Development of a risk-based mine closure cost calculation model

by A. du Plessis* and A.C. Brent*†

Synopsis

The study summarized in this paper focused on expanding existing South African mine closure cost calculation models to provide a new model that incorporates risks, which could have an effect on the closure costs during the life cycle of the mine. This research is important because currently there are a number of mines that do not have sufficient financial provision to close and rehabilitate the mines. The magnitude of the lack of funds could be reduced or eliminated if the closure cost calculation is done in a more risk-orientated manner. The model consists of an expansion of existing closure cost calculation models, by applying the Monte Carlo risk simulation technique to model influences of external and internal changes affecting closure costs. It is shown that the proposed risk-based model provides a way to understand better the implications of uncertainty on the closure costs.

Introduction

The mining industry, as with many other industries all over the globe, has to face new challenges. One of these challenges is the ever-increasing stricter social and environmental legislation and environmental awareness of the community in which it operates.

From the early seventies, a number of Acts* were passed in South Africa, of which the most significant environmental legislation was the Environment Conservation Act (ECA), Act 73 of 1989. This Act provides a general structure for management activities. The next Act, which together with the ECA forms the basis of today's environmental management, was the National Environmental Management Act (NEMA), Act 107 of 1998. This Act took management principles from the ECA a step further and mainly focused on comprehensive environmental management[1].

There are a number of principles contained in these and other Acts that govern the way mining companies should operate. As an example, 'cradle-to-grave' is one of the principles included in NEMA, which implies consideration, investigation, and analysis of all aspects in the life cycle of a product, process, or service. This principle is being implemented through various frameworks of which ISO 14040 is one example[2]. Further environmental legislation is contained in the new Mineral and Petroleum Resources Development Act (Act 28 of 2002), which requires that an environmental management and rehabilitation programme be in place before new-generation mineral rights are granted. Regulations 53 and 54 of this Act describes the methods, as well as the quantum of financial provision.

The primary concerns for decommissioning and rehabilitation are to ensure public safety and health, and environmentally stable conditions compatible with the surrounding environment, and consequently minimize the environmental impacts caused by mining. The overall objective is to have socially, economically, and environmentally sustainable development. For example, the objectives of mine closure as set out in the South African Department of Minerals and Energy (DME) policies are:

- Safety and health of animals and humans must be safeguarded
- Environmental damage and residual impacts must be minimized to a level acceptable to all parties, i.e. avoidance of future pollution
- Land must be rehabilitated to as close to natural state as possible, i.e. creation of a stable land surface
- Physical and chemical stability of remaining structures must be such that they are not affected by natural elements
- Mines are closed effectively and cost-efficiently
- Mines are not abandoned, but closed in terms of policy.

*All South African Acts are obtainable from the central government website: http://www.gov.za

* *Department of Engineering and Technology Management, University of Pretoria.*

† *Natural Resources and the Environment, CSIR.*

 SA ISSN 0038–223X/3.00 + 0.00. Paper received Mar. 2006; revised paper received May 2006.

In summary, the closure process should be a life-of-mine process, where risks are quantified and managed proactively.

Background and objectives of the study

In the past, most companies followed the 'command and control' approach to manage environmental problems, where the strategy was a typical 'end-of-line' one, e.g. abiding by emission standards and limits and following maximum permitted rates of resource use. Problems were solved as they occurred[3]. It has been stated[4] that mine closure is, typically, required at a time when the operation is no longer economically viable, when cash flow is often severely restricted or negative, and when the value of assets is below the expenditures required to achieve the environmental objective of mine closure. Furthermore[4], the objective of securing mine closure funding at an early stage is to mitigate against the risk that an enterprise may either be unwilling or unable to undertake mine closure due to lack of funding.

Currently a number of mines, both locally and internationally, are in the process of closing and are near the end of their economic life. However, it is realized that most of these mines do not have sufficient funds to close the mines to an environmentally acceptable condition. The effect of the problem is usually addressed by different means, but the main causes for this lack of provision are not always clearly defined or addressed. Some of the reasons for the lack of financial provision, which is addressed by this research, include:

- Improved technology that has brought about the economic viability of exploiting increasingly lower-grade ore from mines[5], resulting in greater environmental impacts and changes from design criteria
- Underestimation of required funding; escalation is higher than expected in a particular industry sector
- The rehabilitation concept was not properly investigated during the early phases of the project and then requires more resources than expected at the time of implementation
- Early closure, either due to technical or financial reasons. Declaring bankruptcy would externalize the costs associated with mine closure and result in the financial burden being passed on to the government[4]
- The technical solution implemented at time of closure is different from the expected or designed solution. The lack of a proper or updated mine closure plan can result in severe environmental and economic consequences[6].

