Strategic long-term planning at Anglo Platinum

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Synopsis

This paper consolidates the key elements of seven contributions, on strategic long-term planning, to two of the three international conferences on Strategic versus Tactical approaches in Mining held over the period 2005–2008.

The holistic concept of strategic long-term planning as developed and implemented at Anglo Platinum is described. Consideration is given to the planning cycle, principles supporting the construction of the long-term plan, and aspects of unique best practice as developed in Anglo Platinum. Further description of Anglo Platinum's approach to corporate governance, including the processes, methodology, systems, unique tools and techniques that are applied to value and select capital investment options is also given.

Introduction

Anglo Platinum was created in the mid 1990s as an outcome of the unbundling of Johannesburg Consolidated Investments (JCI) and as a result acquired ownership and control of Rustenburg Platinum Mines Ltd (Amandelbult, Union, Rustenburg and Mogalakwena (previously known as Potgietersrust Platinum) sections) and ATOK or Lebowa Platinum Mine as we know it today.

The consolidation of previous JCI platinum operations brought with it a mix of operational approaches and planning perspectives. The approach to running the Anglo Platinum operations at this time was one of autonomous, empowered, decentralized business units where each business unit developed and pursued its own strategy.

The inevitable result of this philosophy was that each business unit developed its own planning methodology and systems, resulting in difficulty in making comparisons, benchmarking of performance and developing effective Group consolidations.

In late 2003 Anglo Platinum and its major shareholder Anglo American plc conducted an operational review of the company, which highlighted the need to move to a centralized and standardized way of conducting business and running its operations. Subsequently during 2004 restructuring of corporate and technical support staff was implemented. The objective of the restructuring process, in the technical arena, was to streamline decision making from the corporate head office, provide a central knowledge pool of how various technical functions should be undertaken in the Group and assess the competence and capacity of the operational technical support staff.

A critical outcome of this process was the centralizing of strategic long-term planning with the objective of ensuring effective engagement with the operations, in terms of strategic long-term planning, and the executive committee (EXCO) in terms of strategic alignment, scenario development and evaluation, and capital investment prioritization.

Key deliverables from the strategic long-term planning department are:

➤ Creation of single point of accountability for the entire Group's strategic long-term planning activities
➤ Development and implementation of an integrated strategy, planning and capital management process and systems on a coordinated timeline for the Group mineral assets
➤ Effective integration of scenario optimization and capital efficiency prioritization into the long-term planning process
➤ Development and implementation of an enhanced Group value optimization process and systems.

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The annual strategic long-term planning cycle

Anglo Platinum's long-term planning cycle is initiated in the first half of the year (see Figure 1), with clear objectives (production output volumes and headgrade, draft operating cost and draft capital expenditure) defined by the Anglo Platinum EXCO in the context of the Group strategy.

Within this strategic context each operation conducts a review of its strategy and previous long-term planning to ensure alignment with Group objectives. Detailed operational planning is conducted to develop an optimized long-term plan (LTP), based on forecast economic parameters, anticipated production performance and updated mineral resource estimates.

The first three years of this LTP, which is completed in June, provides the basis for refinement of the operational budget during the second half of the year. Subsequently, following the budget approval, final budget parameters are aligned within the original planning resulting in a final budget aligned LTP in the fourth quarter of the year.

The long-term planning process is thus a continuous process, that when carried out comprehensively reduces risk and improves accuracy, integrity and achievability with each cycle.

Strategic long-term planning (systems and methodologies)

Mining operations within the Group develop and articulate a mine strategy, from which a mining right plan (MRP) is developed. From this the most appropriate option is put forward and represents the operations LTP. Each step in the process is a path along a decision tree with choices being identified, rationalized, motivated and implemented.

The relationship of these integrated planning elements within the overall strategic planning process is represented in Figure 2.

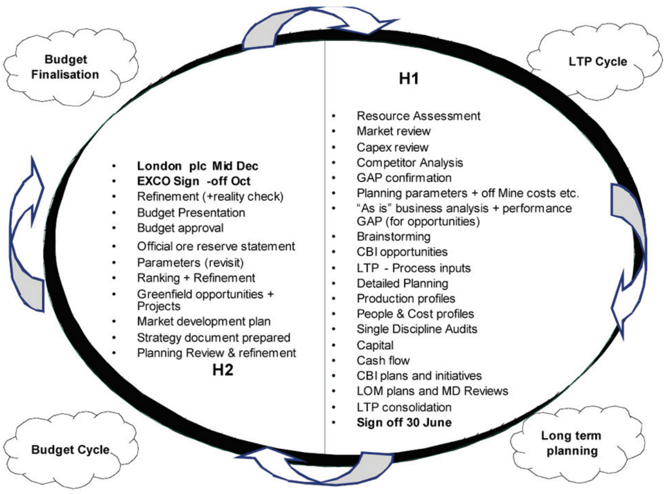

Figure 1—Long-term planning cycle (Andersen *et al*., 2009)

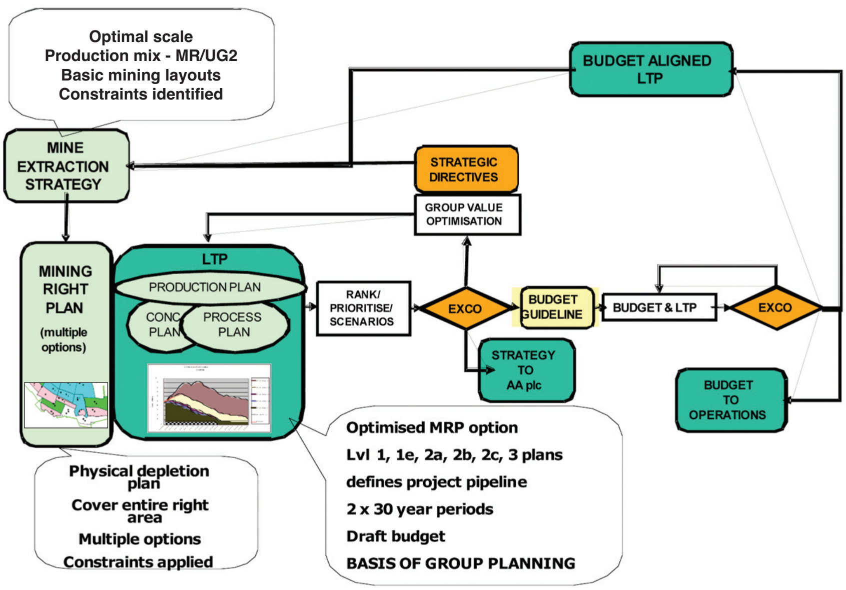

Figure 2—The integrated strategic long-term planning process (Smith and Pearson-Taylor, 2006)

Mine extraction strategy

The mineral resource forms the fundamental asset of any mining company. In order to optimise economic return (viz. to maximize net present value (NPV)), clarity is required on:

- ➤ How the entire mineral resource associated with the mining right area (MRA) is to be exploited
- ➤ Over what time period
- ➤ At what cost (capital and operating).

