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Optimizing project value by defining and modelling key drivers in the concept phase

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Global supply of platinum fell by some 2.0 per cent in 2007 to 6.66 million ounces. Reduced output from the three major producers in South Africa contributed largely to this reduction, by producing some 70 thousand ounces less than in 2006. Anglo Platinum announced operational shutdowns due to safety concerns, Lonmin closed their No. 1 furnace for a rebuild, and a short-lived strike at Implats affected their production.

Many of the trends in platinum demand for 2007 are expected to continue in 2008, and given the reduced supply of 2007, there may well be even more pressure on the major platinum producers to deliver more ounces into the growing demand.

Amongst others, Anglo Platinum's Board approved new capital expenditure in 2007 to the value of R10.7 billion in continued support of maintaining and expanding production capacity. An additional amount of R5.9 billion was approved in 2008 to expand output at their Twickenham mine.

With significant capital programmes and project pipelines in a buoyant and heated market underpinned by strong demand, mining companies aim to optimize value in the early phases of projects and deliver projects faster. This is largely compounded by high escalation rates and resource shortages. Value based management starts by identifying and modelling the key value drivers of projects in the concept phase, which would enable executives and project managers to select possible options with the best potential to optimize value.

This paper will discuss the importance of identifying and modelling key value drivers during project conceptualization. This process is to ensure that scarce skills focus on items and issues that have a material impact and reduce effort on the superfluous.

Objectives

The objectives of the paper are to discuss the importance and relevance of identifying and modelling the key value drivers of a project during the concept phase in the project pipeline. The modelling process will be discussed briefly, and some key results typical to platinum projects will be highlighted.

Importance

Mining is a destructive process. You have only one chance at removing any orebody and it is our duty as custodians of this national asset to unlock the maximum value for all stakeholders. Implementing a suboptimal design is criminal as it destroys value that would never be unlocked again. It is therefore critical that the study ensures the design is optimal.

Many managers when faced with the challenge of assessing a business opportunity will begin to prepare a spreadsheet model with little or no preparation, without giving real and thorough thought to what the modelling process should include. Often the path of least risk is chosen and conservatism is encouraged as a method of risk mitigation. Such a process should always start with a clear definition of the fundamental business question that needs answering. A simple question might be—should we sink a vertical shaft or a decline shaft to extract the ore from the reserve? A more complex one might be—what is the optimal way to deplete the orebody with say a 25 km strike. Furthermore, it is important that the whole universe of solutions is considered to ensure the optimal solution is not missed.

The next step is to identify all the outputs that are required to make the decision. The outputs themselves are determined through a combination of input variables, such as the production profile, product type content (prill splits), prices, recoveries, capital and operating costs, etc. A good understanding and experiential intuition of these variables together with techno-economic methods are essential to identify the key drivers.

Describing how the variables will behave over time is of key importance to achieving the goal of answering the business question initially defined with enough confidence to make a decision. This behaviour over time of the key variables include, amongst others, changes in aspects such as product price, production output, capital expenditure, changes in input and operating costs. At present the market in South Africa is experiencing inflationary pressure on fuel, electricity supply and human resource kills, to name but a few. Predictions of this variability should be included into the model based on the best assumption available to modellers, to ensure a realistic outcome.

In the conceptual phases of projects, there is often little definition and low accuracy of the input variables. Capital expenditure, for instance, can at best be estimated based on typical other installations or projects, internal databases, or from the experience of the modellers, resulting it fairly large potential variance capital estimate, and hence the outcome of the model. Suffice to say that options other than fatal flaws should not be eliminated at this stage due to inherent inaccuracies in conceptual studies.

By identifying the input variables that will have the biggest effect on the outcome of the modelling process, in other words the key value drivers, and focusing on those to determine the most realistic outcome, chances are that managers and executives can make the best value decision early. Suboptimal project options could be discarded much earlier (prefeasibility) and more time can be spent on optimizing the preferred option. Project teams could focus on the key aspects that provide the most value, and have the biggest effect on the project in further development phases and reduce variance in project value in the project over time.

Value based strategy

With a value based strategy in place, companies have the aim of maximizing value and making the best use of their assets. By going through a process of developing a value based strategy, project managers would be able to determine how best to maximize value creation opportunities.

The first question that project managers will ask is what are the key value drivers of the project? The starting point in answering this question is to revert to the fundamental business activities and associated costs for each work stream or activity. In the case of platinum mining, key activity streams would be tonnes produced, grade, metal content, recovery, operating costs, capital expenditure, etc.

