2005 Survey of evaluation practices in the mineral industry
CIM Management & Economics Society

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The Management and Economics Society has undertaken a survey of industry practice in the evaluation of mineral projects. The survey addresses a number of issues relating to evaluation techniques, discounted cash flow methodology, and risk. Completed during the spring and summer of 2005, the results provide a record of opinion at an active and vital time in our industry.

The 2005 survey questionnaire was distributed by e-mail to groups and organizations around the world. There were 22 respondents out of several hundred questionnaires distributed (we gather this small proportion of respondents is typical for such surveys). The responses, although a small number, show a consistency that suggests that the survey has captured the views of the industry. The results of the survey are summarized below in series of tables and graphs.

The reader is cautioned that the results are a snapshot of industry practice at a point in time as represented by a small sampling of the industry's practitioners. These results should be viewed as indicative values.

Table 1 - Respondents by Affiliation

Mining company exploration	1
Mining company operations	2
Mining company corporate	9
Government	1
Investment house & analyst	1
Consultant	5
Other	3
Total 2005	22

Table 2 - Respondents by Country

Asia	1
Australia	1
Canada	13
Europe	2
Latin America	4
USA	1
South Africa	0
Total 2005	22

Figure 1 - Evaluation methods at the Feasibility Study stage (2005)

At the feasibility study stage, the survey results show a strong preference for the conventional discounted cash flow metrics of net present value (NPV) and internal rate of return (IRR), both of which were indicated to have "high importance". Metrics based on accounting and market values were shown to have significantly less importance to the respondents. Methods in the middle range include dollars per metal unit, hurdle rate, payback, NAV, break-even price unit. Real options does not appear to be widely used by the respondents.

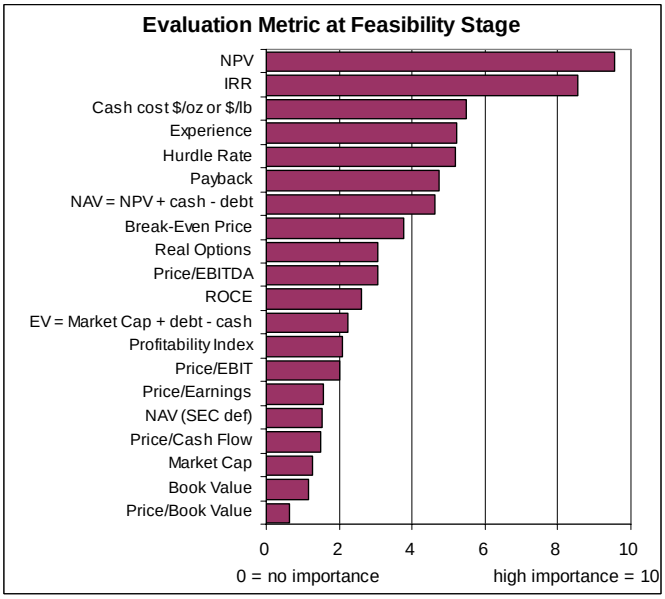


Figure 2 - Evaluation methods by development stage (2005)

The survey results indicate that as a project moves from the exploration stage towards feasibility and operation, there is a clear shift from evaluation methods based on costs (e.g. the cost of exploration work) to income based methods (e.g. cash flow). The results also suggest that the use of market based metrics, although less favoured than income methods, are used throughout the development cycle of a mineral property. (The scale on the graph is the sum of all respondents who indicated they "always" used a method plus half of the respondents that indicated that they "sometimes" used the method.)

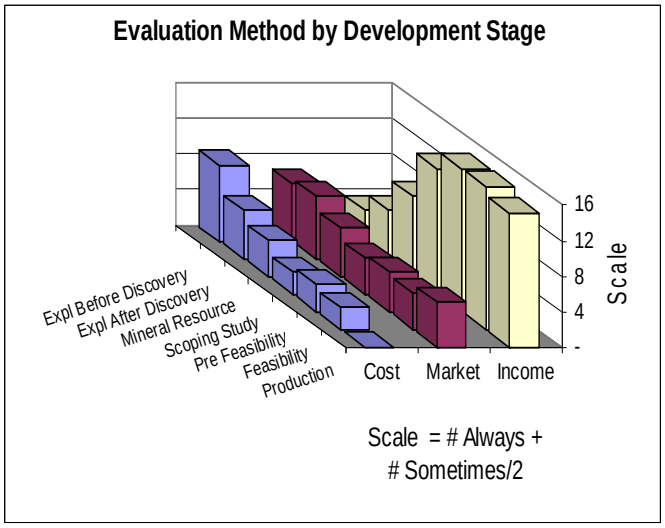


Figure 3 - Evaluation assumptions (2005)

The survey results indicate a strong preference for calculating NPV using an end-of-year convention (as opposed to a mid-year convention).