The mine extraction strategy (MES) sets the context in which all other strategic planning is done. Key issues that must be addressed are:

- ➤ Optimal scale of operations
- ➤ The associated tonnage source split from multiple reef horizons
- ➤ Technology selection and associated mining layouts
- ➤ Critical constraints, e.g. water supply, tailings disposal
- ➤ The influence of existing asset base, e.g. timing to optimal rate and split
- ➤ Identification of consequences for downstream recovery processes and other critical interfaces such as skills resourcing.

The mine extraction strategy thus informs the nature of the MRP specifically: optimal scale, associated reef mix (where multiple economic horizons occur in a MRA), basic infrastructure options and critical constraints.

It is important to note that the MES is not 'the plan' but a clear, motivated statement of the basic rules that will guide development of the MRP and the subsequent LTP upon which investment decisions will be made.

Mining right plan

This is a physical depletion plan that covers the area over which a mining right has been granted in terms of the Mineral and Petroleum Resources Development Act (MPRDA). The MRP is driven by the MES as outlined above. As such it is not time limited and will have a life span, resulting from the optimal scale of operations as identified in the MES.

It is not necessary that the MRP be economically viable across the full life span but rather that the full extent of the mining right is planned out in a technically defensible manner using appropriate capital and operating cost estimates, and the prevailing global planning parameters. Several options (normally extraction sequencing) should be developed in order to identify an optimized (maximize NPV) plan.

The planning horizon of the MRP must cover the entire MRA (it is not time constrained but area constrained). The MRP is reviewed and updated annually as part of the LTP process.

Long-term plan (LTP)

The LTP, which comprises production, operating cost and capital cost estimates for the life of the operation or the first 60 years (two periods of 30 years), which ever comes first, provides the basis from which requirements for concentrating, smelting and refining capacity are estimated. Two 30-year periods are considered because 'new order' rights are granted in terms of the MPRDA initially for a period of 30 years with a right of first refusal for a further 30-year renewal period.

The LTP is a full economic plan indicating the optimized exploitation option selected from the MRP. Support infrastructure and service requirement forecasts are based on the production profile and project pipeline as defined in the LTP.

The LTP is composed of a number of investment centres (IC), which are logical physical extraction blocks of ground within a MRA. These differ in confidence levels (as outlined below) from existing operations through to blue-sky scoping studies. This logic is represented schematically in Figure 3.

- ➤ *Level 1*—comprises current operations and approved projects (in implementation/execution phase, Level 1e) that have all the necessary capital expenditure already approved and thus requires only the necessary stay in business capital expenditure for the balance of its life
- ➤ *Level 2*—proposed capital investments or projects and are divided into 3 subcategories (a, b and c), which are related to the confidence stage that the respective proposed capital investment or project has last been reviewed. These subcategories are governed by a stage-gate review and approval process and comprise:
  - – Level 2a Feasibility study = ± 10%
  - – Level 2b Prefeasibility study = ± 15%
  - – Level 2c Conceptual study = ± 25%
- ➤ *Level 3*—Level 3 models effectively cover the remaining extent of potentially extractable resource within the area covered by the current MRP. The models are, at best, scoping studies (not yet a project in the stage-gate review process), and capital expenditure by definition would follow the classification methodology as applied to the Level 2 models, with a 'very low' confidence being attached to the capital estimates (> +/- 30%). (Andersen *et al.*, 2005).

This approach to the development of the LTP defines a project pipeline and as such forms the basis of the Group production and cost (operating and capital) forecasting and is used for capital prioritization and value optimization.

For the purpose of coherent and logical consolidations, model file naming conventions, consistent with the MRA for each mining right are established. This approach facilitates the Group consolidation and scenario evaluation and culminates in the development of the project pipeline.

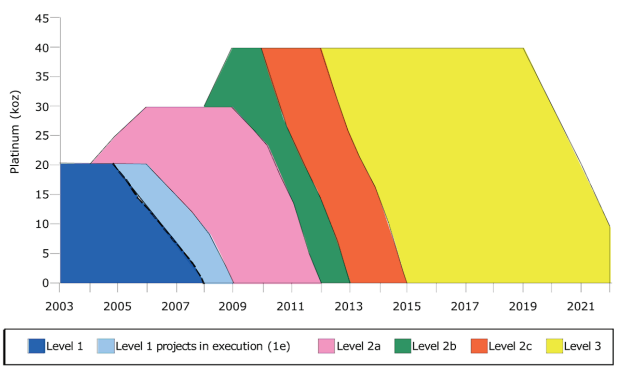

Figure 3—Schematic representation of a mining right plan and associated project pipeline (Pearson-Taylor and Smith, 2006)

Strategic long-term planning at Anglo Platinum

Project pipeline process

The development of an identified opportunity through the various project phases and review stage-gates into an approved capital investment is illustrated in the schematic Figure 4 below reflecting the project pipeline process.

Capital expenditure categorization in the LTP

Capital costs are divided into two broad categories; projects (proposed capital investments) and stay in business (SIB). The purposes of this classification is to provide a more meaningful distinction between capital expenditure, which is in the normal run of business (typically relating to existing assets and likely to be relatively stable from year to year), and significant projects, which are 'one off', and serve to expand or maintain total business capacity. The relationship of these categories is indicated in Figure 5.

