Risk in project preparation—'determining the project needs and the effects on the management strategy'

by A.M. Clegg*

Synopsis

In general, overall experience has shown that the approach to the appointment of a project manager is given much attention, but little specific attention is given first to the risk associated with the project conceptual design and its overall executability within either the new legislative framework or the sustainability of the outcome.

The risk in project executability and sustainability within the 'new age' legislative framework of the Mining Charter, etc, is itself however, of far greater importance. The degree of importance being defined by the intended projects impact on the business going forward. This is particularly the case where the intention of the implementation is effectively to turn around or even enhance a loss-making strategic investment like a mine or process plant operation in an 'old-order rights' or Brownfield's operation.

This paper attempts to highlight the importance of a 'pre-project project' (PPP) to mitigate the risk in the 'new age', with specific reference to operational due diligence (ODD) and project conceptual design.

Introduction

A project may be defined as 'any undertaking with a defined starting point and defined objectives by which completion is identified'[1]. Generally, most projects depend on finite or limited resources by which the objectives are to be accomplished.

Some of the undertakings in South Africa that have the attributes of a project are the conceptual study, engineering, construction and commissioning of industrial and infrastructure facilities such as:

- Mines
- Beneficiation plants
- Oil from Coal plants
- Smelter plants
- Refrigeration plants
- Power plants (fossil fuel and nuclear).

The successful management of projects whether greenfield or brownfield in nature, requires that a careful planning process be followed. This is then followed by the accomplishment of the work itself. These two principal steps of the project management time frame are further divided into a total of four phases, which form the sequential phases of the project life cycle.

The four life cycle phases of the time frame through which any project passes are therefore:

- Concept (c) } PLANNING
- Development (D)
- Implementation (E) (Execution) } ACCOMPLISHMENT
- Termination (F). (Finish)

Each of these phases is further divided into stages, which are generally industry specific, and subsequently into project-specific tasks. It is on the first two life cycle phases that this paper is focused, particularly the concept phase (c), which it is important to note can carry copyright. Some examples of the subdivision into stages where lack of adequacy results in failures occurring are:

Concept phase

- Research and development
- Operational due diligence (brownfield projects)
- Market research
- Value engineering
- Feasibility study.

Development phase

- Project plan
- Work breakdown structure
- Project procedures
- Risk analysis.

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The activities of each of these two phases may be typically as follows:

- Concept phase (pre-project project)
  - Gather data (greenfield projects)
  - Operational due diligence (brownfield projects)
  - Identify the need
  - Establish:
    - i. Goals, objectives
    - ii. Basic economics, feasibility
    - iii. Stakeholders
    - iv. Risk level
    - v. Strategy
    - vi.Potential team
  - Estimate resources (for sustainability)
  - Identify alternatives (trade-offs)
  - Present proposal
  - Third party audit
  - Obtain approval for next phase
- Development (definition) phase
  - Appoint project manager
  - Appoint key team members
  - Conduct studies (trade-offs)
  - Develop scope baseline:
    - i. End product
    - ii. Quality standards
    - ii. Resources
    - iv. Activities
  - Establish:
    - i. Master plan
    - ii. Budget, cash flow
    - iii. Work breakdown structure
    - iv. Policies and procedures
    - v. Organization structure
  - Assess risks
  - Confirm justification
  - Present project brief
  - Obtain approval to proceed.

It must be recognized that these two phases generally overlap each other to a greater or lesser degree; i.e. the boundaries between phases are fuzzy and not necessarily seen as definite. Also, stages and tasks do vary depending on the project. However, it is in this area in the author's view that project degrees of failure are born and that the greatest risk lies. This is borne out of direct experience from both operating within project teams and from outside projects looking in.

Project life cycle[1], uncertainty and risk

The importance of the concept phase (c), or in the author's words, the 'pre-project project' (PPP) must at this point be emphasized as paramount. It is in this phase that the basic 'THINKING' and end- to- end 'CONCEPTUALIZATION' of all inputs and outputs for sustainability of the end product is undertaken.

All projects must pass through this phase, but all too often projects jump straight into the development phase, with the team and project manager being oblivious to this as they may be associated with only a single phase or even with only certain specific tasks in a phase. For such a party, their specific involvement comprises a project in its own right. This lack of awareness then adds significant unseen risk to the eventual project success and sustainability.

Further, general project management conventions and teaching on project life cycle effort plots effort versus time with effort in the concept phase (c) being by far the least. Figure 1 depicts the traditional curve; when plotting the effort required for all the activities over the life cycle of a project, one obtains a distinctive curve in the shape of half-a-pear, which is cut in two with the stem at the point of zero time.

It is the author's view that the plot of life cycle effort traditionally taught is misplaced in the current environment of the new legislative framework and the requirement for sustainable development and triple bottom line governance principles. Corporate reputation management for maintenance of stakeholder value also demands deeper levels of end- to- end, customer- to- customer 'THINKING' and 'CONCEPTUALIZATION' for reducing risk in the final project delivery and sustainability.

Therefore it is the author's proposition, against convention, that the 'new-age' plot of project life cycle effort

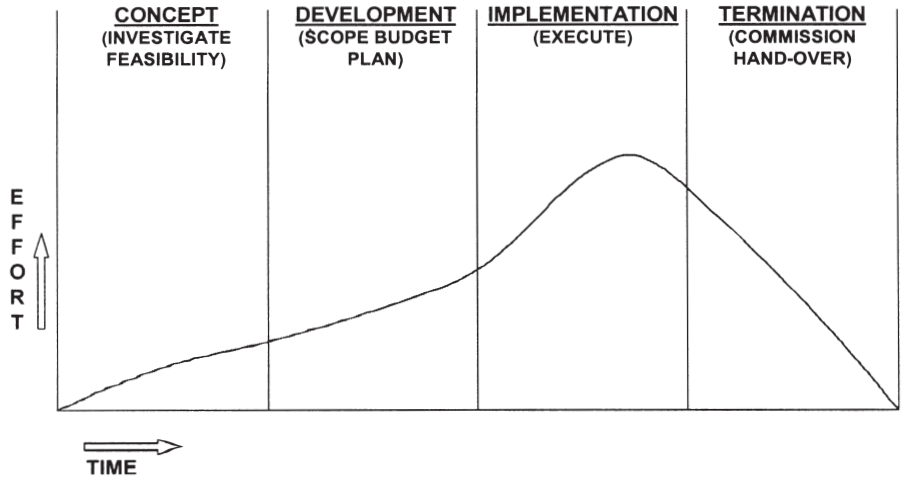

Figure 1—Project life cycle

should be represented by the curve profile depicted in Figure 2. This curve plot profile is similar to a 'camel's back' or to a half-a-pear cut in two, where both pieces are placed stem to tail. This representation clearly depicts the more enhanced effort versus time in the PPP or concept phase (c).

The level of project uncertainty and associated risk will remain relatively high during the first two project phases of concept and development after which it would start to reduce once unknowns become known during the third phase of execution. Once again, the rate of uncertainty and risk over the project life cycle phases would depend on the degree of effort put into the PPP phase on the particular project.