The rationale for the study[7] was therefore that there is increasing pressure on mines to provide sufficient funding for end-of-life. Communities and different governmental departments such as the Department of Minerals and Energy (DME), the Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT), by means of the laws mentioned previously, are exerting this pressure.

It was subsequently proposed[7] to consider the current practices and requirements of mine closure. This study thereby aimed to review the existing closure cost models, and attempted to combine project and risk management principles with existing financial models to develop a model that will assist both companies and governments to predict better closure costs at end-of-life. An existing mine's closure costs were compared to the closure costs calculated with the proposed model. One of the objectives was to provide a distribution of closure cost, which can allow companies to choose how much risk they are willing to provide for. This model also takes better cognizance of fluctuations in construction rates and product price escalations.

Existing models

Two proposed methods were specifically investigated in line with the objectives of the study[7]:

- A mine closure model (MCM), which describes how the closure or rehabilitation process can be done in a more systematic way, based on project management principles
- A 'rules-based' approach that is currently being implemented by DME for calculating the quantum of financial provision.

A mine closure model (MCM) has been proposed[8], which is based on project management principles, to assist mining companies and governing bodies to plan for rehabilitation and closure in a more structured manner. The model emphasizes the importance of considering risks, the whole life cycle of the mine, and having contingency planning in place. The problem with this approach is that it still does not cater for unexpected changes such as a possible increase or decrease in mine life, fluctuations in construction rates, and escalation rates.

In September 2004 the South Africa Department of Minerals and Energy published a guideline document[9]. This document provides guidance for the calculation of the quantum of closure-related financial provision. This 'rules-based' approach in the closure costing guideline describes a methodology to determine the quantum for financial provision. The quantum refers to the amount of funds required for closure of a mine. This guideline is generic in nature; it does not supersede legal requirements. The guideline covers the most essential closure components that are generally required for closure of a mine site. These additional costs need to be considered to illustrate the 'complete picture' of the quantum for financial provision. The described method consists of a model, which could be used to first classify the mine in terms of risk and sensitivity of the area. It then determines the closure cost components, weighting factors, and closure costs.

The master rate for each closure component is based on the 'generally accepted closure methods' for each of the closure components listed in Table B.4 of the DME guideline[9]. The master rate is in all cases applicable to a Class A (high risk) mine in a high environmental sensitivity area. In instances where these closure methods will not be applied, e.g. where in the approved environmental management plan (EMP) indicates different closure methods, then the costs for this closure component must be determined by a specialist study.

The multiplication factors are applied to the master rate, which depend on the risk class and the area sensitivity. There are two weighting factors. The weighting factor 1 relates to the nature of the terrain where the mine is located. This factor is applicable as it is more difficult (and hence more costly) to undertake work related to mine closure in areas that are undulating or rugged. The weighting factor 2 relates to the proximity of the mine to an urban centre. This factor is applicable as there will be increased costs to transport machinery, goods and personnel to more remote mine sites. This second weighting factor is applied to the preliminary and general items only.

The methodology is based on the assumption that a third party will be employed by the DME to undertake necessary rehabilitation and remedial work, should the mining operation close prematurely. It is further assumed that the mine infrastructure has no salvage value. It may be possible to offset the salvage value if the mine can prove that a formal arrangement exists; there is thus a probability of lower costs. This model also does not take into account the effect of risks such as excessive inflation over time, changing technologies, etc. The current practice is to revise the quantum calculation on an annual basis. The master rates will be updated based on the consumer price index (CPI).

Proposed risk-based model

Simulation models are used when the behaviour of a system cannot be expressed in mathematical equations[10]. The Monte Carlo simulation technique is typically used to model risk[11]. This method expresses uncertainty in a number of variables by means of a probability distribution. A random sample from each variable is taken to produce the total output. The process is repeated many times to produce an output distribution. The Crystal Ball software package[12] was utilized, which is a Monte Carlo simulation add-in for MicroSoft Excel spreadsheets.