Projects (proposed capital investments)

- Expansionary projects, where no minimum value of project is set, but in practice expansionary projects involve only material increases in production output rather than small-scale capacity creep. Expansionary projects typically comprise new operations (greenfields projects) or an increase in output at an existing operation on a trajectory towards optimal scale
- Replacement projects, the primary objective of which is to replace capacity lost due to the decommissioning or 'working out' of an existing production unit, thereby maintaining the overall level of output. Replacement projects typically involve a collection of assets that together represent a discrete new income generating unit, although the new unit may share certain infrastructure with existing production units. Replacement projects would therefore not include

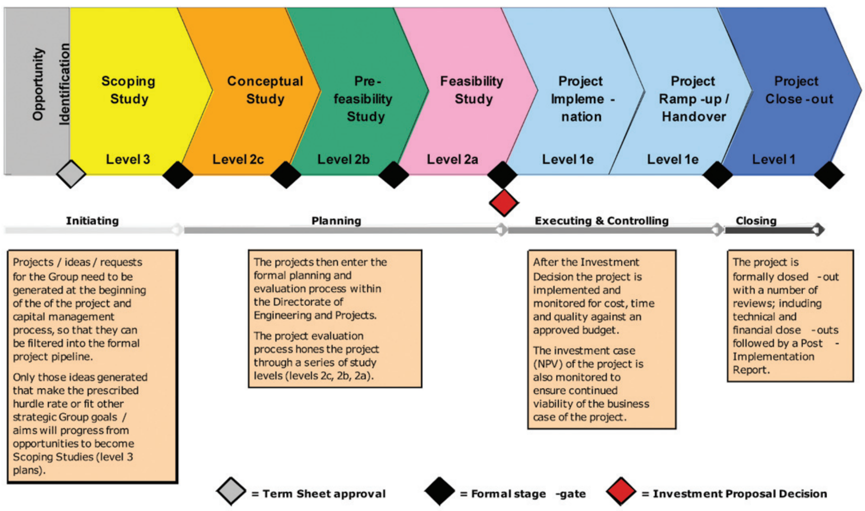

Figure 4—Project pipeline process

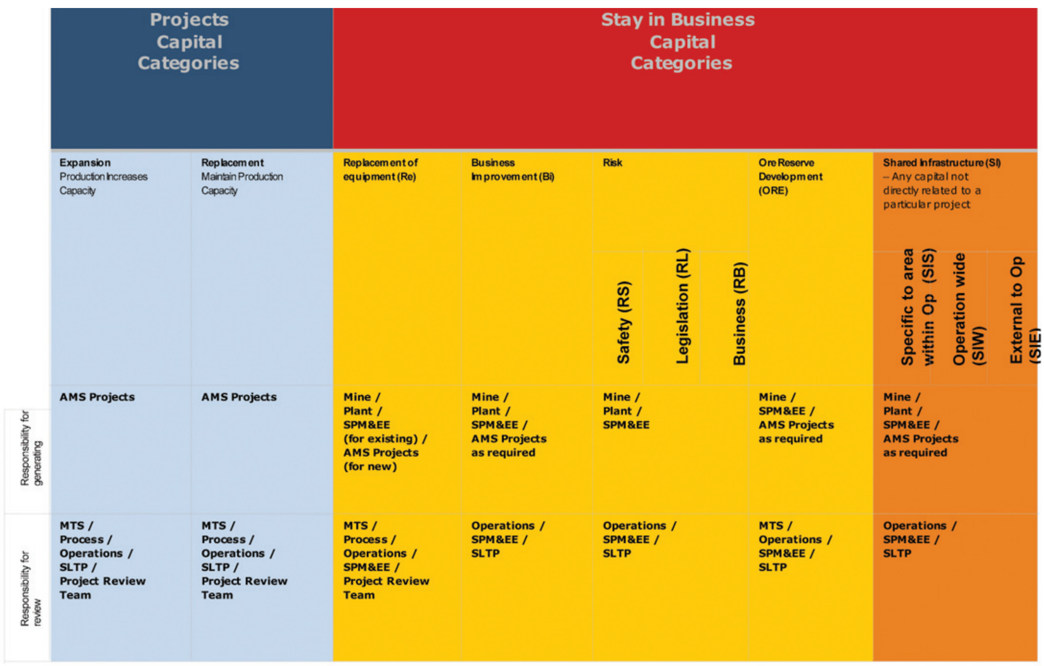

Figure 5—Capital categories

replacement of individual assets such as haul trucks, loaders, or capitalized rebuilds of existing equipment, which should be included in SIB capital.

Stay in business

- Capital expenditure undertaken in order to maintain the life of existing assets without materially increasing capacity. This would typically include:
  - Replacement or capitalized rebuild of individual assets such as vehicles, machinery, plant and other equipment, etc.
  - Business improvement initiatives
  - Ore reserve development, where relevant
  - Capital expenditure undertaken primarily for non-financial reasons in order to mitigate risk, such as in the safety, health and environment area
  - Shared infrastructure, which is capital not directly related to a particular project, such as the tarring of a road between a number of shafts, etc.

Capital prioritization process

Central to the success of any mining company is the ability to effectively manage capital investment so as to ensure acceptable stakeholder returns within an overall strategic context. Typically a mining company investment portfolio would encompass options ranging from geological exploration through to market development. A key challenge is thus to ensure the alignment of investment with strategic intent whilst ensuring that the day-to-day viability of operations is not compromised.

Critical to this process is the effective selection and implementation of a strategically aligned project portfolio that enables optimal resource exploitation whilst operating within mandated strategic bounds and identified constraints.

The LTP provides a forecast of production, capital and operating costs across existing operations and the project pipeline at a range of confidence levels from scoping to feasibility study. This portfolio is consolidated across the Group and further categorized on the basis of defined strategic objectives such as retention of mineral rights, critical path projects, sustainable development and targeted growth rates. Investment options are further prioritized on the basis of forecast value within the confidence level sub-categorizations of each logical grouping.

Individual projects thereafter compete, within a common confidence estimate categorization, with each other on the basis of value and rate of return (where applicable). This categorization approach is indicated schematically in Figure 6 in which base, target and growth scenarios are developed. Scenario criteria are based on strategic objectives relating to dimensions such as market supply/demand dynamics and associated metal pricing forecasts, overall business returns and targeted debt/equity ratios.

Concentrating, smelting, converting and refining projects are identified and motivated to match forecasted production outputs and timescales. Individual process directorate projects compete with each other on a trade-off study basis to ensure that the optimal value solution is developed to meet anticipated production levels. Capital requirements for these projects are defined and associated with specific forecast production levels, timelines and scenarios.

In this approach competing investment options are logically grouped, like compared with like, values assessed and ranked within an overall prioritization framework, which is completely aligned with strategic imperatives.

Corporate governance

Effective governance of the planning process is essential to ensure overall integrity and is achieved primarily through data validation and auditing processes (planning components and valuation modelling) coupled with a comprehensive risk assessment process.

Validation and auditing of the various components of the LTP is due to the following requirements:

- Good business practice—the application of due diligence and corporate governance
- Group consistency—a requirement of the Turnbull Report (Turnbull, 1999)
- Mitigation of risk—secondary view on issues may pre-empt negative occurrences
- Quality assurance—ensuring correctness as opposed to accuracy
- Identification of skills shortage and training requirements
- Skills development function.