When considering the levels of uncertainty and risk with the 'new-age' legislative framework, governance and management of corporate reputation, and the resultant necessity for earlier increase of resources invested, it becomes self evident that the period of highest risk impact in the later stages of execution can be more effectively mitigated through implementation of the 'new-age' life cycle effort profile.

The opportunities to add value to the products of a project are highest during the PPP phase and would hence decrease to a low level in the execution phase and zero during the termination phase. Similarly, the 'cost to change' of a project will be lowest during the PPP phase, after which it will gradually increase during the development phase and accelerate rapidly during the execution and termination phases.

When considering the two aspects of 'opportunity to add value' and 'cost to change' there will be a point PC^{min} during the project life cycle after which any change will not add significantly to the value of a project products. Figure 3 illustrates the traditional curves 'opportunity to influence cost' versus 'cost to change' which result in the generation of the point PC^{min} at the intersection of the two curves.

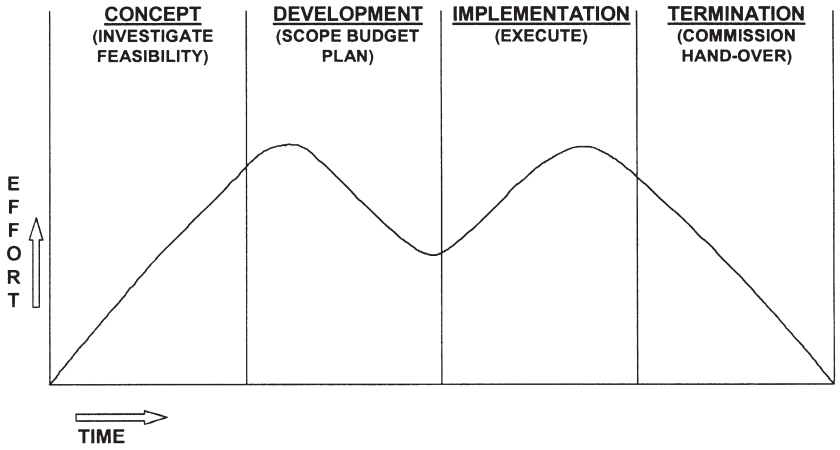

Figure 2—'New-age' project life cycle

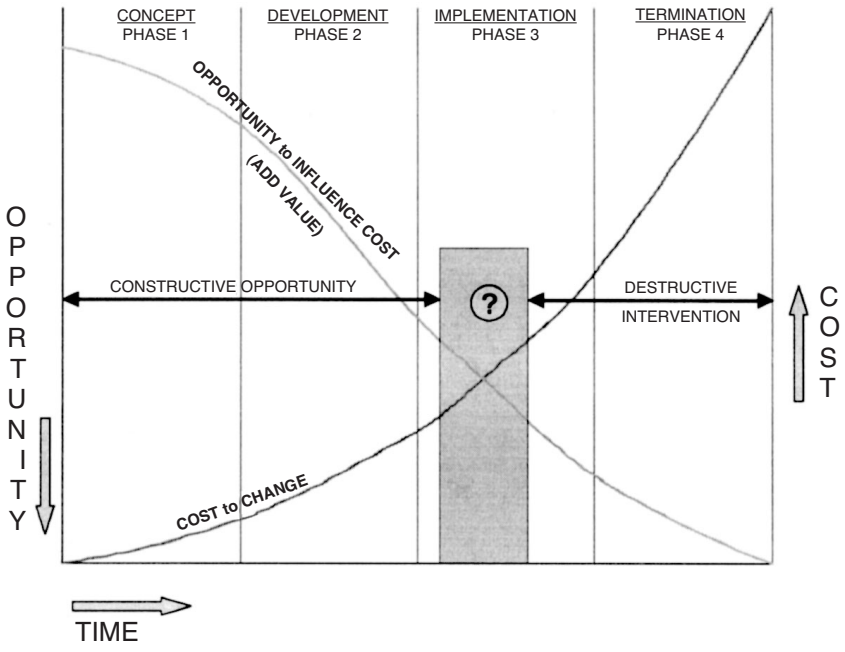

Figure 3—Influence on cost vs. cost to change

Figure 4 illustrates the relative positioning of this PC^{min} on the old established project life cycle curve.

In the 'new-age' environment this point PC^{min} will from necessity move forward from the traditional position on the old established curve. The new point is generated at the intersection of the 'new–age' curves for 'opportunity to influence cost' versus 'cost to change'. Figure 5 illustrates the 'new-age' curves for 'opportunity to influence cost' versus 'cost to change' and the new PC^{min}.

Figure 6 illustrates the relative positioning of this PC^{min} on the 'new-age' project life cycle curve.

This position may vary from project to project in the 'new-age' environment but once again this underscores the necessity for a change in the project life cycle model to incorporate the increased levels of effort in the PPP phase.

This point PC^{min} has been moved forwards due to the demands and requirements to fulfil all of the following:

- Conversion of rights, old order to new order
- Environmental impact assessment (EIA)
- Environmental management programs (EMPR)
- Social plan and sustainable development plan
- Community resolutions
- Equity participation
- Payment of royalties
- Closure plans and funding guarantees.

Similarly, the relationship between 'uncertainty and risk' and 'the amount at stake or resources invested' has also moved. The 'new-age' environment, which deals with the items and requirements above, necessitates higher earlier