The proposed model utilizes the DME guideline as a framework and then applies the Monte Carlo simulation to calculate a distribution for the expected closure cost. The proposed model consists of the following:

- The closure components and costs, per mining class and with similar weighting factors as the DME guideline[9]
- The application of life cycle engineering principles as per the mine closure model[8], to cater for the full life cycle.
- Additional components of the model[7], which are:
  - Escalation distributions for the last 5 to 10 years for major cost components such as earthworks, transport costs and steel, depending on the specific project
  - Probabilities of extensions or reductions of mine life—based on, for example, a change in production rate, possible new orebodies or borderline ore grades included or excluded from the mine plans
  - Probability of increase in costs due to having only a conceptual plan for closure during the detail design phase.

The proposed model is summarized in Figure 1. For illustration purposes, it was assumed that the mine will follow the 'rules-based' approach. Therefore only 'Route 2' from the DME guideline is used, but with the addition of some risk examples as discussed above, each with its own probability density function (PDF).

Application of proposed model

The mine used as a case study to demonstrate the proposed model, is situated in the KwaZulu-Natal province of South Africa. The mine consists of three main areas: the mining area, the primary wet plant (PWP), and the residue storage facility (RSF). The mining area is approximately 260 ha, the PWP area is 10 ha, and the RSF is 180 ha. All these areas have to be rehabilitated during operation and/or after mining activities have stopped. The areas need to be rehabilitated to such an extent that they comply with the requirements of the Environmental management plan (EMP), which states that the areas need to be rehabilitated to its original land use, which in this case is for agriculture purposes.

The proposed model uses variable quantities, rates, and escalation factors to predict what the closure costs could probably be. To have an understanding of the variability of these factors, one must consider past projects and indices to predict what may happen in the future.

From past experience on similar projects and due to the significant number of factors that could influence the quantity of work that is required for rehabilitation and closure, it was assumed that the quantity could reduce by 5% and increase by 20%[7]. This results in triangular distributions as shown in Table I.

It was assumed that the rates may decrease by 10% or increase by 20% (also shown in Table I). This assumption is conservative and is based on past experience of budget rates usually being lower than actual rates[7].

The last variable considered for this study, which also has the most significant impact, is the variability of the escalation factors, which are used to calculate the final closure amount to be provided for over the life-of-mine.

The indices from Statistics South Africa† were used for particular industries and closure cost components. The seven indices used for this case study were:

- *CPI for the metropolitan areas*—transport running costs, petrol (STATSSA document P0141.1: Table 15).
- *PPI for materials used in certain industries*—building and construction, ivil engineering (STATSSA document P0142.1: Table 15).
- *PPI* for all commodities for consumption in SA—manufacturing, transport equipment, motor vehicles, parts and accessories (STATSSA document P0142.1: Table 10).
- *PPI for selected materials*—civil engineering plant (STATSSA document P0142.1: Table 16).
- *Table C3*—SEIFSA index of actual labour cost: all hourly-paid employees (SEIFSA website: http://www.seifsa.co.za).
- *Table G*—STATSSA production price index: building and construction materials.
- *Wholesale prices of diesel*—coast (Department of Minerals and Energy website: http://www.dme.gov.za/energy).

The average increase per year was determined for each index from January 1996 to December 2004. These averages gave distributions with most likely values as indicated in Table II. This is not necessarily the average value.

Table III shows the initial assumed contribution of each index in Table II, to the different cost components. Note that the average value for escalation is approximately 9.5%, which is double what is normally applied in these types of projects, and which was used for the base case.