In terms of metal price forecasts, there is a preference for using a single metal price throughout a project, although a significant number of respondents use a cyclic price in the early years followed by a flat price.

The survey suggests that base cases are typically calculated after tax, without debt, and with no escalation (real or constant money terms).

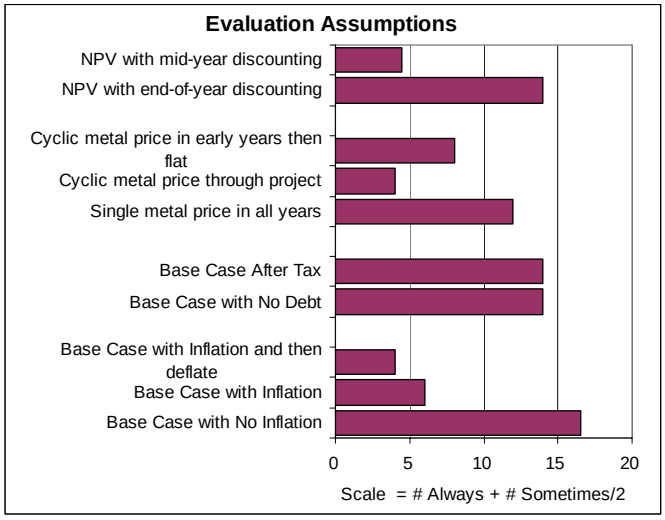
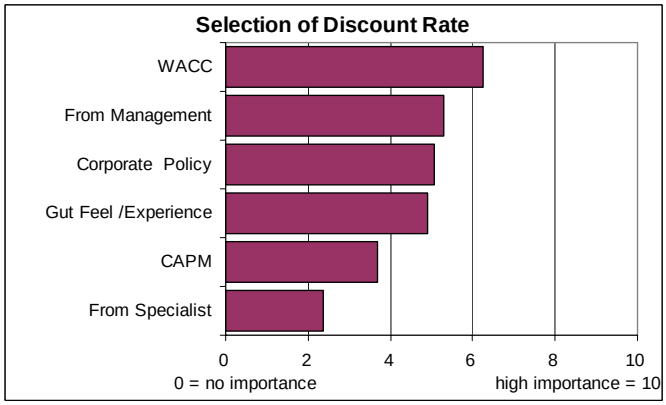


Figure 4 - Selection of a discount rate (2005)

The methods used to select a discount rate indicate a slight preference for the use of the corporate WACC (weighted average cost of capital) but otherwise a lack of differentiation between methods except that the use of specialists to provide an opinion on discount rates does not appear to be significant to the survey respondents. (If the respondents indicating CAPM (capital asset pricing model) can be counted with the WACC total, since CAPM is a component of WACC, this would show WACC to have a strong overall preference.) The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).



Tables 3, 4 & Figure 5 - Discount Rates (3 surveys)

The 2005 survey is the third undertaken by MES. Surveys were also conducted in 1996 and 1997-9). The

results shown in Tables 3a, b, Table 4, and Figures 5a, b, c, present data from the all three MES surveys for the purpose of providing an expanded insight into this important evaluation variable.

The surveys suggest that there are several consistent patterns between surveys:

1. Discount rates for gold projects are 2%-3% lower than for base metal projects
2. Discount rates are increased at higher levels of perceived risk.
3. The increment in discount rates is increasing larger from scoping study to preliminary feasibility study to feasibility study to operating mines.
4. The discount rate for gold projects at the feasibility study stage is essentially the same in all three studies.

There are also some differences in the patterns between surveys:

1. The results for the 2005 survey show flatter curves, suggesting less differentiation between levels of studies than in earlier surveys.
2. The results for the 2005 survey for gold are similar to the previous studies for scoping, pre-feasibility, and feasibility studies but somewhat higher for operations.
3. The results for the 2005 survey for base metals are similar to the previous studies for feasibility studies and operations but somewhat lower for scoping and pre-feasibility studies.

The survey results should be thought of as indicating a range of values, not as single average values. The ranges indicated in the tables are set to a spread of 2%. The values shown for the ranges are the individual average values +/- 25% of their standard deviation for gold and +/- 37% of their standard deviation for base metals. The outer boundary values in the figures are based on the average values +/- 100% of the standard deviation for each population.