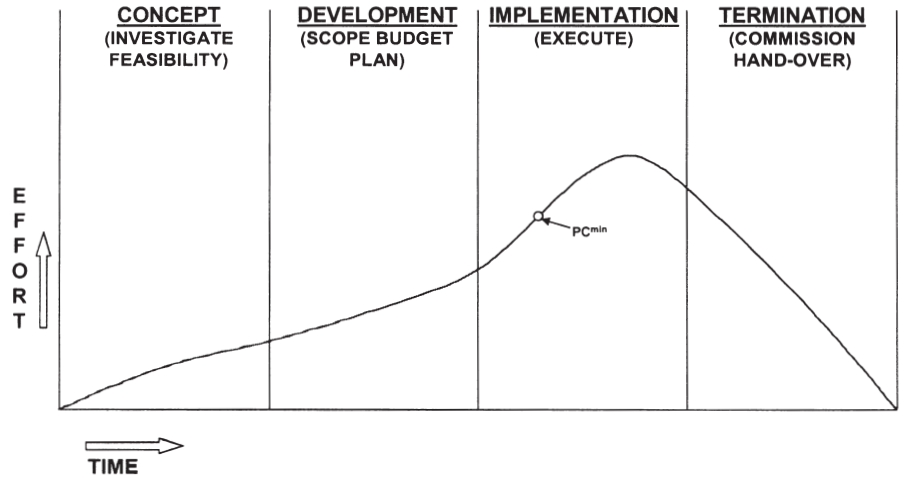

Figure 4—Relative positioning of the point PC^{min} on the project life cycle

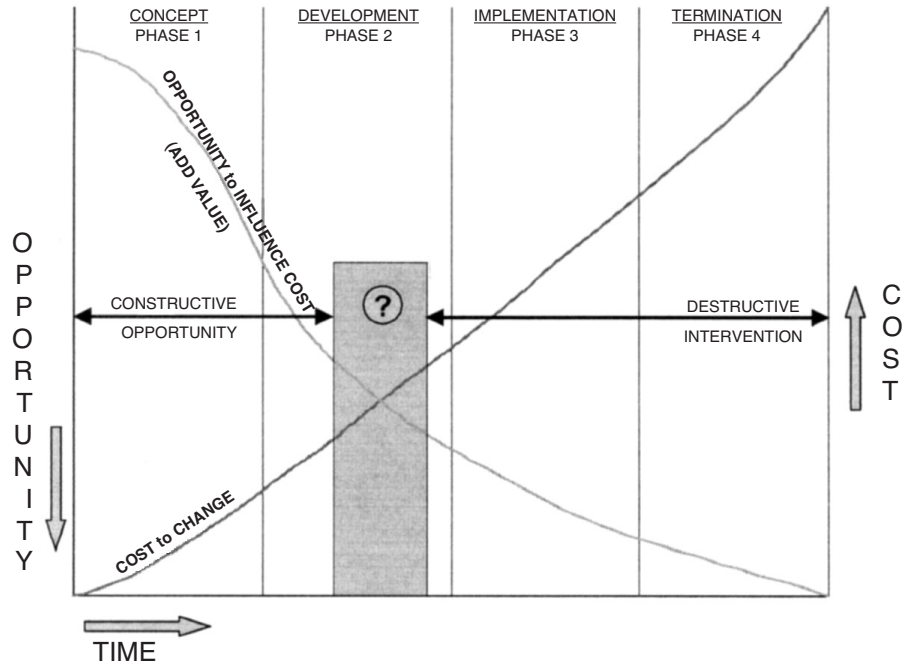

Figure 5—'New-age' project life cycle influence on cost vs cost to change

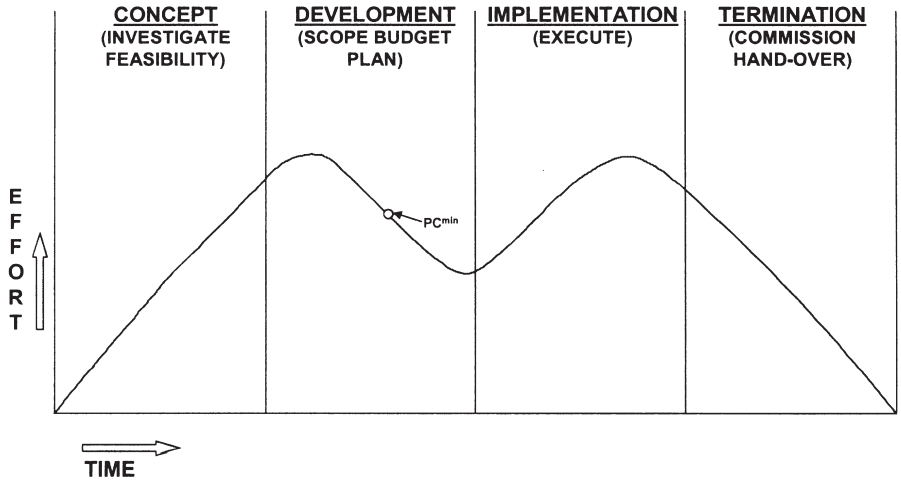

Figure 6—Relative positioning of the point PC^{min} on the 'new-age' project life cycle

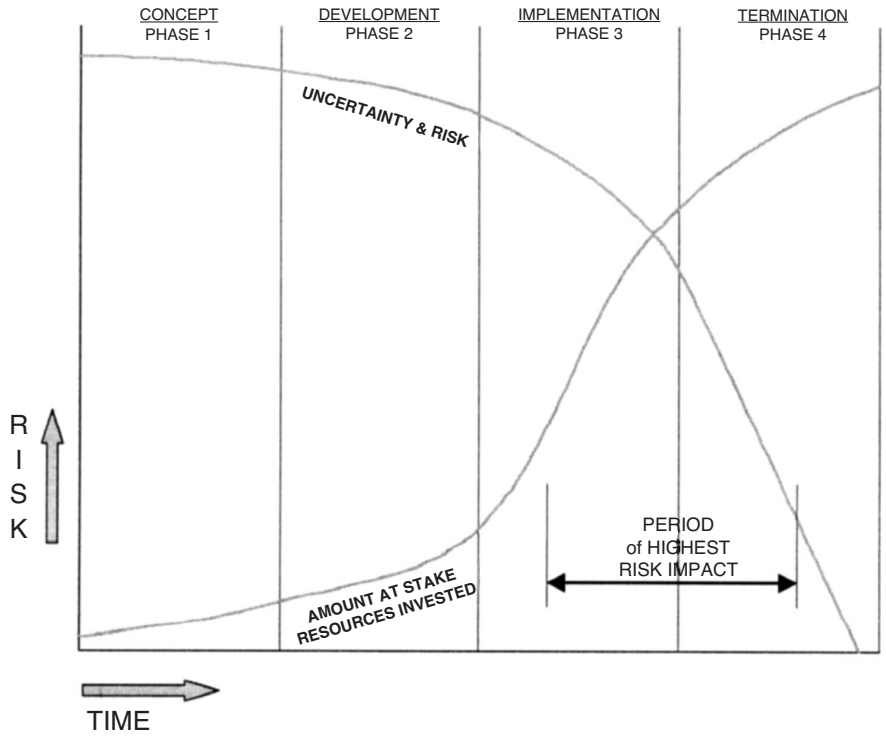

Figure 7—Project life cycle uncertainty and risk vs. resources invested (amount at stake)

investment in resources, which will commensurately change (reduce) the level of risk and uncertainty earlier. Figure 7 illustrates the generally accepted traditional profile curves for these items.

Figure 8 illustrates the 'new-age' profiles for 'uncertainty and risk' versus 'resources invested' suggested by the author.

In view of all of the above, the question arises whether project management has changed, or needs to change, in the 'new-age' environment in which one finds oneself. Clearly the answer proposed by the author is yes!

Project management body of knowledge (PM BOK®)[6] in the 'new-age'

The special features of projects in the 'new-age' environment demand that they receive a different emphasis and more explicit attention, and earlier than in the past. In terms of the PMI, the project management required to achieve the objectives may be defined as 'the art of directing resources throughout the life of a project by using 'modern management techniques' to achieve predetermined objectives of scope, time and cost and participant satisfaction'.