Identifying the critical factors that determine the outputs of the model also involves asking the question: what do we need to know about the future in order to answer the fundamental business question? Topical questions at present in the South African context are—will we have electrical power to support our expansion plans? Can we source enough water in time? Can we recruit the required skills that we need over the next five years to support our capital programmes? How will the diesel price affect our strategic plans to mine with trackless machinery?

The evaluator should not only identify crucial factors such as these, but also do realistic forecasting as inputs to the model. Forecasting here is used quite loosely. Some of the critical factors will be related to regulatory, legal or political concerns and may not be directly associated with a particular element within the model. These factors will nonetheless be crucial in describing the context for the answer, and assist in making a strategic decision.

The importance of describing all the relevant macroeconomic variables is often overlooked. Most modelling includes an outlook on inflation, exchange rate and metal prices, but does not cover factors such as population growth, urbanization and skills shortage. These may not be relevant to all platinum projects, but modellers should open their span of focus and ask the questions to identify factors on a macroenomic level that will affect the project. Furthermore, the benefits are usually measured only from the investors' perspective and not from other stakeholders' viewpoints.

Once all the critical factors have been identified, they should be divided into those that will be explicitly modelled and those that simply provide the context for the forecast and are likely to be described in a business planning document[1].

Following the above definition, the next step would be to determine which factors improve the economic value. Some of the obvious examples would be higher grade, lower inputs costs, higher productivity, and the like. Having identified and defined the key value drivers and works streams for input in the modelling process, the project manager or modeller should embark on a benchmarking exercise not only with competitors but more importantly so with the internal customer, or operation. It is key to the reliability of the results to ensure that the needs, preferences, and experience of the internal customer are incorporated into the modelling process.

Analysis of all the facts as briefly outlined above will identify the key value drivers and issues that the modelling process should address.

With a good fact base about the key value drivers established as described above, it is normally possible to decide whether a particular project or business venture is worth pursuing further. If it viable, the project team will get approval to start with the identification and analyses of various options, with the goal of identifying the single option that will create the maximum amount of value, or minimize value destruction. It is probably prudent to track the value add the project team has unlocked throughout the process.

Uncertainty and risk analysis

Normally in the concept phase of a project, when executives of organizations are required to make strategic business decisions, there is often uncertainty and little detail information is available. The only decision they are able to make at this early stage is whether to pursue the venture or project further by starting more detailed study work, i.e. the prefeasibility study, or not take it further at all.

Typically there may be uncertainty about the timing of the project and the cash flows it is expected to generate. There may be uncertainty about the direct outcomes of the project, like the ability to mine safely within uncertain geological structure. There may even be uncertainty about the side effect of the project, its unforeseen consequences. Uncertainty can take many shapes and forms, and needs to be identified before the modelling process starts.

It is obviously important to consider the extent and nature of uncertainty associated with the variables and key value drivers that will influence the decision. Although this uncertainty (risk) can be applied to most kinds of value drivers and decision variables, risk analysis is mostly understood to use financial measures to determine whether and investment in a project should be made or not. A distinction should be made between risk analysis and financial analysis, because the former incorporates uncertainty in the decision input data. Instead of point estimates for variables, probability distributions are determined or subjectively estimated for each of the uncertain input variables[2]. The outcome from the risk analysis is probability distributions for NPV and IRR determined by simulation and considered with the intangible (and other) decision parameters by management to make decisions.

Discounted cash flows have been used to evaluate projects for many years and every so often the validity of using these matrices is questioned. The problem is not in using a discounted cash flow but rather how it is interpreted. There is a familiar set of sayings of 'garbage in garbage out' and 'gospel in—gospel out'. This should be accompanied by a saying which more aptly describes the way discounted cash flows are used, namely 'garbage in gospel out'. Too much significance is placed on the outcome of these numbers. What is true is that this outcome is valid only for the series of variables assumed in the valuation. There is significant uncertainty about input variables, and these should be recognized in the answer. Hence, the recommendation that a stochastic approach using discounted cash flows would result in a better probabilistic based decision making process.

With this principle of incorporating risk into the modelling process, the decision-maker not only has probabilistic information about the rate of return and future cash flows, but also gains knowledge about the variability of such estimates as measured by the standard deviation of the financial returns. With this methodology, both the expectation and its variability come forward, which are the two most important aspects of uncertainty to the evaluator.

