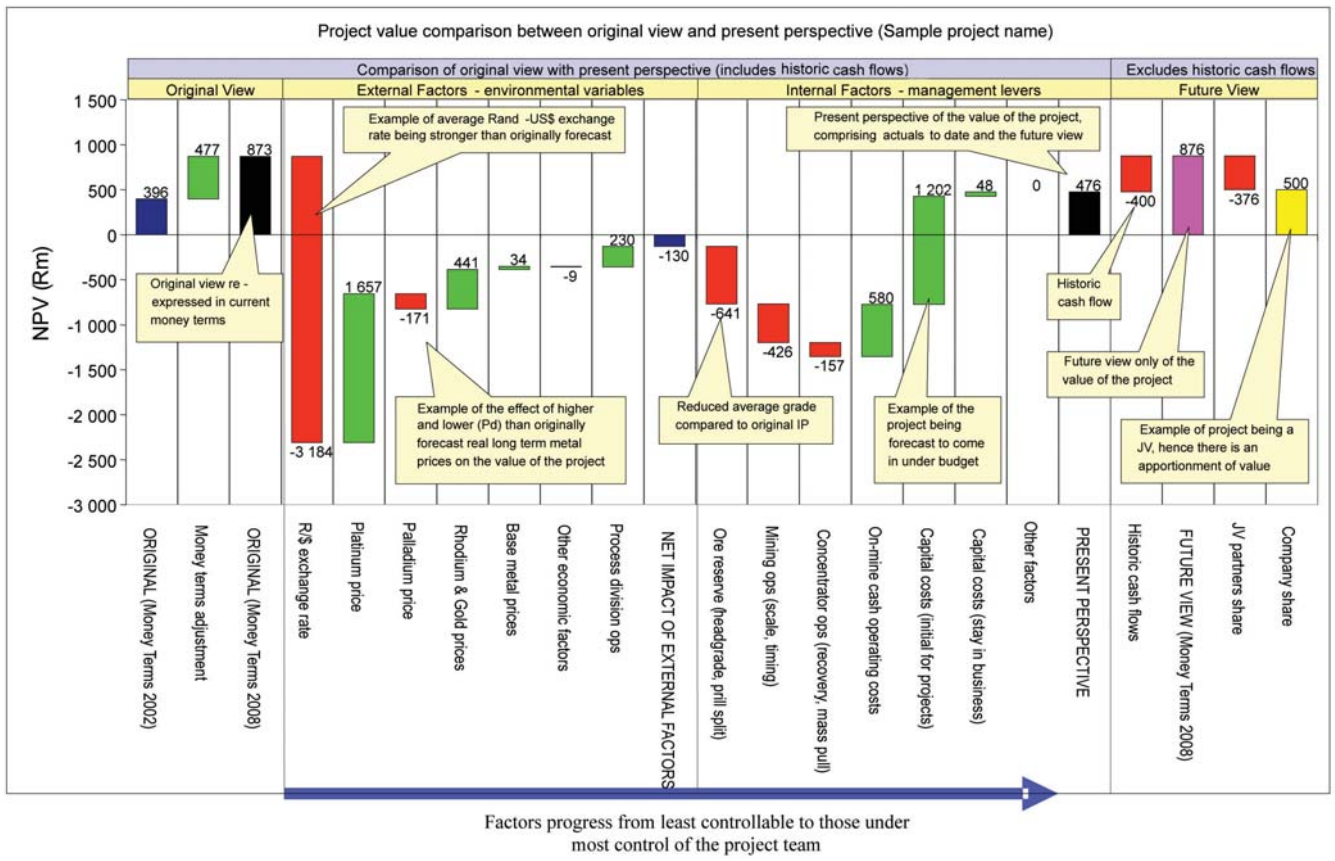

Figure 5—Project value tracking – example waterfall chart for a South African PGM producer

Enterprise/portfolio value optimization

Business strategy defines the context in which the mineral assets are to be exploited. Strategic objectives relating to market capacity (the ability to absorb output, ultimately leading to market share), operating cost curve positioning, and targeted return on investment (leading to capital availability), coupled with the nature of the mineral assets in the portfolio, shape the potential overall exploitation trajectory. For a multi-mineral asset holding organization, i.e. one with multiple possible sources of metal production, it is highly unlikely that the business strategy will allow unbridled expansion. Typically this constraint manifests as capital availability (based on sustainable growth and necessary return on capital) and the inability of the market to absorb increased production volumes without significant reductions in metal prices. Within this context the business plan portfolio, thus comprises those investment centres which meet a value maximization objective within the strategic constraints.