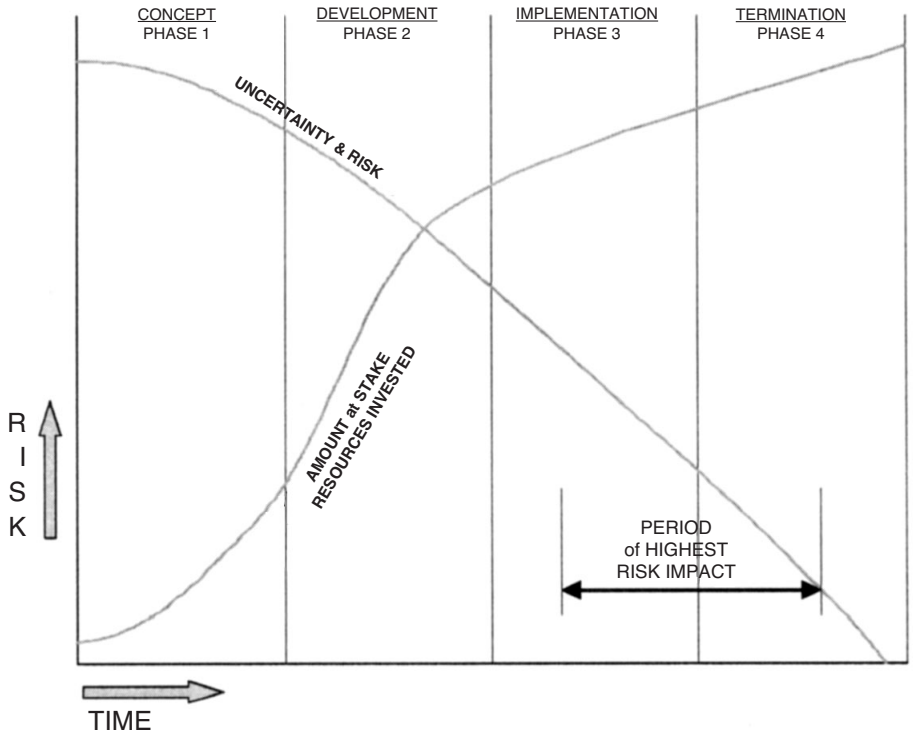

Figure 8—'New-age' project life cycle uncertainty and risk vs. resources invested (amount at stake)

'Modern management techniques' in the context of the 'new-age' environment means changing the emphasis towards the PPP as being the key to success or failure. Taking all the various aspects described into consideration the PMI has defined the project management body of knowledge (PM BOK®), which emphasizes the knowledge skills and techniques that are either unique to project management or are fundamental to carrying out the project management processes.

In the traditional definition of the PM BOK® the first four functions of scope, quality, time and cost, are considered to be the 'core' functions. In terms of the implementation or execution phase in the 'new-age' they remain the core; however, a greater emphasis on other bodies of knowledge is now required to reduce the risk of:

- Failing to receive statutory and/or regulatory authorizations required to proceed or
- Failing to achieve profit and sustainability from the project products.

These other bodies of knowledge have become the 'core' and hence the new elevated importance of the PPP in the concept phase (c) to deal in particular with the list of demands and requirements, as given earlier arising from the new legislative framework for the mining and minerals industry.

As an industry, it is believed that one is in general aware of the standard techniques for risk classification, risk identification, project risk assessment (now legislated) and project risk responses. Hence, it is not necessary to go into any detail here on these. Rather, one feels it is of more value to illustrate the potential impact of not applying the author's proposed 'new-age' project management life cycle profile; i.e. conduct a PPP with increased effort. This is done herein via the presentation of a case study, which is summarized within the body of the paper later. The full case study executive summary is attached as an appendix.

Project risk management and a 'project strategic scorecard'

As a pragmatic means of addressing the strategic oversight gap in business, the Chartered Institute of Management Accountants (CIMA)[8] propose the use of a strategic scorecard. The strategic scorecard approach is fully complementary to the PPP approach and can be adopted as a specific tool, adjusted for project fit, to assist in the completion of the PPP. Figure 9 Illustrates the CIMA Strategic Scorecard adapted for projects and its four basic elements.

The fundamental objectives of the PSC are that it:

- Assists the client board, particularly the non-technical or independent directors, in the oversight of the strategy underlying the project decision to proceed that will be required later
- Is able to deal with project strategic choice and transformational change
- Gives a true and fair view of the projects strategic position and its impact on the future progress of the company
- Tracks actions in, and outputs from, the strategic project decision making process—not the detailed content.

This generic approach would need to be adapted to each project's own situation. It helps to identify the decision points and then the timing of strategic options, milestones in strategic implementation, together with the mitigation of strategic risks.

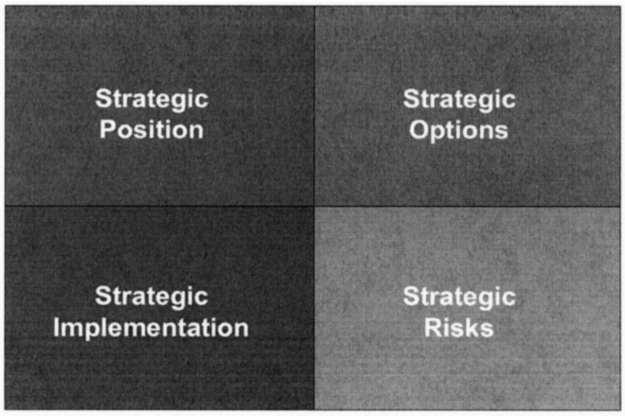

Figure 9—Strategic scorecard

The PSC—the generic elements

Element 1—The project strategic position (information for the client board, no decision points)

Project clients need to be continually reviewing their strategic position. In the case of projects' this would need to occur for each major project in the context of the overall business. The areas that should be reviewed in the PPP under this element fall into the following categories:

- *Micro environment*(*s*)—e.g. market, competition, customers
- *Macro environment*(*s*)—e.g. economic, political, legislative, regulatory
- Threats from significant/abrupt changes e.g. strategic inflection points
- *Business position*(*s*)—e.g. market share, differentiation on pricing, quality, delivery
- *Capabilities*—e.g. core competencies, skills availability, SWOT analysis
- *Stakeholders*—e.g. investors, employees, suppliers.

The example case study illustrates several of the strategic failures that took place from element 1 of the PSC above.

Element 2—The project strategic options (how the board considers decision points on change in the proposed project(s))

The client board needs to be aware of what strategic options are available in terms of the following:

- *Change of scope*—e.g. in a mine–exploration and resource classification, extraction method, access method, production rate, product grade
- *Change of direction*—e.g. high output/low grade, low output/high grade, processing methodology and product(s) definition.

Generally, in the project context, these would be those big strategic bets that have the greatest potential for creating or destroying shareholder value. Such bets are often difficult, if not impossible, to reverse, and in the case study presented, perhaps unwisely in retrospect, amounted to betting the company's existence.

These kinds of decision fit under the heading of 'real options'. Real options are features that make a project flexible. The word 'real' signifies that they concern real assets rather than financial securities. For each project there are probably only about three or four real strategic options that will be under active consideration at any one time. For each of these, it is useful for the client board to know in the PPP phase what analysis has been done, what the resource constraints are, and when the final alternatives will be presented.

Elements 3 and 4—Project strategic implementation and project strategic risks

Once a project has moved through the PPP stage to implementation, the client board needs to be updated on progress. The detailed evaluation of a specific project option should have developed and set out attainable milestones and time lines to be met. Critical success factors should also be clearly set out—what are those things that must happen to make the project strategy successful? Invariably there will be a critical path linked with the milestones.