Taking this approach a little bit further, it can be applied to wide range of project related decisions. For example, simulation risk analysis was used to select the best method of mining a particular orebody in terms of operating cost. The major task elements were identified and cost distributions were programmed for analysis in a Monte Carlo analysis. A cost-probability distribution was constructed to help identity the lowest cost alternative and also the alternative with the lowest risk of high cost, alternatives that are often not the same[3]. Figure 1 shows the results of the Monte Carlo simulation.

Key drivers

Further to the discussions in the preceding paragraphs, the cash flow of the project should be analysed in more detail. Figure 2 shows a typical cash flow curve for a mining project, including the discount impact or time of value of money. Plotting this curve can assist the modeller and project manager even more to understand where to focus in the quest for value optimization.

The normal life cycle of any project starts with expenditure early in the project's life to construct the facility, and is indicated here on the graph mostly by the negative cash flow. Once the facility starts operating it generates income and in time the net cash flow turns positive for a period into the future, until the revenue starts declining as the facility reaches the end of its useful life.

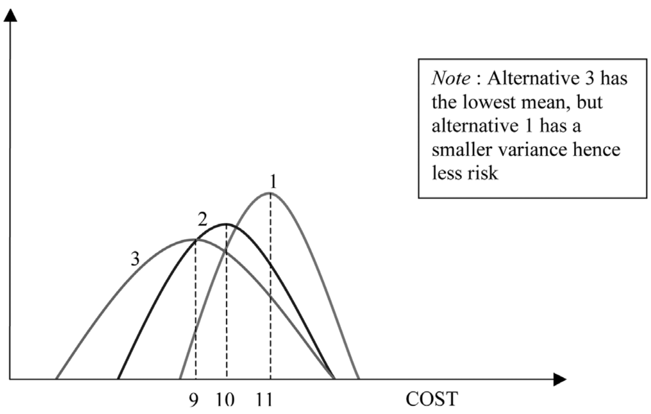

Figure 1. Probability density for cost of three alternatives

Following the definition and understanding of the cash flow curve (Figure 2), one plots the sensitivities of the key value drivers. In most platinum projects, it is found that the key drivers are platinum and palladium prices, exchange rate, operating cost, capital cost, and grade. Figure 3 shows a typical sensitivity graph (spider diagram) for a fairly current major project.

The most important observation to be made from spider diagrams is the economic gearing of each variable which can be calculated by determining the improvement or deterioration to the return for a certain amount of variation within the variability. Spider diagrams are often fundamentally flawed as they do not consider the correlation between variables, nor the scope of change for the different variables. However, they are useful tools to determine what should be focused on.

One could argue that project managers and executives cannot influence key drivers such as metal prices and exchange rates, and it may be true, but understanding the project's sensitivity to those factors underlines the importance of good market analyses and forecasts of the macroeconomic factors that affect these drivers. In terms of the other variables, operating cost, capital cost and grade can be directly influenced by the project manager.

Continuing with the spider diagram in Figure 3, it is obvious that a higher grade would increase the rate of return directly. However, one cannot do much about the geology

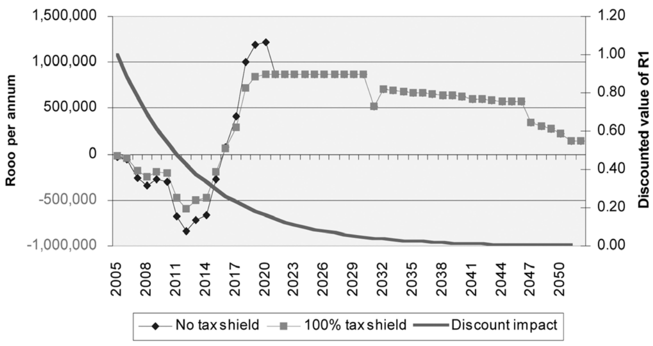

Figure 2. Typical cash flow diagram of a project over time. Note: the discount impact is shown on the graph indicating the time value of money

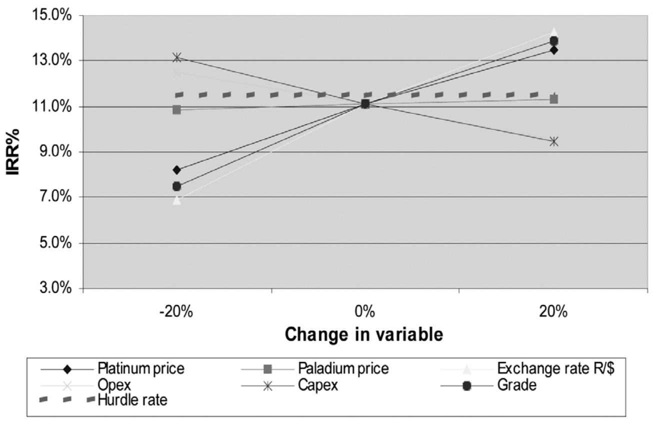

Figure 3. Typical spider diagram indicating the sensitivities of the key value drivers

that is in the ground, but the way it is extracted could be designed to get the best possible reserve grade. It is also obvious that savings on capital and operating cost would benefit the project, but what more can be done?