*All South African related statistics are obtainable from STATSSA website: http://www.statssa.gov.za

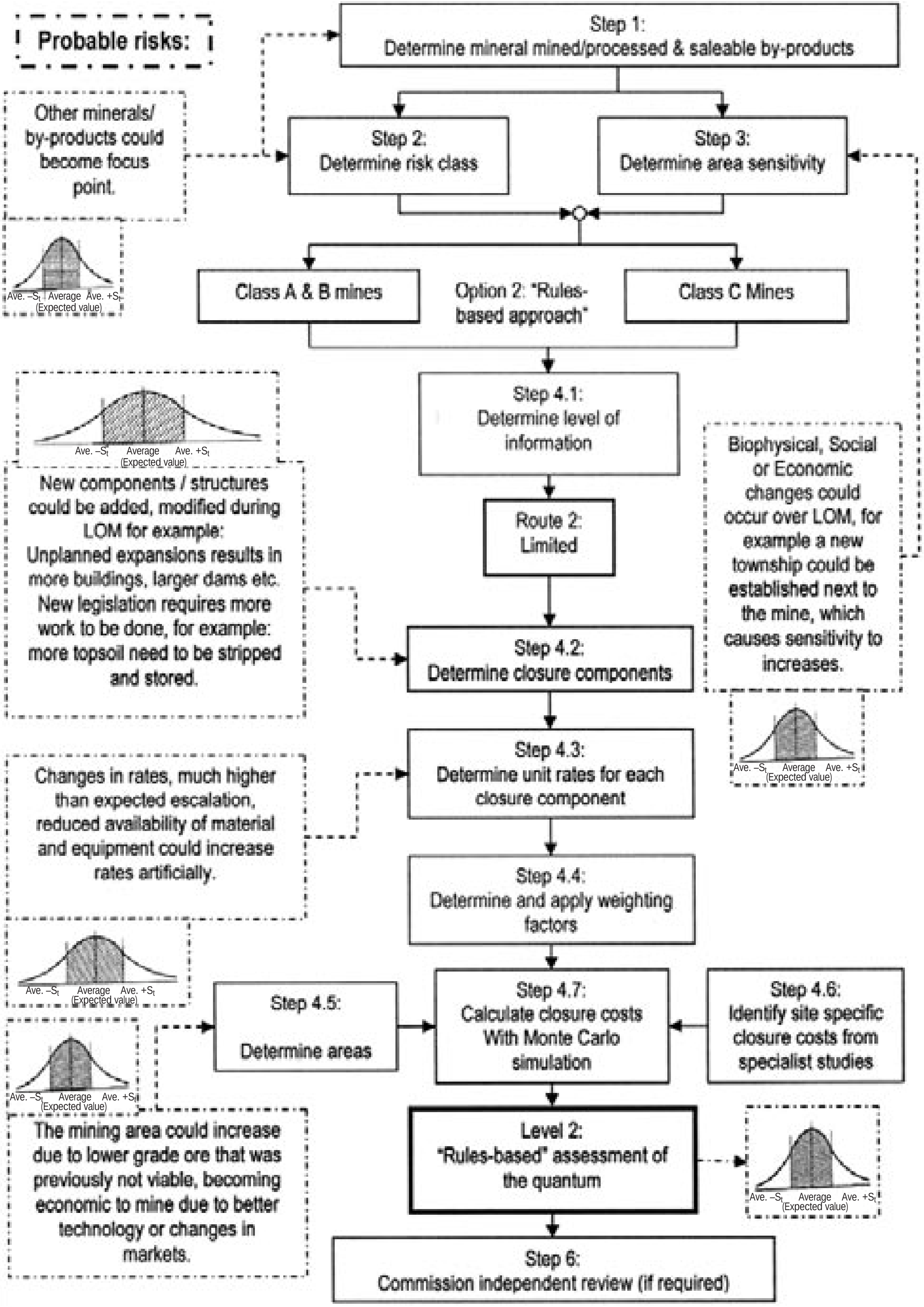

Figure 1—Proposed modified model to determine quantum for closure

Table I

Assumed quantity and rates distributions

Description	Unit	Quantity			Rates (R/unit)		
		Min (-5%)	Most likely	Max (+20%)	Min (-10%)	Most likely	Max (+20%)
Dismantling of processing plant and related structures (including overland conveyors and power lines)	m^3	9 500	10 000	12 000	6.138	6.82	8.184
Demolition of steel buildings and structures	m^2	13 300	14 000	16 800	85.5	95	114
Demolition of reinforced concrete buildings and structures	m^2	24 700	26 000	31 200	126	140	168
Rehabilitation of access roads	m^2	18 050	19 000	22 800	15.3	17	20.4
Demolition of housing and facilities	m^2	1451.6	1 528	1 833.6	171	190	228
Opencast rehabilitation including final voids and ramps	ha	9.5	10	12	89 640	99 600	119 520
Rehabilitation of overburden and spoils	ha	66.5	70	84	59 760	66 400	79 680
Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	ha	95	100	120	74 430	82 700	99 240
General surface rehabilitation, including grassing of all denuded areas	ha	38	40	48	47 340	52 600	63 120
River diversions	ha	9.5	10	12	47 340	52 600	63 120
Fencing	ha	2850	3 000	3 600	54	60	72
Water management (separating clean and dirty water)	ha	9.5	10	12	18 000	20 000	24 000
2 to 3 years of maintenance and aftercare	ha	2 18.5	230	276	6 300	7 000	8 400
Specialist study—biomonitoring	Sum	-	-	-	225 000	250 000	300 000

Table II

Most likely values for escalation indices

Number	Item	Most likely value
1	CPI for the metropolitan areas: transport - running costs - petrol	11.7%