The client needs to be aware of where there are break points such as those highlighted in the context of project life cycle above, i.e. PC^{min}, when decisions and/or intervention might be required. These decisions in the PPP phase would include whether to accelerate, abort, delay or, possibly, switch strategy. The client needs to react to new information rather than sticking rigidly and dogmatically to the original plan, as was the case in the case study presented hereafter.

The heading of Project Strategic Risk encapsulates the framework for enterprise governance, i.e. corporate governance, performance management, internal control and enterprise risk management. It strives to achieve a balance between conformance and performance. In the context of the project strategic scorecard, the types of assurance on risks that would need to be covered in the PPP stage are:

- A thorough review of risks in the strategy – the top ten tough questions that need asking
- Impact and probability analysis for key risks
- Strategic risks embedded in the project plans
- Due process to review risks (e.g. risk workshops, etc.)
- Action plans for key risks monitored against milestones
- Risk management is embedded in major projects.

A case study for illustrating the necessity of the undertaking of a 'PPP' within the concept phase©

The case study[7] as presented in Annexure 1 to this paper involves the undertaking and findings of a post-project execution operational due diligence (ODD) for a base metal operation involving primary mining, beneficiation and smelting.

The project that had been executed was the addition of smelting capacity to fulfil escalating demand for the operation's products in the steelmaking industry worldwide.

Summary

Assistance was required to design a plan to effectively turn around a major loss-making strategic investment in smelting

capacity. This non-performing investment was represented by the collective financial performance of a base metal mining, beneficiation and smelting operation.

Following the execution of a project to add smelting capacity, the company was facing technical insolvency and hence a need for urgent operational due diligence and a technical audit to ascertain the extent of the business failure.

A team formed was made up of a group of specialists from a wide variety of mining, engineering, process, environmental, safety, and business management disciplines. These individuals spent significant amounts of time within the operations, envelope of each of the main three areas of concern highlighted. The team also investigated all contiguous and related areas that may have impacted both upstream (inputs) and downstream (outputs) within the overall business process affected by the execution of the project.

The operating and executive management reports from each of the areas of concern were reviewed extensively for verification and benchmarking of operating performance versus project design and business plan targets.

As part of the ODD audit it was necessary to access specific documentation with regards to the overall medium-term business plan. Of particular relevance were the feasibility studies into the viability of the additional smelting capacity and the 'bankable plan' submitted to bankers in support of the financial facilities granted for the construction of the smelting plant expansion.

Sectional discipline reports covering the broad findings and headline risks associated with the discovery of the following specific project management deficiencies illustrated the severe failures result from the lack of a PPP or concept phase (c):

- Little or no project conceptualization or PPP undertaken
- Little or no project development
- No effective project planning
- Little project leadership, organization and integration control
- Little evidence of effective project cost control
- No effective adherence to industry standards, legislation and regulations regarding safety, health, and the environment
- Inadequate project financial provisions for future mine closure per regulatory requirements
- Lack of due care and attention regarding capital expenditure and the exposure of the company to unserviceable loan finance
- Lack of due care and attention regarding the awarding of outsourced project-related contracts
- A lack of transparency and corporate governance
- No real investment in sustainability.

All of these conditions were compounded into the result of imminent total business failure.

It was estimated that the level of refinancing and capital investment required, excluding the repayment of the bank facilities and loans, to ensure an ongoing sustainable operation, was well in excess of R100 million as follows:

- Environmental issues, R35+ million
- Mine underground infrastructure, equipment and engineering rehabilitation, R12+ million
- Mine ore reserve development, R12+ million over two years
- Beneficiation plant and materials handling systems refurbishment and re-engineering, R12+ million over two years
- Refurbishment and re-engineering of old furnace, R10+ million
- Critical and contingency spares, R7+ million
- Working capital, R20+ million.

The result of a PPP not taking into account the 'new-age' business conditions is the requirement for a total management and culture change and the possible inclusion of a new and suitably experienced investor to assist in the required re-engineering for future sustainability if the operation is to survive as a going concern.

Conclusion

It can be clearly seen from the brownfield case study that the impact from the lack of a PPP in the concept phase (c) of the smelter expansion project has been potentially fatal for the sustainability of the business. This is just one of many examples of varying degrees of project phase and entire project failure observed in recent times by the author.

Of course, the measure of project success[2] and failure can be viewed differently and by degrees from different groups of project managers, project owners, project executors, etc., generally using a subjective rating system based upon delivery of the work breakdown structure[3] (WBS). This is why the use of the ODD tool is so powerful in the context of a PPP to generate a relatively lower risk foundation within the concept phase of any envisioned project. It generates real factual evidence on the integrative possibilities with the current business for any project whether for a greenfield or brownfield implementation or execution.

Therefore it is the opinion of the author that the proposed 'new-age' project life cycle profiles, shown as Figures 2, 5, and 8 in the body of the paper, be applied to any potential project in the mining and minerals industry today.

A management-directed PPP will offer a 'new-age' foundation for work structuring within the WBS that will give creative technical approaches to both project and business management challenges. Project owners and project managers alike in employing a PPP as a key management tool as the foundation will increase efficiency on their projects and significantly reduce the risk of:

- Failing to receive statutory and/or regulatory authorizations required to proceed or
- Failing to achieve profit and sustainability from the project products.

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Annexure 1

Case study

Preamble

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Following the execution of a project to add smelting capacity, the company was facing technical insolvency and hence a need for urgent operational due diligence and a technical audit to ascertain the extent of the business failure.

A team of specialists from a wide variety of mining, engineering, process, environmental, safety, and business management disciplines was formed. These individuals spent significant amounts of time within the operation's envelope of each of the main three areas of concern highlighted. The team also investigated all contiguous and related areas that may have impacted both upstream (inputs) and downstream (outputs) within the overall business process affected by the execution of the project.

The operating and executive management reports from each of the areas of concern were reviewed extensively for verification and benchmarking of operating performance versus project design and business plan targets.

As part of the audit it was necessary to access specific documentation about the overall medium-term business plan. Of particular relevance were the feasibility studies into the viability for the additional smelting capacity and the 'bankable plan' submitted to bankers in support of the financial facilities granted for the construction of the smelting plant expansion.

Sectional discipline reports covering the broad findings and headline risks associated with the discovery of the following specific project management deficiencies illustrated the severe failures resulting from the lack of a PPP or concept phase (c):

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The result of a PPP not taking into account the 'new-age' business conditions is the requirement for a total management and culture change and the possible inclusion of a new and suitably experienced investor to assist in the required re-engineering for future sustainability if the operation is to survive as a going concern.

Sectional discipline reports

Environmental

The principal risks and first cost estimates of remedial measures required immediately were:

- Statutory financial provision for rehabilitation—R 17 million
- Slimes dam—R 7 million
- Furnace off-gas and cleaning system—R 7 million
- Statutory compliance in respect of domestic waste and the rehabilitation of polluted soil—initial capital R 1.5 million and a subsequent ongoing maintenance fee of R5 000 per month
- Tailings dam and slimes disposal area—R 5 million.