A key component of the validation logic and process is the concept of a single point of accountability for data

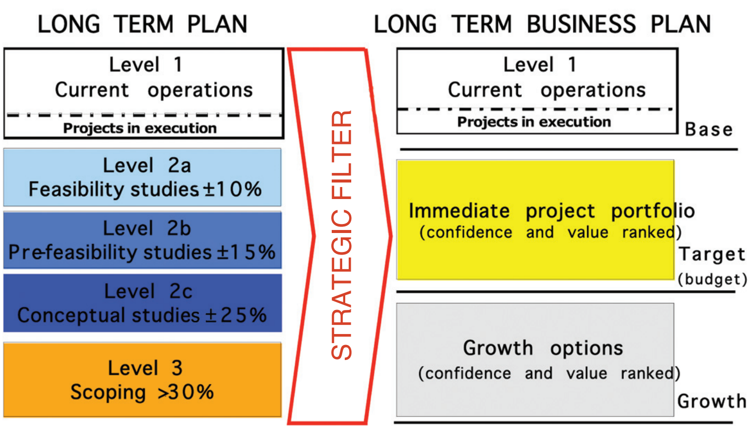

Figure 6—Long-term plan to business plan – categorization and ranking (adapted from Smith and Pearson-Taylor, 2006)

integrity, control and reporting. The entire process is structured to pass on only validated authorized data from one component of the planning sequence to the next.

Auditing of the LTP is effected through both a single discipline audit aimed at assessing the viability of the individual disciplines and processes through which long-term planning data is determined and reported. This is followed by a multi-discipline audit of the consolidated LTP, which assesses the technical content, achievability, practicality, continuity, integrity and integration into the MRP.

Application of a qualitative risk assessment to establish and record issues of potential threat to achieving the LTP is carried out in conjunction with the multi-discipline audit. Additional issues highlighted by the array of disciplines represented in this forum are added to the issues collected from other risk assessments and consolidated in a central risk database used for Turnbull reporting.

Tools and techniques

The tools and techniques applied by Anglo Platinum Limited to value and select investment options to create a company production portfolio are largely predicated on the use of discounted cash flows.

The Group operates a significant suite of technical applications (mineral resource management, survey, geology, labour, etc.) to ensure effective planning and management of its operations. Within this context planning and scheduling of mining operations is primarily conducted with CADSmine®, as the standardized planning tool. CADSmine® schedules thus form the basis for the monthly planning protocols, which form the basis for the first three years (budget period) of the LTP. Longer-term scheduling of level 3 exploitation options in the projects domain may, however, be executed in a range of applications more suited to rule based planning such as Mine 2–4D®.

All plans regardless of level of estimate are ultimately imported into the LTP application, which is a centralized data warehouse, holding core input data for discounted cash flow analysis.

Financial valuation is conducted on a discounted cash flow (DCF) basis using Hyperion Strategic Finance (HSF) software (Smith *et al.*, 2006). This valuation package has been extensively customized to meet Anglo Platinum requirements (Marsh *et al.* 2005).

Valuation modelling based on the discounted cash flow technique

Discounted cash flow analysis provides a means of relating the magnitude of all expected future cash flows to the magnitude of the initial cash investment required to purchase the asset and develop it for commercial purposes. The objective of discounted cash flow analysis is to determine:

- ➤ The NPV of a stream of expected future cash flows
- ➤ The rate of return (IRR) which the expected future cash flows will yield on the original cash investment.

Within this context NPV was initially applied to capital investment decisions with later application as a guiding principle throughout the mine planning process as the principal determinant of value assessment. The realization that planning options that demonstrate increments in value, have the potential to create value for the business, and are generally cumulative, has rapidly lead to the concept of value maximization or 'optimization' of strategic mine plans, with the term 'optimization' largely coming to mean 'maximization of plan NPV' in the minerals industry.

IRR and NPV

Value accretion from an investment option occurs when the NPV > 0 and the IRR > selected hurdle rate, where the hurdle rate is determined by considering a minimum rate of return in conjunction with a variety of risk premiums, such as operational, project and country. In general larger NPV and IRR values indicate better returns and inherently lower risk of value destruction.

Value accretion from individual projects should, however, always be considered in the context of the largest logical decision making unit, e.g. a mining complex rather than a single shaft basis in order to accommodate interdependencies. A project may not necessarily have a positive NPV when evaluated on a standalone basis; however, value that may be derived from the benefit this project affords the rest of the complex through the sharing of infrastructure and hence the dilution of fixed costs (Ballington *et al*, 2005).

Money terms

Due to the nature of mining taxation and its treatment of capital investment, it is essential that project cash flows are initially calculated in nominal terms, so that accurate taxation can be computed and included, prior to de-escalating to real terms for discounting to present values.

This valuation is normally achieved when modelling by inputting values in real money terms (regardless of when in the future the income or expense is to occur) and then computing nominal terms through escalation factors (different rates for revenue, material cost, labour cost and capital, etc.) to facilitate taxation computation. Furthermore, cognizance of the real changes in capital expenditure, due to the imported component's future inflation and the exchange rate, needs to also be taken into consideration. The calculated after taxation nominal cash flows can then be adjusted for domestic inflation into real terms, and the NPV calculated at an appropriate real discount rate.

Discount rate

The discount rate (the hurdle rate) is the rate used to calculate the present value of future cash flows. Discount rates can be in nominal or real terms and must be clearly stated (money terms and rate). Use of real discount rates is advocated as good practice as:

- ➤ Most investment evaluation assumptions will be developed initially in real terms
- ➤ By applying a real discount rate to real cash flows, the risk inherent in nominal terms valuations (e.g. the mismatch between the inflation rate assumed in the derivation of the discount rate and the inflation rate assumed in the cash flows projections) is avoided.

Currently the South African economic environment indicates an appropriate real discount rate of 9% to 12% for mining projects, namely

- Minimum acceptable rate of return of 8% to 10% (real) for existing operations
- Project risk rate of 1% to 2% (real)
- Country risk rate of zero for projects funded from local sources.

This equates to a nominal weighted average cost of capital of 14.5% to 17.6% at a 5% annual inflation rate.

Global planning parameters

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 <10% error. While similar degrees of rigour are applied to tonnage, grade and recovery estimates, in order to achieve comparable levels of accuracy in recovered metal estimation.

Similar rigour should be applied to the assumptions made relating to metal (commodity) prices, exchange rate, inflation rates (domestic and foreign), and escalation (capital expenditure and operating expenditure) factors. 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 will have a significant effect on projects with 10 to 15 year life spans. (Ballington and Smith, 2002).