2	PPI for materials used in certain industries: building and construction - civil engineering	8.9%
3	PPI: All commodities for consumption in SA - manufacturing - transport equipment - motor vehicles, parts and accessories	6.5%
4	PPI for selected materials: civil engineering plant	8.4%
5	Table C3: SEIFSA index of actual labour cost: all hourly-paid employees	9.0%
6	Table G: STATSSA - production price index: building and construction materials	7.9%
7	Wholesale prices of diesel: coast	13.5%

Table III

Assumed percentage contribution to cost components by each index

Description		SEIFSA / STATSA items								
		1	2	3	4	5	6	7	Total	Escalation
1	Dismantling of processing plant and related structures (including overland conveyors and power lines)	10	0	10	0	70	0	10	100	9.5%
2 (A)	Demolition of steel buildings and structures	10	10	10	20	30	0	20	100	9.8%
2 (B)	Demolition of reinforced concrete buildings and structures	10	10	10	20	30	0	20	100	9.8%
3	Rehabilitation of access roads	15	10	10	20	15	0	30	100	10.4%
5	Demolition of housing and facilities	10	10	10	20	30	0	20	100	9.8%
6	Opencast rehabilitation including final voids and ramps	0	10	10	20	20	10	30	100	9.9%
8 (A)	Rehabilitation of overburden and spoils	0	10	10	20	20	10	30	100	9.9%
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	0	10	10	30	20	0	30	100	9.9%
10	General surface rehabilitation, including grassing of all denuded areas	0	10	10	20	20	10	30	100	9.9%
11	River diversions	0	10	10	20	20	10	30	100	9.9%
12	Fencing	0	0	10	0	60	30	0	100	8.4%
13	Water management (separating clean and dirty water)	0	20	10	20	20	10	20	100	9.4%
14	2 to 3 years of maintenance and aftercare	0	0	10	10	50	20	10	100	8.9%
15(A)	Specialist study—biomonitoring	0	90	0	0	10	0	0	100	8.9%