All of the above issues have been well known to the management and are reported on regularly, but had unacceptably not been acted upon. The regulations pertaining to self assessment and monitoring of environmental management were being ignored and contravened on all fronts, with required reports not being submitted to the DME.

The principal reasons for not addressing these issues were given as a lack of funds and skills, specifically at project execution level. The incumbent risk superintendent is very knowledgeable about the subject matter and needed to be supported by management on these issues for timeous and urgent rectification.

Safety

Two experienced auditors conducted a safety, health, environmental and skills development assessment at the site, using internationally accepted SHE and SAQA guidelines as the measurement tool.

Full evidence of a formal SHE management system could not be established/found during the assessment. The lack of such a system will result in the continuous breach of the following aspects: legislated requirements, company requirements and general good practices, which will inevitably result in undesired events.

It is evident from the incident/accident statistics and outstanding actions acquired from inspections and audits that there is no system to ensure that corrective and preventative measures are implemented, monitored and continuously measured to ensure a continuous improvement model.

The baseline assessment revealed that there was a strong focus on trying to implement ABET training. Notably, the supervisors in the engineering and smelter beneficiation departments provided a higher skills profile than the mining department.

Training is of concern as several serious deviations were identified. These deviations included the lack of training records, lack of outcomes based training material and lack of formal standards and procedures.

None of the training interventions fully comply with legislative requirements. No set competency criteria for evaluation were available. The system for claiming from the Skills Development Levy/Fund is also complicated by the fact that there are two registration numbers, i.e. one for the mine and one for the smelter.

Evidence found during the assessment indicates that quotes obtained from some of the training providers are not compliant with SAQA (South African Qualifications Authority) and MQA (Mining Qualifications Authority) requirements. If the training courses do not comply with these requirements then the 'owner' will not be able to claim any refund from the Skills Development Fund.

Using the internationally recognized 'common audit approach' (CAP) the safety audit team:

- Identified work needed to improve the project site's SHEQ management system.
- Measured work being done to improve the project site's SHEQ management systems.
- Objectively quantified work being done to prevent nonconformities/incidents and accidents from occurring. The incidence of the imposition of administrative fines from the DME was an alarming trend as these follow an escalating scale, ultimately resulting in closure of the operations for non-compliance, with massive financial loss implications for the owners/shareholder
- Identified the vast majority of management system deficiencies, which could lead to nonconformities/incidents and accidents
- Finally, and very importantly, CAP assisted in gaining a view on compliance with external management system standards such as ISO 14001, ISO 9001: 2000, OHSAS 18001 and legislative requirements.

The rating achieved by the project for this audit was the worst ever recorded by the auditors, a totally unacceptable 23% compliance ratio.

Mining

A business process review was completed on the complete chain of mining process events, from mining the ore through the screening and beneficiation to the final feed stockpile for the smelter.

Mining specialists took a detailed visit to all the operating sections and different departments of the mine and gathered information about actual conditions underground, planning, actual surveyed information on a monthly basis, ventilation, personnel, shift times, blasting schedules, procedures, codes of practice and other relevant information to compile a detailed report on the status quo.

Headline risks were identified that will prohibit the mine from producing on a safe and sustainable level commensurate with the levels required for supply of the expanded smelter capacity result from the project, namely:

- Legal restrictions, rules and procedures pertaining to a gassy mine are not adhered to
- Emergency preparedness is totally inadequate and following several unadhered to warnings from the Inspector of Mines; administrative fines have been imposed
- Medium- and long-term mine layout and production planning does not exist, with mine surveying being hopelessly inadequate, and the DME recording his concerns in writing. Such concerns have been to date ignored to the extent that the outsourced responsible mine surveyor also recorded these concerns in writing again
- No ore reserve development has been done for several years so no tonnages are available to feed the completed smelter project
- Ventilation of the workings is totally inadequate
- physical condition of the infrastructure underground is in a terminal state

Mine engineering

The mine mechanical and electrical infrastructure is in a general state of neglect. The engineering department does little or no planned maintenance. Maintenance is done on a breakdown basis at best, with an attitude of 'if it isn't broken do not fix it'.

The engineering department is insufficiently staffed with a high turnover of staff and supervision, with any good staff immediately transferred to the smelter operations.

Little or no management control systems are in place to ensure that the proper maintenance is done. Proper facilities and resources to perform the required maintenance are limited and totally inadequate. There are no engineering maintenance management systems in place to ensure that the mine is maintained satisfactorily and historical data recorded.

The shaft system is in a poor condition, and loose shaft tracks pose a high risk. In addition, the practice of travelling by persons in the shaft while hoisting is taking place is very unsafe. The electrical system of the mine is in a serious state of neglect and potentially dangerous condition.

Due to the state into which the mine has fallen, a major effort and significant expenditure will be required to bring the infrastructure back to an acceptable standard. Headline risks identified are:

- A failure to the shaft belt system would stop all material transfer with immediate effect. Considering the condition of the belt system and the lack of spares, this is highly likely to happen
- At the level required to feed the executed smelter project, the current ore resource and tribute areas cannot deliver and sustain the required production.

It is clear from the above-mentioned that a lot of time and a baseline minimum estimate of R30 million need to be spent on the human resources, planning and management control systems, general infrastructure, etc., to ensure the future provision of safe sustainable production at a level not less than that required to feed the expanded smelter capacity.

Beneficiation plant

The primary purpose of the audit in this area was to investigate the current operation of the plant in order to determine its capacity for treating sufficient smelter feed for the executed project. In addition, the study was intended to identify the capacity constraints in the process and to benchmark the operation with similar plants.

The beneficiation plant is the intermediate processing step between the mine and the smelter. The objectives of the plant are to remove all gangue material from the run of mine (ROM) ore and to crush and screen the material to a size that can be handled by the smelter feeding system. During the crushing and screening operation, a fine fraction is generated that is processed through a gravity concentration circuit to produce a high-grade product. This material is exported and is sold at a premium, compared to the lumpy smelter feed.

The headline risks that were identified during the audit of the beneficiation plant can be summarized as follows:

- The mechanical condition of the plant was generally poor and there were a number of safety concerns, particularly about the condition and operation of the conveyors and crushing plant.
- The maximum process capacity of the current operation is 29 000 tpm based on a historical operability figure (availability x utilization) of 67%. This falls short of the minimum requirement of 50 000 tpm ROM required to operate the furnaces resulting from the project execution.
- The availability and utilization figures for the plant are very poor. This is due to the age and condition of the equipment and the lack of stand-by units for critical pieces of plant. The lack of maintenance personnel also reduces the availability as repairs are only undertaken on a breakdown basis (often after hours).
- The quality of the ROM ore from underground varies considerably. This is made worse by the manual method of hand picking the gangue material from the ore. This results in excessive waste rock being included in the lumpy feed to the smelter complex, which reduces the efficiency of the furnaces delivered by the project execution.
- The operating costs are generally excessive for this type of operation. The primary causes are the high transport costs, caused by double and triple handling of the various products around the plant. This can be reduced by installing an ergonomically designed plant that makes use of conveyors to transfer products instead of outsourced and hired vehicles.