Referring to Figure 2 on cash flow, project managers could optimize value by influencing the cash flow in various ways, apart from changing the volumes and quantities as indicated in the spider diagram on sensitivities. Spending capital later in the life of the project increases value, mainly due to the discount effect (time value of money) as shown by the downward sloping curve in Figure 2. Capital costs that are spent later in the project life cycle have a declining value with time. Installing infrastructure and just in time, is the best way to plan capital expenditure, provided it does not compromise any other project drivers or technical characteristics of the project. Later expenditure of capital will also attract escalation, and there is a balance to be found in the modelling process.

The rate of production build-up is another key aspect on which to concentrate. It is no news to any manager that the sooner a business or project generates income, the better the value of the project or business. This principle is merely reinforced by looking at the slope of the cash flow graph in Figure 2. It is therefore critical to the project manager to design the mine such that saleable product comes out the mine as early as possible. The caveat here is realism in planning. The tonnage build-up should never be unrealistic in order to demonstrate a good return on the project, at the cost of not being able to achieve that rate of build-up during project implementation.

Taking this principle further, it makes absolute sense to see most platinum mines in South Africa having been started as shallow decline mines (in some cases even open pit), spending as little capital possible, and getting early ounces. Such mines are later deepened, still operating from decline infrastructure systems, with vertical shafts being established only much later in the life of the mine. Currently standalone vertical shaft projects experience difficulty in yielding positive returns, due to high upfront capital, followed by late and slow ounce profile build-ups.

The risk-reward relationship

One of the fundamental shortcomings in projects would be the lack of understanding between the costs of mitigating risk versus the benefit derived from the expenditure. These relationships are often not clear and can be quantified easily. Often project value is destroyed by mitigating risks well within the tolerance of the project scope. (A typical example would be overdrilling to satisfy the need for better geological definition). Furthermore, lip service is often paid to significant risks as mitigation cost and activities do not form part of the action items of a project. Recent examples of power and skill shortages could be considered in this class.

In fact, it is often practice to conduct a risk analysis after the completion of a study project as an afterthought rather than including it as an integral part of the thinking process of the project team. The first exercise should probably be a risk analysis and the key risks should become key drivers for a project. The mitigation costs and activities should be designed to be part of the process. Furthermore, many of the risk, processes used in projects consider only the downside risk whereas the upside risks or opportunities are totally ignored.

Putting theory into practice

So how does a project manager put the puzzle together for strategic decisions to be made? Figure 4 describes a very simple, yet hugely valuable process of analysing project concepts. The process starts with a process identifying and analysing the risks in the project concepts. These risks are related to technical issues, most often a probable solution to manage or mitigate the risk. For instance, it could be said that tramming of ore underground poses a risk to the production build-up profile of the mine. The project team then typically identifies various ore tramming options to address this risk, and systems such as trackless machinery, conveyor or track bound systems could be possible options.

Once the project team has defined the key aspects of these individual systems (cost, system utilization and availability, safety, etc.) the process goes through an iterative process of techno-economic evaluation and redefining the technical issue, until such time that there is sufficient confidence that the decision made is the best one to cover the risk identified. By including the techno-economic review as well as the upfront initial risk analysis into the decision making model, the decision that is made will also be the best value decision.

Whereto if a definite decision cannot be made yet with the information available, or if a potentially better value proposition is identified during the prefeasibility phase, for instance? The process depicted in Figure 5 is a defendable