Table IV

Spreadsheet used to run proposed model in the Crystal Ball software package

No	Description	Unit	A Quantity Step 4.5	B Master rate Step 4.3	C Multiplication factor Step 4.3	D Weighting factor 1* Step 4.4	Year 0 E=A*B*C*D Amount (ZAR)	Escalation per year	Year 10
1	Dismantling of processing plant and related structures(including overland conveyors and power lines)	M^3	10 000	6.82	1	1.1	R 75020	9.5%	R 185,408
2 (A)	Demolition of steel buildings and structures	m^2	14 000	95	1	1.1	R 1463000	9.8%	R 3,722,821
2 (B)	Demolition of reinforced concrete buildings and structures	m^2	26 000	140	1	1.1	R 4004000	9.8%	R 10,188,774
3	Rehabilitation of access roads	m^2	19 000	17	1	1.1	R 355300	10.4%	R 953,460
5	Demolition of housing and facilities	m^2	1 528	190	1	1.1	R 319352	9.8%	R 812,639
6	Opencast rehabilitation including final voids and ramps	ha	10	99 600	1	1.1	R 1095600	9.9%	R 2,805,744
8 (A)	Rehabilitation of overburden and spoils	ha	70	66 400	1	1.1	R 5112800	9.9%	R 13,093,470
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	ha	100	82 700	1	1.1	R 9097000	9.9%	R 23,402,932
10	General surface rehabilitation, including grassing of all denuded areas	ha	40	52 600	1	1.1	R 2314400	9.9%	R 5,926,992
11	River diversions	ha	10	52600	1	1.1	R 578600	9.9%	R 1,481,748
12	Fencing	ha	3 000	60	1	1.1	R 198000	8.4%	R 444,385
13	Water management (separating clean and dirty water)	ha	10	20 000	0.67	1.1	R 147400	9.4%	R 361,968
14	2 to 3 years of maintenance and aftercare	Ha	230	7 000	1	1.1	R 1771000	8.9%	R 4,161,931
15(A)	Specialist study—biomonitoring	Sum	N/A	250 000	N/A	1.1	R 250000	8.9%	R 586,972
						Subtotal 1 (sum of items 1 to 15 above)	**R 26781472**		**R 68129244**
						Weighting factor 2 Step 4.4)*	1.05		1.05
1	Preliminary and general					12.5% of Subtotal 1 + weighting factor	R 3515068.20		R 8941963
2	Administration and supervision costs					6.0 % of Subtotal 1	R 1606888.32		R 4087755
3	Engineering drawings and specifications					2.0 % of Subtotal 1	R 535629.44		R 1362585
4	Engineering and procurement of specialist work					2.5 % of Subtotal 1	R 669536.80		R 1703231
5	Final groundwater modelling					2.5 % of Subtotal 1	R 669536.80		R 1703231
	Subtotal 2 (Subtotal 1 plus sum of management and administrative items, 1 to 5 above)						R 33778131.56		R 85928009
7	Contingency					10.0 % of Subtotal 2	R 3,377,813.16		R 8592801
						Subtotal 3 (Subtotal 2 plus contingency)	**R 37155944.72**		**R 94520810**
						VAT (14%)	R 5201832.26		R 13232913
						GRAND TOTAL (Subtotal 3 plus VAT)	**R 42357776.98**		**R 107753723**

* Weighting factor for undertaken work related to mine closure in more remote areas[7, 9]

Table IV shows the spreadsheet used in the Crystal Ball software package[12] to calculate the distributions as summarized in Table V. The steps referred to in Table IV are as per the DME guideline.

The values of interest, which are compared in Table V, are:

- Sub total 1: closure cost at end of life-of-mine.
- Sub total 3: immediate closure costs if a contractor is required.
- Escalated subtotal 1.

From Table V it is concluded that, if one assumes the predicted variability in quantities and rates are correct, the probability of the actual closure costs being the same as what the DME model predicted is very low. This can mainly be attributed to the fact that the distributions of the quantities and rates were assumed skewed towards the higher side.

The last column in Table V is graphically illustrated in Figure 2. The base case escalated subtotal 1 shows a 9.5% probability of being similar to the closure cost calculated with the DME method. This is due to the distributions used for calculating the escalation for each component. It is clear that when risk factors such as possible rate and quantity changes

Table V

Comparison of DME model and proposed risk-based model

Item	Subtotal 1: final closure	Subtotal 3: immediate closure	Subtotal 1: escalated
DME method	R 26 781 472	R 42 357 776	R 43 624 196*
Proposed model's outcomes:			
Mean**	R 29 052 899	R 45 950 281	R 81 368 460
Minimum	R 25 685 711	R 40 624 713	R 26 375 289
Maximum	R 32 858 472	R 51 969 206	R 264 440 317
Standard deviation	R 1 005 686	R 1 590 600	R 34 690 632
Probability of => DME method	0.8%	0.8%	9.5%

* Escalation at 5%
** The mean values differ from Table IV due to the shape of the distribution (Figure 2)