Typically the business plan would thus comprise a collation of investment centres that:

- Generate a production profile that provides metal to market at a rate that matches the most likely macro-economic world view (scenario)
- Give an acceptable return on investment (meet a prescribed hurdle rate) for a defined balance sheet structure (debt levels)
- Ensure security of mineral right tenure through progressive utilization of mining rights ('use it or lose it').

Within this framework individual projects (expansion or replacement) will compete for funding based on criteria of:

- Return on investment
- Timing of metal to market
- Future operating cost positioning relative to the competitors
- Sequencing or ability to unlock future higher value options.

Critical to this overall approach is understanding where the greatest opportunity and flexibility exists, within the value chain, to optimize overall business value. Optimization techniques can be used to enhance the value of the business by maximizing value associated with the flow of metal through the different elements of the value chain. The key challenge is to simultaneously optimize elements of the value chain rather than to optimize component parts in isolation from the remainder of the elements. Enterprise optimization is therefore based on building an integrated geological, mining, processing and market model which allows optimization of variables along the value chain. This allows development of strategic long term plans that are optimized on a value chain basis using mineral asset portfolios coupled with existing and planned infrastructure (mining, process and transportation). Enterprise optimization is thus the process whereby all the elements of the value chain are examined and optimized simultaneously, to allow decisions on:

- Mining schedules—where and at what rate to mine (pit and/or underground)
- Cut-off grade and blending—what to discard, stockpile or process
- Processing path and/or plant operating strategy
- Processing capacity requirements
- Logistics configuration
- Capital sizing of all steps in the value chain
- Product specification, mix, and timing.

The result is a long term plan with significantly improved cash flow profile, reducing risk and creating value options that can be varied according to the anticipated scenario/world view. Additional opportunities thus exist to model potential future scenarios and identify how to capitalize on potential opportunities and/or mitigate threats. Development of in-house enterprise or group value optimization tools/expertise, or the contracting out of this work to external entities, is an integral part of value-based management.

Execution plans for supporting capability

The ability of a mining company to effectively execute an integrated business plan is dependent on alignment of activities of all participants in the company value chain (mining, process, projects and engineering infrastructure, human resources, marketing, corporate affairs, and finance). One of the key objectives of the strategic long term planning framework is to create alignment of activities across functional groupings and along the company value chain. This is facilitated by the integrated process and dependencies created between the business plan and resourcing of the various support functions.

The business execution activities of an integrated minerals and metals company can be broadly sub-divided along the value chain into two groupings—operating and support. The operating activities are mining and process, underpinned by project and engineering execution. These core operating activities are in turn provided support services by the functions of human resources, operational engineering, marketing, finance, and corporate affairs. This is schematically represented in Figure 6.

Core optimization of production in response to anticipated market and stakeholder demand occurs, for a multi-mining right entity, within the mining activity. The related operating activities of process and projects are structured and optimized to match the anticipated strategic long term plan (SLTP) production profile. Process capacity is designed and implemented in anticipation of the aligned mining production profile developed in the SLTP. Projects necessary to the SLTP are then optimized, engineered, and executed according to the SLTP timing requirements. Similarly, the support functions of human resources, finance, engineering, marketing, and corporate affairs create capacity and capability to allow effective execution of the SLTP.

Process: Alignment of the process value chain activity is primarily capacity-driven. Consideration is given to installed capacity for each of the key process elements such as concentrators, smelters, and refineries. Based on this type of data, opportunities for scale and timing optimization are