The risk of value destruction resulting from not undertaking viable projects because of a pessimistic long-term view is best addressed through scenario evaluation and risk profiling.

The hill of value concept

Mineral resources are a finite, non-renewable resource. The optimum exploitation strategy therefore needs to be dynamic due to the continual changing of commodity prices, rate of extraction and life of mine over time.

The seemingly competing objectives of maximizing profit and maximizing extraction are constrained by the spatial characteristics of the orebody and extraction technology. Trade-off studies to evaluate the scale of operation will tend to focus on maximizing the production rate that can be sustained by the orebody's geometry. The use of discounted cash flow analysis allows for the impact of varying price regimes over time and at real discount rates of 10% to 20% ensures that the value created beyond 30 years into the future has little impact on the overall value.

The economic life of mine for a mineral resource is thus a key decision variable, which is largely driven by the rate of extraction, with the optimum strategy encompassing the entire resource. The optimal strategy should be focused on exploitation of the entire resource so as to maximize the present value; the challenge is, however, to find the optimal trajectory, which achieves the maximum as conditions vary over the life. In other words, maximizing value over time requires the optimization of each subsequent extraction step under an environment with continual changes in market perspectives and operating conditions.

This problem can be compared to climbing a hill where the topography is contingent on three aspects: the geological characteristics of the resource (size, grade, spatial characteristics), the scale of operations (mining, concentrating, smelting and refining rate), and the prevailing market conditions (metal prices, exchange rates and working costs). The topography of the 'value hill' is thus a function of the mineral resource, its depositional environment, exploitation strategy, pre-existing infrastructure and associated constraints. If the peak of the hill represents the potential extractable value of the resource then maximizing value (optimization) implies taking the shortest (steepest) route to the top. The top can also be reached by longer, less steep routes (different time periods, capital profile, etc.) and as such the gradient of these optimization approaches offers a relative indication of inherent risk associated with options to achieve the peak.

This 'Hill of Value' concept (Hall, 2003) can be reduced to an X-Y-Z chart representation where the X axis represents the extraction rate (the scale of operations dimension), the Y axis the cut-off grade (the geological characteristic dimension) and the Z axis is value (the financial aspects). The value surface created then shows the overall relationship between the value and the two variables of scale of operation and geological characteristics. A hypothetical 'Hill of Value' is indicated in Figure 7.

The value surface indicated in Figure 7, which is specific to the orebody, selected extraction technology and economic assumptions, provides insight from a strategic planning perspective, namely

- Similar maximum value can be obtained from extraction rates of 150 and 300 units
- These value peaks coincide with a cut-off grade of 7 units
- A production rate of 200 units is to be avoided regardless of cut-off grade.

Further insight relates to:

- Capital efficiency: optimal utilization of capital infrastructure occurs at 150 units, with a step change in infrastructure investment at 200 units but under-utilization occurs until a production level of 300 units is achieved. The question that must be asked is 'what happens at a rate of 350 units?'

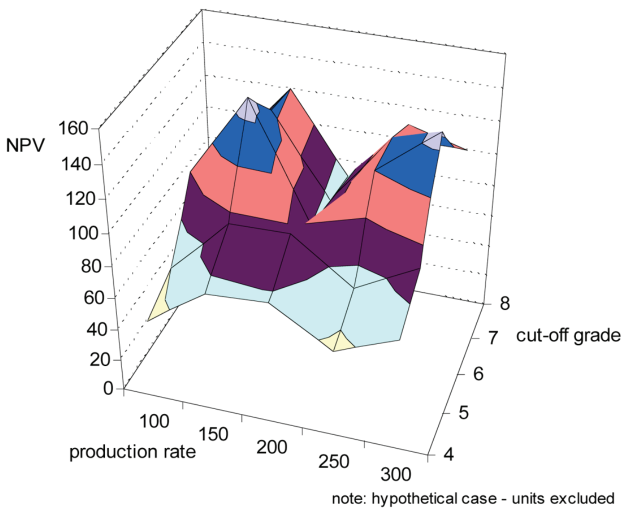

Figure 7—Conceptual diagram, 'Hill of Value' (adapted from Smith and Ballington, 2005)

- Cut-off grade: a grade of 7 units appears to be optimal for the tonnage/grade characteristic of the mineral resource, at the resource cut associated with the given production rates
- Exploitation options: a fundamental choice must be made on scale of operations. What are the risk elements inherent in the design, funding and implementation of an operation at a scale of 150 or 300 units?

This approach can be applied at differing levels of detail at different stages of the value chain to understand the implications of design choices in areas such as extraction rate, technology selection and market/price forecasts for a given mineral resource.

Scenario evaluation and probabilistic risk analysis

Uncertainty in the external planning parameters such as commodity/metal pricing, exchange rate and relative inflation requires that investment decisions should embrace the concept of scenario evaluation to assess project sensitivity to external parameters. A range of techniques exist to develop scenarios and are not considered in the context of this paper. It is, however, necessary that at least three scenarios be developed for a strategic mine plan, an upside, best estimate and downside in order to understand potential strategic bounds:

- *Upside scenario*—this scenario should embrace a justifiably optimistic perspective on metal pricing and all pertinent economic parameters
- *Downside scenario*—the alternate view to the upside scenario encompasses situations such as price or quantity depression resulting from reduced market demand, oversupply and/or substitution
- *Best estimate*—the best estimate scenario should reflect the most pragmatic view of the project.

The application of simple 'plus 10%, minus 10%' scenarios does not adequately address interdependencies between key variables. For example, a sustained 10% increase in metals prices will result in an increased capital escalation.

The use of probabilistic tools, such as @Risk®, can add confidence to the valuation by indicating a possible distribution of results associated with a given set of assumptions per key variable. As such it is an alternative indication of the potential impact of upside and downside scenario parameters on specific modelling elements (assuming that the variable range simulated is the same as the scenarios) without reflecting the sustained impact of a particular scenario on value.

Hyperion Strategic Finance

As mentioned above the valuation of strategic long-term planning scenarios at Anglo Platinum is conducted, on a DCF basis, using a specific software application—Oracle Hyperion Strategic Finance (HSF).

HSF is used to perform valuations and assess capital investment decisions, and to run, consolidate and produce the Group's LTP.