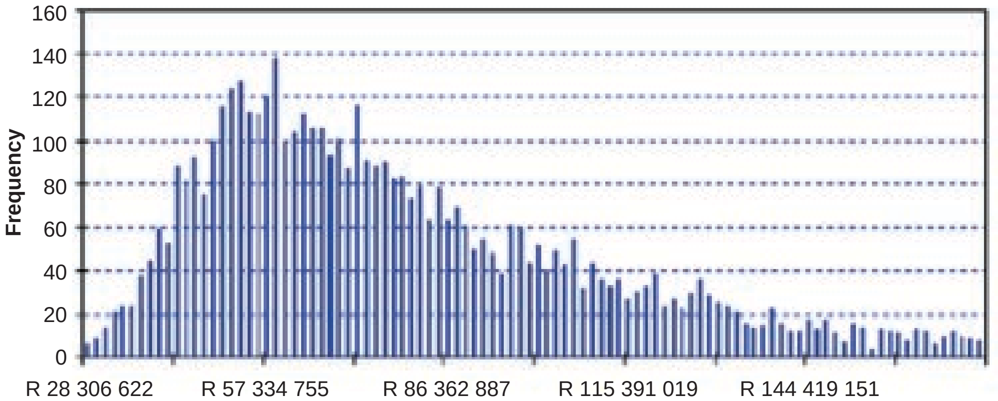

Figure 2—Distribution of Subtotal 1 – (Escalated values)

Table VI

Level of risk for closure

Risk level	Level of risk provided for	Subtotal 1: final closure	Grand Total: immediate closure	Subtotal 1: escalated
Low	100%	R32 858 472	R51 969 206	R264 440 317
	75%	R29 699 878	R46 973 551	R99 402 667
Medium	50%	R28 996 981	R45 861 843	R72 550 351
	25%	R28 334 684	R44 814 348	R55 746 475
High	0%	R25 685 710	R40 624 712	R26 375 289
	DME method	R26 781 472	R42 357 776	R43 624 196

and variable escalation factors are brought into consideration, the possible closure costs could be much higher than expected.

This risk-based model now allows the mine to decide the level of risk it is willing to take in providing for closure (see Table VI). Note that the closure costs calculated with the DME method, in each case falls somewhere between the 0% and 25% level of risk provided for; thus in the high risk area.

Conclusions

Due to new challenges faced by the mining industry, mining companies need to change the way they look at operations and specifically closure. Increased focus on closure during planning stages is also necessitated by various sources of legislation. Historically, financial provision has not been sufficient for most mines due to a number of reasons such as under estimation of closure costs, changing concepts, etc.

Using the DME's 'rules-based' approach as a starting point, a new risk-based model was developed, which employs the Monte Carlo Risk Simulation technique to incorporate risk into the model and determine a distribution of probable closure costs. This allows the mining company to decide what level of risk they are willing to take and then provide only for that risk.

When using relevant CPI and PPI tables for the last decade, it is shown that the mean of the distribution of escalation factors is higher than what is generally used in the mining industry to escalate closure costs. The distributions, however, range widely. These wide distributions resulted in a large standard deviation for the escalated closure cost distribution. It was further shown that the closure costs calculated with the DME method have a low probability of being the actual closure costs.

Recommendations

It is therefore recommended that this risk-based model be used, with appropriate master rates, quantities, and escalation factors applicable to the specific project, to calculate the expected closure costs. The proposed risk-based model will add value to the life cycle management (LCM) of the mine because it will give a better understanding of the project costs before the project is implemented.

It is further recommended to test this proposed model on more case studies and on completed projects to determine if the cost would have been predicted correctly. More research should also be done on the effect of the indices and what percentage contribution each index has on which cost component.