There was no planned or routine maintenance in place on the plant. At the beneficiation plant, maintenance was undertaken by the mine engineering staff, and the logistics mean that there are often no artisans available on the surface to undertake repairs. This philosophy guarantees the presence of significant safety risks and detrimentally affects the plant availability.

The mine beneficiation plant is in a serious state of neglect. Little or no maintenance is done to the plant by the mine engineering department. The engineering staff available for the maintenance of the plant as well as the mine is limited. As a result, the available engineering staff are used in the bigger problem areas i.e. the mine. No engineering supervision is available to ensure that the correct maintenance is conducted. Maintenance and repairs are at times conducted by the operational staff that are not suitably trained and competent to conduct such repairs.

There are no planned maintenance systems in place to ensure that the plant is maintained satisfactorily. There is no system in place to replace or improve old, and redundant equipment. The electrical system is old without any circuit diagrams available.The motor control centre is continuously exposed to high levels of vibrations.

Smelter

The smelter plant is the final step in the metal production process and is supplied with material from the beneficiation plant; was also studied as a part of the ODD.

The function of the smelter is to produce a saleable grade of metal from the ore supplied by the mine and processed by the beneficiation plant. The ore feed is blended with a number of reductants and fluxes before being fed into one of the two electric arc furnaces. The products of the furnace are metal, slag and off-gas. The molten products are cast and crushed and the off-gas is cooled, filtered using a bag filter and discharged to atmosphere.

The general concerns with the operation were the lack of control of the blending of the feed and the high levels of gangue material in the lumpy feed from the beneficiation plant. If waste rock is present in the feed, it reduces the efficiency of the furnaces and decreases the metal content in the metal.

The headline risks that were identified during the audit of the smelter complex can be summarized as follows:

- Inefficient material handling in terms of stockpile control and identification could lead to incorrect material feed and consequent inefficient furnace operation. The incorrect identification of the blending bins could also lead to mistakes during the preparation of furnace batch charges.The possible consequence is the furnace capacity being reduced by an incorrect metallurgical recipe

- Consistent quality and quantity of ore and reductants are required to ensure efficient furnace operation. This is particularly applicable to the quantity of gangue material that is present in the lumpy feed to the furnaces. If excessive waste rock is present in the feed, it will reduce the efficiency of the furnaces and hence the MW consumption and cost per ton of metal alloy will increase. The current power consumption per ton of metal alloy produced from the executed project is 4.3 MW. This is well above the industry norm of 3.6 MW and can even be reduced further (to 3.1 MW) if the feed is prheated
- The manual method of charging the furnace is not ideal, as it is reliant upon the presence of a skilled operator of which there are insufficient in service. The full automation of the process (based on the power input) should have been investigated in a PPP or concept phase
- The lack of operable thermocouples in the executed projects' furnace crucible and freeboard could lead to undetectable furnace failure and consequent lost production. Again, this should have been taken care of at PPP phase
- The furnace feed bins have a reduced feeding capacity as half of the feed ports were 'blocked' off during project execution. This needed to be rectified to ensure material feeding of furnace is uniform and consistent
- The mud gun and drill combination for the executed project furnace requires the aisle crane for positioning purposes; this reduces the availability of crane and leads regularly to a bottleneck of production as the crane is also used to remove the ingots from the casting pits for both furnaces
- The bag house availability is low, due to the frequent failure of the ID fans. This poses an environmental and safety risk due to an increase in CO gas and heavy metals being emitted around the casting floor level. With the emergency vent ducts open, environmental exceeding of dust concentrations in the area is also inevitable. Due to the different motor sizes for both fans, a motor is not kept as a critical spare
- The current lack of operation of the filtration plant results in high concentrations of metal that present in the bag house dust being pumped to the tailings dams. This is leads to poisoning of the watercourses in the area supported by the high levels of heavy metals being reported in the borehole samples. The tailings dam will need to be reprocessed and all of the current arisings treated with reagent for reducing metals in bag house dust, prior to pumping to a new dam
- The closed circuit cooling on electrode seal/pressure rings etc. is identified as a major cause of breakdowns due to water leaks. This must urgently be rectified to increase the relatively low furnace availability
- The possibility of installing a jigging plant to separate the entrained alloy from the slag dump and current arisings should be investigated. This has significant potential for improving the profitability of the smelter plant operation
- It is calculated that the maximum theoretical smelting capacity of the current operation with both furnaces operational is 12 000-tpm metal production (assuming an operability of 96% for 365 days per year 24 hours per day). In practice, the availability is only 83% and the utilization is reduced due to the furnaces not operating at maximum power. This equates to a maximum capacity under the current conditions of 7 750 tpm. This is 22 5% below the design of 10 000 tpm and accounts for the lack of profitability of the site
- The maximum demand meters on the furnaces should be commissioned urgently. This will add significantly to reducing the power consumption costs and increase the profitability of the smelter.

A number of process considerations, metallurgical and mechanical, could have been investigated in a PPP phase to try and improve the metal recovery over the plant (beneficiation and smelter), namely:

- Reductant addition optimization should be investigated to optimize fixed carbon requirements to improve reduction efficiencies. Losses from slag and off gas-dust represent nearly 40% of metal that is irrecoverable at present
- The planned maintenance and down time database is not backed up onto the server. This poses the continuing risk of losing valuable historical data and information, which it appears has happened previously
- There is no system in place to control and/or log any changes being made to the PLC programming. Since the executed project smelter plant is PLC controlled, it is critical to ensure that programme changes are recorded and approved at the highest level of authority.

The engineering department does not have a clear vision of what is expected of the smelter. The production call and production achieved is not communicated to operating staff at any levels. Neither is the smelter staff aware of the mine and beneficiation plant call and actual performance as far as it impacts on them.

Headline risks

- Uncontrolled changes to the PLC programme could have detrimental effects to the operation of the smelter
- The single raw material feed system would disable the entire smelter plant from operating, should a failure occur
- No critical spares are available for the smelter plant. A critical component failure would result in a prolonged stoppage to the plant

Marketing and business plan

Marketing and sales policy is centrally controlled. It could be said to be something of a 'black box' as only one person seems to know and have access to market information, and no communications with customers were allowed from the project management team.

This policy should be the domain of the board, and in the current climate reversed for the following reasons:

- Production capacity is declining (for the reasons stated in this report) and only long-term contracts taking precedence are being serviced
- Marginal revenue analysis from the due diligence shows losses will continue to escalate under the current operating conditions
- Opportunity revenue losses are climbing as no supplies are available for the spot market to take advantage of the monthly rise on already significantly higher prices
- Rising freight costs to long distance destinations in the Far East and Asia
- Use of long-term contracts with agents forces non-negotiable commissions of 3.0% of FOB price
- Cash shortage is forcing the necessity for preferential commercial terms of cash against documents arranged with agents, resulting in an unnecessary additional cost of interest charged.