Throughout the years since 1998 the application has been highly customized to meet company requirements through which formatted technical input data (tons milled, headgrade, plant recoveries, operating expenditure (opex) and capital expenditure (capex) is coupled with a set of long-term macro economic and planning parameters (rand-US dollar exchange rate, Consumer Price Index excluding interest rates on mortgage bonds (CPIX) percentages, opex and capex escalation percentages, metal prices and process division assumptions) to perform a DCF analysis on a series of calculated annual cash flows.

The structure of HSF enables individual component parts of the organization to be modelled independently and then consolidated up in a multi-level hierarchy. The base modelling unit is an investment centre (IC) which represents the minimum scale of operation at which an investment decision would be taken. Investment centres by reef type are subsequently consolidated at shaft, mine, complex, company and Group level as required.

HSF components and relationship/structure

The HSF system comprises a suite of template files that are tailored for the particular application. These component files are used to create the modular and consolidated simulation of the organization. The component parts and their interrelationship are outlined below and graphically illustrated in Figure 8.

Investment centre

IC files/models are the basic building blocks of the HSF analysis and perform DCF valuations and other user defined projections of individual operational units. They appear very much like spreadsheets. That is they are composed of cells arranged in rows and columns. By default the columns represent time periods, which may be defined as years or months.

Consolidation

Consolidation (CONS) files add (or subtract) defined percentages of data from IC models according to user definition as specified in the relevant CONSDOC file. CONS files also appear similar to spreadsheets and have the same format as IC models with the same accounts and time periods. However the difference is that in the CONS files the data are

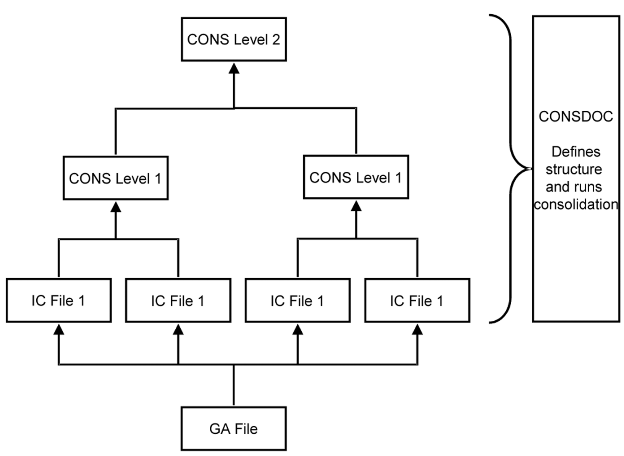

Figure 8—Structural relationship of HSF files

added (or subtracted) from the selected IC models. The user selects the IC files when creating the consolidation structure in the CONSDOC file. Account data pulled into the CONS file is predefined in the CONS file by the software developer according to customer requirements.

CONSDOC

The consolidation document (CONSDOC) files enable the user to define a consolidation structure and run it. Different consolidation structures may be defined in separate CONSDOC files according to requirement. Any number of structures can be created accessing the same IC building blocks, but a separate CONSDOC file is required for each structure.

The consolidation structure as represented in Figure 8 is created graphically. Entities are added by clicking on an existing entity box and selecting 'add parent', 'add child' or add sibling. The individual IC and CONS files may be accessed directly by clicking on the relevant box to open them. The consolidation is run from the graphic by clicking on the CONS file box and selecting run. If the top level consolidation is chosen then the entire underlying structure is run. If an intermediate consolidation is run then it consolidates only the underlying structure and not the overlying structure. The consolidation structure may also be created, viewed and run from an alternative tabulated view. The tabulation also presents other information such as the percentage ownership of each entity to be incorporated.

Global assumptions

The long-term macro economic and planning parameters (or global assumption (GA)) files are the repository of data common to all models (e.g. metal prices, exchange rates, etc.) and are linked to other models as defined by user. GA files are very similar in appearance to IC files in terms of format and account content. However, they are used only for collating the defined GA data, calculating it and then transferring it to the IC and CONS files.

The links to the other files may be established from the GA file by identifying the target files and then pushing the GA data through. A comprehensive list is created in the GA file as the target files are selected, as illustrated in Figure 8. Clicking on run executes the pushing through of the GA data to the target files.

Alternatively links may be established from individual IC files to the appropriate GA file. However, this method does not create a comprehensive list of all the links associated with the particular GA file.

Alternative global assumption scenarios can be created and stored in the GA file enabling rapid selection and transfer of different suites of global assumption data to the IC and CONS files.

HSF architecture in Anglo Platinum

The HSF client/server architecture adopted within Anglo Platinum provides a way of centralizing and controlling the models, their versions and respective users within the organization.

It allows control of the rights and permissions of the users, who may be allowed restricted access to the models, e.g. may be allowed only to change models that they are directly responsible for. The database environment helps to ensure control so that only 'a single version of the truth' for the models exist, thereby preventing the creation of multiple, uncontrolled copies of models.

The architectural structure is illustrated in Figure 9.

Project value tracking analysis

Background

Anglo Platinum's long-term strategy has been and continues to be the promotion of the demand for Platinum Group Metals (PGMs) and the expansion of its productive capacity to meet this growing demand, while conducting business in a competitive, cost-efficient and safe manner.

The implementation of this strategy is subject to adjustment in the light of changing market and general economic circumstances. To this end the nature of the Group's resources, in particular the number, variety and output capacity of existing production sites and potential projects available to it, enable it to respond flexibly to any major changes.

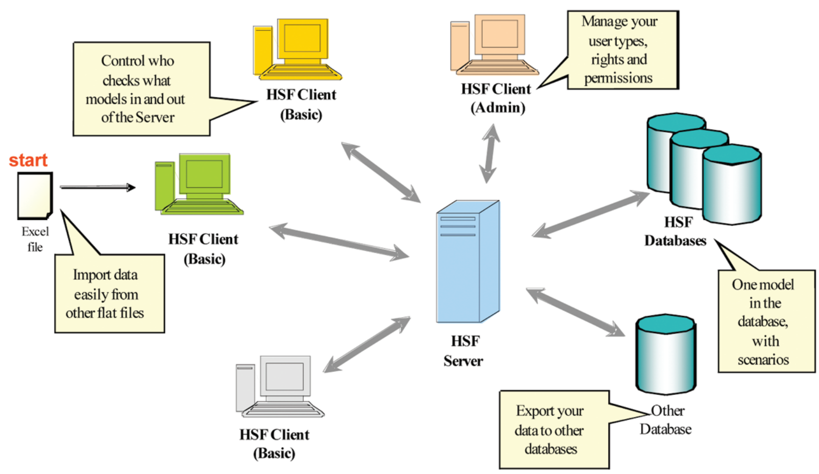

Figure 9—HSF architecture (adapted from Marsh *et al.*, 2005)

Strategic long-term planning at Anglo Platinum

In order to assist Anglo Platinum management in the optimal allocation of capital for developing and exploiting the company's mineral resources, the systematic tracking of the business case value of an operation or a project has been implemented.