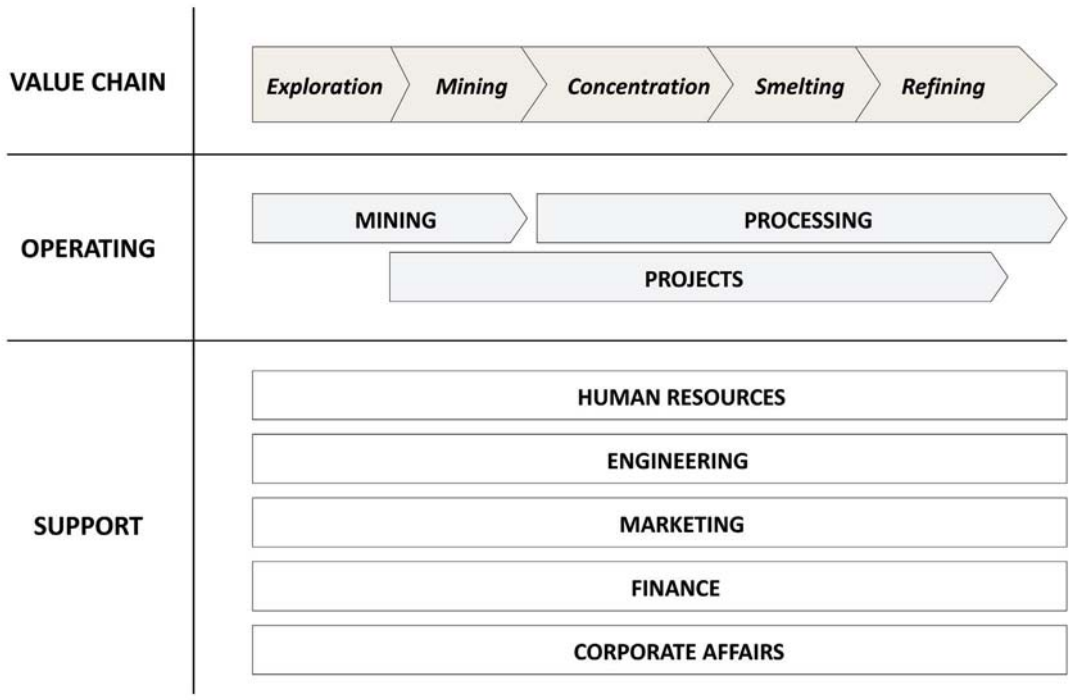

Figure 6—Alignment of operating and support activities to the value chain

explored to ensure timing and capital efficiency. Capacity decisions defined during this process then influence parameters applied in the global assumptions where relevant. Decisions on installed capacity associated with the final business plan then influence staffing structures, operating cost, and capital (project and SIB) requirements.

Projects: The project portfolio for the company is defined by the project content of the business plan. Each mineral asset has, by virtue of its long term plan, a sequence of projects that require execution, on a timeline, to deliver on the plan. The aggregated project requirements across the company provide the projects portfolio. Necessary capacity, capability, and infrastructure can then be created to execute the project portfolio as per the business plan timelines. Opportunities may exist to smooth capacity requirements through outsourcing, depending on the overall business model applied. Staffing and operating cost is determined by the capacity required to execute the project portfolio, while overall project capital is defined by the project portfolio in the business plan.

Engineering and infrastructure: Engineering activities are focused primarily on maintenance of the existing asset base (the routine engineering activities required to maintain the engineering infrastructure) and the establishment of the necessary infrastructure to match SLTP requirements. To allow execution of the SLTP, critical infrastructure in the areas of electricity supply and distribution, water supply and distribution, and transportation systems is necessary. This infrastructure has long lead times and requires engagement with governmental structures and communities for approval and execution.

Electricity supply requirements are estimated from the business plan profiles based on project requirements plus anticipated process power draws. An interactive long term consumption estimation model should be constructed to forecast average power and peak power requirements based on production profiles. An integrated power supply and distribution strategy can then be developed that integrates anticipated utility power supply profiles with anticipated energy savings, self-generation requirements, and any shortfalls to be supplied from independent power producers.

Water is fundamental to the business of mining. Development of a SLTP-aligned strategy for the use and discharge of water that caters for various medium- and long-term scenarios/world views is therefore critical. A water strategy plan that considers existing supply, potential storage facilities, and inter-basin water movement should be developed. This plan should indicate anticipated shortfalls/excesses in supply at various stages in the business plan and contingency plans for alternate supplies, e.g. use of municipal grey water. Maintaining a close relationship with Government in the development of the medium- to long-term water strategies to avoid competition for water resources is crucial. The overall water strategy should be fully integrated with provincial and municipal development plans. Key principles are to:

- Manage water consumption to as low a level as possible
- Guarantee water availability
- Limit negative impacts on water sources
- Ensure that mining-related consumption does not adversely impact the availability of water to other users.

The concept of the true value of water that takes into account the other costs of using water, such as social and ecosystem implications, is central to this approach.