The 10-year business plan used as a unilateral basis for the execution of the smelter project is significantly flawed in a number of critical areas that affected the business both immediately and in the longer term, namely:

- It completely ignored the significantly dilapidated and unsustainable operating condition of the only source of saleable ore and smelter feedstock, the mine
- No strategy or plan for sustainable mine production was addressed
- Although an estimated capital expenditure was mentioned, which was clearly taken from outside estimates provided as part of technical reports commissioned by shareholders earlier, it does not clearly show the impact in the cash flow forecasts
- It assumes sustainable solvency ratios and the business could continue to raise cheap capital
- It assumes constant low power tariffs when it is well known that Eskom are to increase tariffs by at least CPI + 4% to major industry users, and by as much as CPI + 6% for the next two to three years to more niche and smaller industrial users
- It assumes the business has the ability to lower the cost of production to remain competitive by increasing sustainable supply capability with no cognizance being taken of where the smelter feedstock will come from
- It recognizes a skills, shortage but does not deal with plans to rectify this situation for sustainability, nor does it cost for this.

The business plan is in essence totally out of date and out of context with the current realities of the business.

HR and finance

Human resources

Although detailed investigations into the area of human resources management were not possible within the time constraints of the due diligence process, it can be said to be a core business process for sustainability and a critical success factor.

Questioning of both the middle management and supervisory levels indicated that they are for the most part unaware of any aspect of the smelter expansion or effective policies and procedures being communicated to them regarding assisting in the effective management and development of their people.

It is clearly apparent that the HR department resources are inadequate to undertake proper management of all the functions required to be undertaken, i.e.

- Recruitment of competent staff to meet the need of the project product
- Benchmarking for attracting and retaining the best staff and skills
- Training for proper induction, skills and competency development
- Salaries, wages and overtime management
- Enforcing basic conditions of employment
- Disciplinary action, disputes and legal cases
- Productivity and efficiency management programmes and monitoring
- Performance management systems
- Management for succession planning and sustainability
- Employment equity planning.

Rather, the department has been reduced to 'doing what it can' on a superficial and ineffective basis with the lack of competent staff, facilities and funding, while focusing on historical and statistical reporting of historical events.

The lack of a coherent and implementable HR strategy is alarming and contributing strongly to the high incidence of the following:

- Deleterious safety-related events and the high incidence of accidents
- High labour turnover
- A dearth of real skills
- Unusually high incidence of litigation against the company
- Steadily accelerating and declining productivity and efficiencies
- Continually escalating costs from operating asset breakdowns and associated overtime paid for repair work.

Clearly the HR function is an area requiring significant input of resources, planning, investment and re-engineering during the PPP phase of the project (which was not done) to turn the business around for sustained profitability and the safety and health of all its employees.

Financial reporting and financing

The financial reporting was again not an area of detailed investigation by the due diligence team, given that the focus was one of technical and operational due diligence and not specifically required by the terms of reference.

However, given that financial performance is a clear reason for the business existing and that it is indelibly linked via the cost and expenditure within the technical and

operations areas, a simple review of the financial management reports distributed was made by the project leader.

The financial reporting is not specifically clear and/or necessarily of use to the uneducated eye. None of the reports has any supporting notes and/or explanations for anomalies that appear on a month- by- month basis in a number of the line items, in both the cash flow and income statements.

Reporting is on a numerical basis only and of little assistance to a shareholder, unless he/she is an accountant or trained in financial accounts analysis, in understanding what is happening in the business and even then it is difficult.

The turnover schedule is also difficult to decipher without intimate knowledge of the sales and selling expenses side of the business. This results in a lack of understanding for effective alignment of the business value chain with profit generation. Generally, each month three sets of numerical accounts are presented, mine, smelter, and a capital expenditure schedule. Each set of accounts includes an income statement, balance sheet, cash flow statement, and a turnover schedule.

As was highlighted above, the lack of commentary on movements in the numbers makes analysis a challenge. However, if one simply reviews trends, it is very clear that over the period reviewed that the business was becoming less stable and bleeding cash at an ever increasing rate.

Review of the capital expenditure schedules shows the reckless expenditure of unapproved and overcommitted capital is also notable for the managements' lack of control and/or adherence to corporate governance principles in the project execution. No clear policies and procedures for the application, allocation and approval of project capital expenditure are in evidence.

The apparent critical failure to have budgeted for insurance and capital loan servicing in a project plan is also evident. This is having a terminal impact on the cash situation from interest repayments on the project bank loan for the smelter expansion.

It becomes clear from the report trend mapping that, as early as mid-project execution, the company was already technically insolvent. By the end of the project implementation phase, the company had already accumulated a significant consolidated loss. Clearly this was a project management failure to take cover on the exposed position resulting from term delivery contracts and project commitments.

The more glaring failure is the project management's continued unrealistic forecasting and assumptions for project product delivery, which is leading to further losses and a situation likely to result in bankruptcy due to negative cash flow and its inability to service its debts.

The volatility in sales made, due to lack of timeous production quantities and the resultant high shipping and selling expense costs applied for missing delivery schedules for which commitments, had been made is clearly noticeable.

Attempts by the executive management to blame everything on the volatility and depreciation of the rand versus US dollar are not supported by the necessary evidence. It was the view of the ODD team that this is a convenient excuse for covering a lack of management competency in managing and balancing the elements of the project from concept to termination and a failure to understand the 'new-age' requirements in mining projects.

Investigation into the procedure and basis for the award of the project loan has highlighted several failings and deficiencies in the entire process by both the project executive and management and the lender's business banking services.

A proper bankable feasibility study was never produced for the smelter project investment, as had been previously done for the old unit, which was required by previous bankers. Rather, management took advantage of a competitive situation when the lender was aggressively pursuing mining business, which resulted in an offer from them costed at an apparent saving of several millions in interest and guarantees to the project.

A two-page letter, in the form of a draft proposal, including a forecasted cash flow, compiled and submitted by the company, was the only documentation submitted to the lender in support of the loan request. The failure to complete a full bankable feasibility was already a fatal flaw in the entire investment strategy for the project executive management.

As has been indicated from the mining, beneficiation and smelter sections of this executive summary above, a proper PPP and or due diligence study of the existing operations would have highlighted immediately that neither operation ever had any chance of being profitable, at the projected and forecasted rates, without additional significant and risky capital investment to guarantee smelter feedstock.

The result is that the business is facing bankruptcy on all fronts on the basis of:

- Continuing negative cash flows
- Escalating costs from poor productivity and asset failure
- Exhaustion of sustainable ore supplies at required tonnages and feedstock quality
- Exhaustion of cash resources
- Servicing of interest charges on overdraft and loans
- Capital loan lump-sum repayments on the loan
- The risk of foreclosure on the loans due to contravention of the terms and conditions of the loan agreement and its applicable sub-clauses
- Deteriorating safety record and high costs from non-compliance with industry standards and recognized good working practices
- The need to refurbish the old furnace
- Looming environmental liabilities and guarantees.

Due to the dangerous conditions discovered during the due diligence process, the executive project and operations management were informed of discoveries and findings that were of immediate concern. Full statutory responsibility was discharged by the ODD team to the company's board of directors. ◆