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 10 below illustrates a typical waterfall chart output that is generated.

Conducting modelling on an incremental stand-alone basis, a project once approved has an original view of how that investment proposal of the project is expected to perform over time. At regular intervals it is therefore possible to compare the present perspective of the project against this original view over the same timeline. The term present perspective refers to the actuals that have occurred to date plus the current view of the future.

Objective

The objectives of being able to compile a 'waterfall chart' in HSF were:

- ➤ To produce an incremental variance (or waterfall) NPV analysis between the two points (illustrated as black bars in Figure 10 above) of the present perspective of a project and the original view over the same project life timeline
- ➤ To utilize existing Anglo Platinum HSF template models in a seamless and easy-to-use system that produces a waterfall chart analysis automatically
- ➤ To replace a manual process of incrementally moving groups of data from one model to the other and documenting the NPV change and then displaying this information in an external EXCEL® waterfall chart.

Waterfall chart methodology using HSF

The waterfall chart solution uses existing HSF model templates and is schematically illustrated in Figure 11 below.

The waterfall chart comparison is conducted as follows:

- ➤ A comparison is made up of three underlying HSF IC models:
  - – The original view of the project model
  - – The actuals to date for the project model
  - – The future view of the project model.
- ➤ The money terms of the underlying models are as follows:
  - – The original view model is in original real money terms
  - – The actuals to date model is in nominal money terms

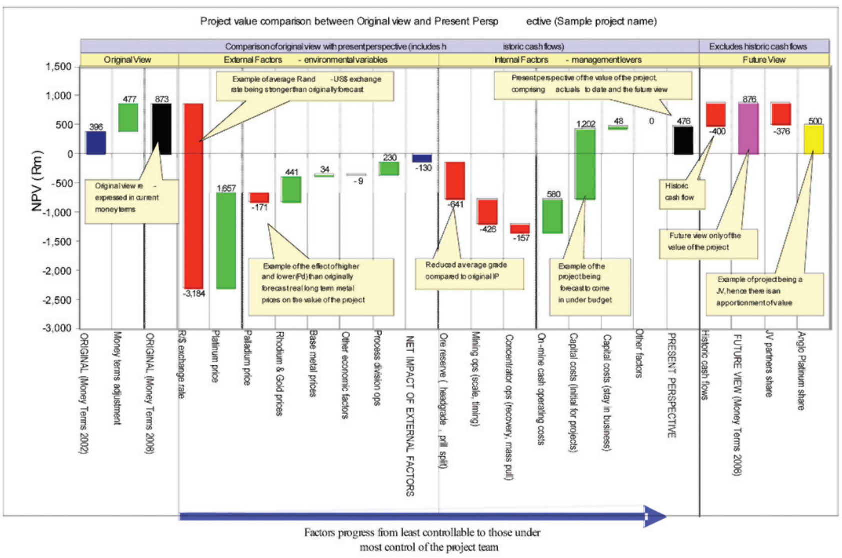

Figure 10—Typical waterfall chart output

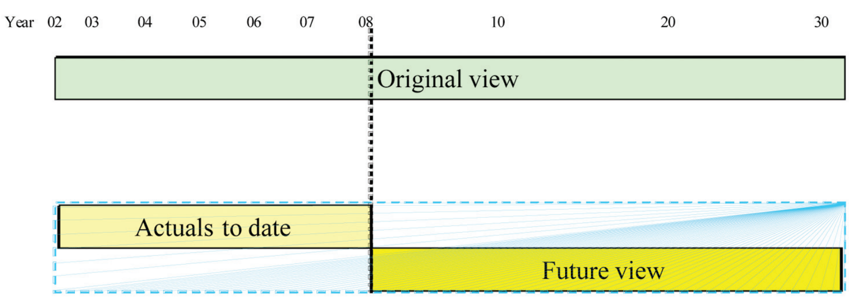

Figure 11—HSF model methodology

   - The future view model is in current real money terms.
- ➤ These models then have their data entered into two separate scenarios in another HSF model, which has been custom-made for the purpose, the waterfall model
- ➤ Using the consolidator function in this model:
   - The original view model data is entered into one scenario, named original view (green rectangular block in Figure 12)
   - Whereas the actuals to date and the future view models are combined (bolted together), and entered into the other scenario, named present perspective (blue trapezoidal block, light yellow rectangular sub-portion block in Figure 12)
- ➤ Next, the present perspective data is restated back to the same money terms as the data of the original view model so that a comparison in the same money terms is possible. This is achieved by utilizing a money terms converter (MTC) sub-program within waterfall model (blue trapezoidal block, dark yellow rectangular sub portion block in Figure 12)
- ➤ The waterfall model then iterates the changes between the two scenarios in the steps outlined in Figure 13 using HSF's combined scenarios feature in original real money terms
- ➤ This is done by each series of data in the present perspective that represents a factor/bar on the waterfall chart being inserted one by one into the original view model overwriting the original forecast assumptions; with the model being calculated at each step to understand the effect on the NPV of the project
- ➤ The model then re-expresses the incremental NPVs for each step in current real money terms and produces a customized waterfall chart, where green bars highlight a positive impact on NPV and red bars illustrate a negative impact
- ➤ The waterfall chart therefore shows the effect of:
   - The re-expression of the original view of the project into current real money terms
   - The iterated NPV steps to arrive at the present perspective of the project in current real money terms
   - The effect of the including and excluding historical cash flows on the value of the project, e.g. a comparison of project value between the present perspective and the future view, both in current real money terms.

Figure 12 below illustrates how the PVT waterfall model achieves this comparison.

Suggested order in which adjustments conducted

The general principal applied for presentation purposes is that original view baseline model NPV is adjusted and re-expressed in the same terms as the current money terms of the present perspective of the operation or project, e.g. a project which was approved in 2002 would have its NPV re-expressed by the nominal weighted average cost of capital (WACC%) to 2008 money terms so that it could be compared to the present perspective of the project.

The baseline against which the NPV is tracked is:

- ➤ Operations: the last signed-off LTP over the operation's MRA
- ➤ Approved projects: the original investment proposal (IP) or latest signed-off change of scope (COS)
- ➤ Unapproved projects: the last signed-off stage-gate study work, feasibility (level L2a), prefeasibility (level L2b), and conceptual (level L2c)) used to obtain funding for the project.