References

1. LE ROUX, F.C. An assessment of South African environmental law. Chapter 4 in: Into a new era: The National Environmental Management Act and The Environment Conservation Act. MBA dissertation, University of Pretoria, 2000.
2. *International Standards Organisation* (ISO). Environmental management —Life cycle assessment—Principles and framework. ISO 14040: 1997, http://www.iso.org/iso/en/, accessed on 18 March 2006.
3. HONKASALO, A. Occupational health and safety and environmental management systems. *Environmental Science and Policy*, 2000, vol. 3, pp. 39–45.
4. NAZARI, M. Financial provisions for Mine Closure. Mineral Resources Forum, Cochilco, Chilean Copper Commission. Research on Mine Closure Policy. A report commissioned by the Mining, Minerals and Sustainable Development (MMSD) project of the International Institute for Environmental Development (IIED), No. 44, 2002.
5. KHANNA, T. Mining and the environmental agenda. *Journal of the South African Institute of Mining an Metallurgy*, 2000, vol. 100, no. 1, pp. 45-47. The article was reprinted from the *Mining Magazine*, September 1999, pp. 158-163.
6. MUDDER, T. and KEVIN, H. Closure Concepts. In: Mineral Resources Forum, Cochilco, Chilean Copper Commission. Research on Mine Closure Policy. A report commissioned by the Mining, minerals and Sustainable Development (MMSD) project of the International Institute for Environmental Development (IIED), No 44, 2002.
7. DU PLESSIS, A. Development of a risk-based closure cost calculation model. Masters project, Department of Engineering and Technology Management, University of Pretoria, 2005.
8. FOURIE, A. and BRENT, A.C. A Project-Based Mine Closure Model (MCM) for Sustainable Asset Life Cycle Management. *Journal of Cleaner Production*, 2006, vol. 14, no. 12-13, pp. 1085–1095.
9. *Department of Minerals and Energy* (DME). Guideline document for the evaluation of the quantum of closure-related financial provision provided by a mine. Official guideline as contemplated in Regulation 54(1) to the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002). Rev 1.6, 2004, Available from: http://www.dme.gov.za.
10. STEYN, H. *Project management: A multi-disciplinary approach*. Third edition, FPM Publishing, Pretoria, 2003.
11. GLASSERMAN, P. *Monte Carlo methods in financial engineering*. Springer-Verlag, New York, 2003.
12. Crystal Ball User Manual, 2004. As provided by Decisioneering, Inc., Website: http://www.decisioneering.com/crystal_ball/index.html. ◆

Regional cooperation in engineering consultancy*

Webster Ndodana, president, and Graham Pirie, CEO of The South African Association of Consulting Engineers (SAACE) recently returned from a well-attended 13th GAMA AGM and Convention in the historic town of Bagamyo in Tanzania. The convention was hosted by The Association of Consulting Engineers, Tanzania (ACET) in collaboration with the Secretariat of the Group of Africa Member Associations (GAMA). SAACE currently performs the function of Secretariat to GAMA. The theme of the convention was 'Networking and Regional Cooperation in Engineering Consultancy within AU/NEPAD Framework'. Ndodana commented, 'Attending the GAMA Conference for the first time was a real eye opener for me and I strongly urge consultants to attend this very important networking event. GAMA provides a platform where we can discuss issues facing the African continent with engineers from a broad spectrum of countries facing similar challenges and to be able to learn from them.'

The convention was preceded by a meeting of the International Federation of Consulting Engineers' (FIDIC) task team responsible for the development of a strategy to assist GAMA to create a sustainable secretariat and to clarify the roles and functions of FIDIC with respect to GAMA and the constituent member associations. The outcome of this meeting was a decision to model the manner in which GAMA operates on a replica of FIDIC with respect to governance and decision-making processes thus enabling it to address the current issues of continuity of office bearers interfering with the effectiveness of the organization.

The convention was well attended by South Africans who had 16 representatives of which 3 were speakers with subject matter ranging from Risk Management for Consulting Engineers presented by Jonathan Horn, Kwezi V3 and Ben Smith of Glenrand MIB to Arthur Taute, Vela VKE presenting Local Experience: An essential to good engineering practice. The object of the convention was to investigate ways to galvanize African capacity in support of the development of the continent through networking and regional cooperation via NEPAD and prevent the continued marginalization of African expertise. In support of this, the Business Integrity Management System (BIMS) training session and manual produced by FIDIC as an add on to an ISO 9001:2000 Quality Management System needs to be rolled out in order to fight corruption, which is of concern and now a top priority of the World Bank and the African Development Bank (AFDB). Countries need to demonstrate good governance and non-compliant countries need to be monitored and blacklisted where necessary.

Delegates at the convention were also treated to a tour of the historic town of Bagamoyo, which used to be the centre of the slave trade, was occupied by the Arabs in the 2nd century, much later by German missionaries and after that occupied by the British. It also played host to Livingstone's body on its journey before being shipped to England for burial at Westminster Abbey. The locals of Bagamoyo are hospitable and friendly and the delegates were well looked after during the convention.

The next GAMA Convention will be held in Botswana in 2007. ◆

---

* *Issued by: Sandy Wardle Marketing and PR*
P.O. Box 311, Douglasdale, 2165
Tel: (011) 462 6216
E-mail: sandywardle@telkomsa.net