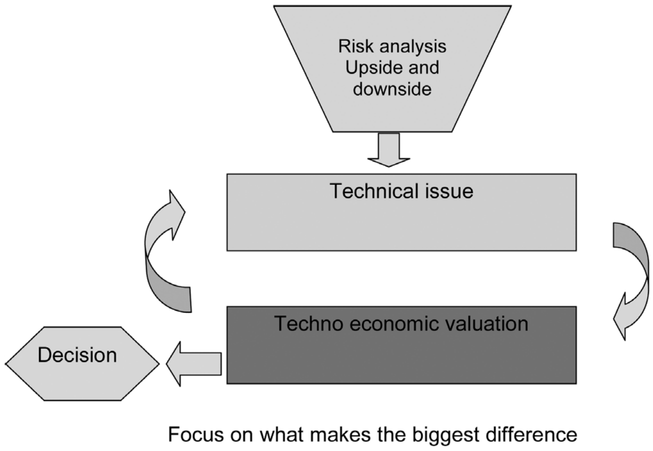

Figure 4. Summarized process of techo-economic evaluations

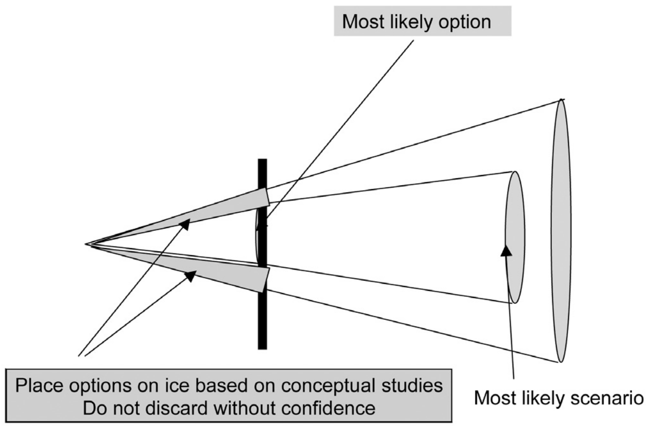

Figure 5. Putting options on hold while more work is being done

process and proposes that the most likely option be taken forward while other options are either put on hold, or analysed in parallel with the most likely option. It ensures acceptable breadth of the study work and option analyses, without losing time on the core study process, and possible delays or lost opportunities.

Holistic approach

A project team must function under the brief or mandate that was given to them. However, this practice might reduce the complexity of the decision-making process but the risk remains that the project team may not fully understand the strategic imperative, nor impact of the work elsewhere in the organization. It is critical that the project team be given the chance to understand fully the strategic fit they need to adhere to and to test whether the mandate is valid and optimal. In other words, the team should think wider than the project.

Often trade-offs are conducted considering part of the process only, for example, saving in capital or saving in operating cost. Incorrect decisions have been made where the full implication of any change on the total process was not considered. It is critical that the evaluator includes the full impact of the decision on the project and beyond in the study as well as considering the risks.

Conclusion

The importance of understanding the key value drivers of a project at concept phase cannot be overemphasized. It is the absolute starting block for success. All project management theory argues that the most value is added in the beginning phases of a project, while it is possible to make changes at a relatively low cost. It is most difficult and costly to make changes to the concepts of the project in the construction phase for instance.

Once a vertical shaft has been sunk, changing that design to a decline system, or relocating the position of the shaft, will come at a tremendous cost and loss in shareholder value, and would for all intents and purposes be impossible. Once you have put your shaft down, you will have to live with that for the life of mine.

By identifying, defining, modelling and focusing on the factors of the project that have the biggest effect—the key value drivers—will allow decision makers to make the right value based decisions early on in the front end loading phases of projects with a high level of confidence. It would be possible to discard options that will not be optimal early in the process, it would save a lot time and money spent on analysing options that are not the best value propositions, and it will most certainly increase the probability of success of any project. This will assist the industry to deliver in a heated market with dwindling resources in terms of skills. Focus on what makes a difference. Furthermore, inefficient design will ensure that the orebody will be extracted sub-optimally, which in turn will ensure the value is destroyed, which can never be unlocked again. It is our duty as custodians of the national treasures to ensure what we unlock maximum value from assets by design.

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Hakkies completed his mechanical engineering degree at the Potchefstroom University in 1994 and started his working career in the mining industry at Leslie Gold Mines as junior engineer.

He moved into the environment of projects with Read, Swatman and Voigt in 1997 and worked on various mining and processing plant projects in the platinum mining industry, staring out as project engineer and later becoming a project manager.

In 2001 he completed the Masters Degree in Business Leadership (MBL) through the University of South Africa (UNISA) at the age of 29. During 2005 he joined Hatch as Project Manager and worked mostly on mineral sands projects, and registered as Project Management Professional (PMP) through the Project Management Institute in 2006.

Hakkies was appointed as Senior Project Manager at Anglo Platinum in 2007, and is responsible for the major replacement and expansion projects for one of Anglo Platinum's joint venture operations.