Similarly, an integrated transportation infrastructure plan that aligns with the SLTP is necessary. Maintaining a close relationship with Government in the development and integration of the medium- to long-term transportation strategies is crucial, as substantial portions of transport infrastructure can be dual-use and are often in public space. Typically the transportation plan would encompass elements of:

- Ore transportation from mines to concentrator facilities (road/rail)
- Concentrate movement between concentrators and centralized smelter facilities (road/rail/pipeline)
- People movement to and from operations – usually road
- Precious metal transportation.

Similar principles to those applied to water are utilized for transportation to minimize negative public impact.

Human resources: Outside of basic human resource strategy encompassing employee relations, industrial relations, HR skills and competencies, culture, and values, the core consideration that is driven by the business plan is that of alignment of capacity and capability. Specific attention should be given to:

- Overall staffing levels and required skills by activity by operation
- Longer-term skills development
- Housing requirements
- Training requirements
- Transformation
- Incentive schemes.

These aligned requirements then define the necessary operating cost structures and capital requirements to effectively execute the business plan.

Corporate affairs: Corporate affairs manifests largely in the realm of sustainable development. In South Africa, the Mineral and Petroleum Resources Development Act (MPRDA) requires all mining operations to have social and labour plans and environmental management programmes in place, and to comply with, and publicly report on, progress towards meeting the requirements of the Mining Charter. The strategic long term plan provides the basis on which social and labour plans and environmental management programmes are structured to ensure alignment with overall business objectives.

Marketing: The interaction between the SLTP and marketing comprises two phases; the supply/demand dynamic and forecast market excesses/shortfalls that provide the initial input into the business strategic intent, and the alignment of sales contracts, by metal, based on the business plan that arises from the SLTP.

An annual industry and competitor analysis is necessary to fully understand the market dynamic and likely supply/demand/pricing scenarios. These inputs are integral to the value-based management approach and definition of metal pricing in the world view or scenario development that defines the global assumptions.

Many minerals and metals products are sold primarily through contractual agreements with the primary consumers. The structure of these contracts (volume, price, delivery, form) is influenced by the forecast availability of metal arising from the business plan as developed through the SLTP.

Finance: Outside of the routine management accounting and corporate finance functions, finance activities are focused fundamentally on cash flow and balance sheet management for the SLTP. Mining projects are invariably long lead time, high capital requirement entities requiring cash flow management over extended periods. The ability to generate pro forma annual financial statements from the economic models of the business plan arising from the SLTP, over a range of time periods for a range of scenarios, facilitates cash flow, and balance sheet management.

The ability of a mining company to effectively execute an integrated business plan is dependent on alignment of activities of all participants in the company value chain. One of the key objectives of the strategic long term planning framework is to create alignment of activities across functional groupings and along the company value chain.

The long term plan thus provides the basis for resource planning of all support capabilities (process, engineering, projects, infrastructure, human resources, finance, marketing, and corporate affairs). Supporting capability plans are aligned with the business plan requirements and resourced to ensure timely delivery of capacity and capability as necessary.

Conclusion

Strategic long term planning of mineral resource extraction is an approach that acknowledges the nature of the depleting mineral asset base, the importance of a defined but flexible project pipeline, variability in market conditions and the requirements of the operating legislative environment. It is a logic construct that translates into a defined outcome—the business plan, through a series of repeated actions, using a standardized set of tools and techniques. It creates discipline and structure to allow shared understanding of the opportunities and challenges facing a mining and metals company. The framework provides the basis for effective management of large, diverse, complex, mineral asset portfolios while creating shared understanding and a common language.

There are no complex equations or processes but a coherent, logical process that integrates various elements, using tools and techniques that are known, or intuitively understood, by most participants—scenarios, discounted cash flow analysis, value-based management, project value tracking logic, ranking and prioritization, option identification, and analysis to create order and logic.

This approach

- Enables integration between corporate and operations, both mines and process operations, and between MRM/finance/business development/projects
- Creates a planning process that is routine but sufficiently adaptable, and which allows for planning flexibility
- Facilitates communication between stakeholders (corporate, operations, services, projects)
- Defines the process, its components, and inter-dependencies
- Produces a defined product that is aligned to expectations and allows effective decision making
- Defines accountability, roles, and responsibilities
- Ensures delivery of a value-optimized, strategically aligned, production profile from the business mineral asset portfolio.

Strategic long term planning is a logic construct that enables delivery of an optimized, strategically aligned business plan from a mineral asset portfolio using a set of tools and techniques with a common language, standards, systems, and processes to align decisions and actions on a cyclical basis.

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