Then adjustments are made, first to those factors beyond the control of the operation or project team (external factors—environmental variables), and then to those factors within the control of the team (internal factors—management levers). Within these broad divisions, the degree to which the factor can be influenced should decide the order in which the waterfall chart is constructed.

The ownership structure of the project (e.g. joint venture (JV) involvement) or any other value issue that needs emphasis is addressed as the final item on the waterfall chart. The order in which the changes are made at present within Anglo Platinum is summarized in Figure 13.

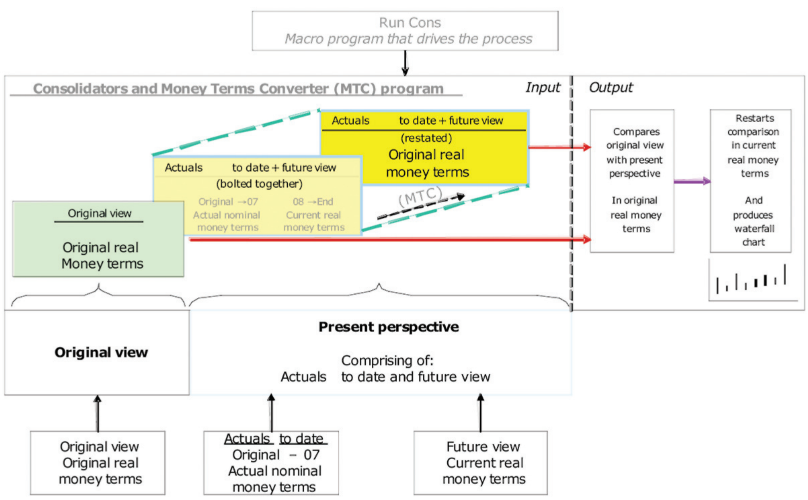

Figure 12—Schematic representation of the waterfall chart methodology in HSF

Step	Description	Comment
Original view (in original money terms)		
0	Original Investment Proposal Or latest Change of Scope	Original money terms & discount date
0	Money terms adjustment	Escalation by CPI X% and appropriate mid -year discount rate for the project to current money terms
0	Re -expressed Investment Proposal Or Latest Change of Scope	Current money terms & discount date of present perspective of the model
Original view (in current money terms)		
Step	**Description**	**Comment**
External factors		
1	Rand -US dollar exchange rate	Rand -US$
2	Platinum price	Pt (US$/oz)
3	Palladium price	Pd (US$/oz)
4	Rhodium, other PGM's & gold prices	Rh, Ir, Ru, & Au prices (US$/oz)
5	Base Metal prices	Ni, Cu & Co prices (US$/lb)
6	Other economic factors	Royalti es, working capital, commissions & discounts, taxation & capitalised interest effects, % sold of production, carbon emission cost effect
7	Process operations	Off-mine cash costs – smelting, BMR & PMR refining & transporting costs, process recoveries & pipelines, cost of third party concentrate purchase (if applicable)
Net impact of external factors only		
Step	**Description**	**Comment**
Internal factors		
8	Ore reserve	Headgrade & prill split
9	Mining operation	Ore tons milled throughput & timing
10	Concentrato r operation	Concentrator recoveries & mass pull
11	On-mine cash operating costs	On -mine cash costs – shafthead, concentrator & indirect, each broken up into labour, stores, contractors, utilities & sundries
12	Initial Capex	Initial capex for major projects (if applicable)
13	Stay in business Capex	Stay in business capex
14	Other factors	Any other changes not covered (if applicable)
Present perspective - net impact of all factors (in current money terms)		
Step	**Description**	**Comment**
Future view (in current money terms)		
15	Exclusion of historic cash flow	Removal of historic cash flow leaves current forward looking cash flow only
16	Future view	Aligns operation or project with LTP and reflects future view on a forward looking basis in current money terms
Other value issues		
17	Partner's share	JV impact on value to Partner (if applicable)
17	Anglo Platinum share	JV impact on value to Anglo Platinum (if applicable)

Figure 13—Project value tracking analysis—description of waterfall chart components

Conclusion

Capital investment is the life blood of minerals companies. Owing to the depleting nature of the mineral resource asset it is necessary to continuously reinvest to sustain production, let alone expand. Within this context there are often many competing investment 'imperatives' that can divert funding from critical projects.

Alignment of capital investment with strategic intent can be readily achieved through structured planning processes based on optimization (value maximization) of underlying exploitation units and subsequent structured competition for financial resources.

The use of discounted cash flow analysis to forecast value has gained acceptance as a primary methodology of project valuation and investment decision making. From a strategic long-term planning perspective, the absolute value of net present value should not be considered as the final investment decision criteria but rather as a key indicator to be assessed in conjunction with other factors. Further, the relative value of differing scenarios is more informative that the absolute value of each scenario.

The adoption of the HSF system has resulted in ongoing improvement in the control of the strategic long-term planning process at Anglo Platinum. It has enabled the group's projected operational plans to be measured on a number of levels and by a wide range of parameters.

Continued sophistication of long-term planning processes creates an increased demand on supporting processes and analytical techniques. The refinement of the pre-existing EXCEL® based techniques of project value tracking into an automated HSF based approach consistent with LTP investment centre data has ensured alignment with developing processes.

Overall the quality of decision making and the associated matching of resources to projects to ensure effective implementation has significantly improved as a result of improved data, interpretation, evaluation and execution processes associated with the tools and techniques applied at Anglo Platinum.

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 decision making and value maximization is to be continuously improved.

Value tracking of capital investment decisions is thus critical for Group value optimization and capital prioritization in a large multi investment mining Group such as Anglo Platinum.

The validity of the strategic long-term planning process as developed and implemented at Anglo Platinum has been demonstrated through the rational, structured, contingency planning response (production level, capital prioritization and operational focus) to the recent dramatic downturn in the global economy and associated impact on the platinum industry.

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Pearson-Taylor, J. and Smith, G.L. The concept of project value tracking and its application in project planning at Anglo Platinum.

Smith, G.L., Surujhlal, S.N., and Manyuchi, K.T. Strategic Mine planning—communicating uncertainty with scenarios.

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OBITUARY

		Date of Election	Date Deceased
R.A.O. Chelius	Retired Fellow	11 November 1955	11 August 2008
R.L. Burger	Member	19 May 1978	17 November 2008
M.D.G. Salamon	Honorary Life Fellow	14 June 1963	Feb 2009
D.A.R. Duke	Associate	21 April 1978	26 January 2009