Table 3a - Discount rates for Gold Projects - Average values (3 surveys)

Level of Project Development	1996	1997-9	2005	All	Step	Range*
Scoping	12.8%	12.1%	12.3%	12.4%		11.5%-13.5%
Pre-Feasibility	11.7%	11.6%	10.1%	11.2%	1.2%	10.2%-12.2%
Feasibility	8.6%	8.8%	8.9%	8.8%	2.4%	7.8%-9.8%
Operating	4.3%	5.2%	7.7%	5.5%	3.2%	4.5%-6.5%
Respondents	11	13	8	32	32	32

(*The 2% spread in the range is equivalent to the average value +/- 25% of the standard deviation.)

Table 3b - Discount rates for Base Metal Projects - Average values (3 surveys)

Level of Project Development	1996	1997-9	2005	All	Step	Range
Scoping	15.6%	14.1%	13.0%	14.0%		13%-15%
Pre-Feasibility	14.4%	13.7%	10.8%	13.0%	1.0%	12%-14%
Feasibility	11.8%	11.3%	10.2%	11.0%	2.0%	10%-12%
Operating	8.8%	7.6%	9.0%	8.5%	2.5%	7.5%-9.5%
Respondents	12	12	10	34	34	34

(*The 2% spread in the range is equivalent to the average value +/- 37% of the standard deviation.)

Table 4 - Discount rates at Feasibility Study (2005 Survey)

Metal	Average	Respondents
Gold	8.9%	8
Base Metals	10.1%	10
Coal	10.7%	3
Diamonds	10.6%	2
Uranium	10.1%	1
Industrial Minerals	12.1%	4

Figure 5a - Base metal and gold discount rates compared (3 surveys)

This figure compares the average values from the 3 MES surveys for gold and base metal projects. The heavier lines indicate the average values and the finer lines suggest that industry practice falls within an range of values. In this graph the range is set to +/- 1% for illustrative purposes. For gold this band represents the average value +/- 25% of the standard deviation. For base metals this band represents the average value +/- 37% of the standard deviation.

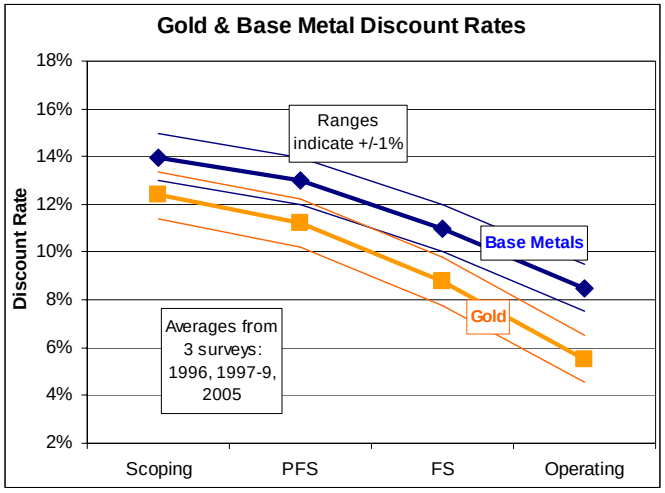


Figure 5b - Base metal discount rates compared (3 surveys)

These figures compares the results of the 3 MES surveys. The significant common theme in all surveys is a clear pattern of using lower discount rates for lower risk projects. The heavier lines indicate the average values for each survey and the finer lines show the range of results +/- 1 standard deviation from the average of the three surveys (not shown in this graph).

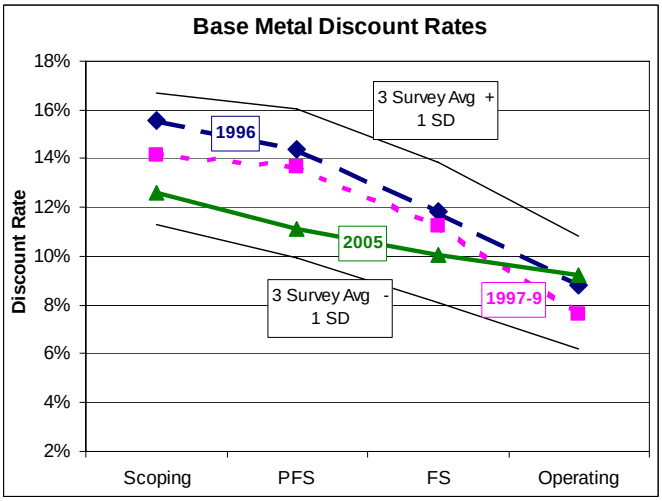


Figure 5c - Gold discount rates compared (3 surveys)

These figures compares the results of the 3 MES surveys. The significant common theme in all surveys is a clear pattern of using lower discount rates for lower risk projects. The heavier lines indicate the average values for each survey and the finer lines show the range of results +/- 1 standard deviation from the average of the three surveys (not shown in this graph)

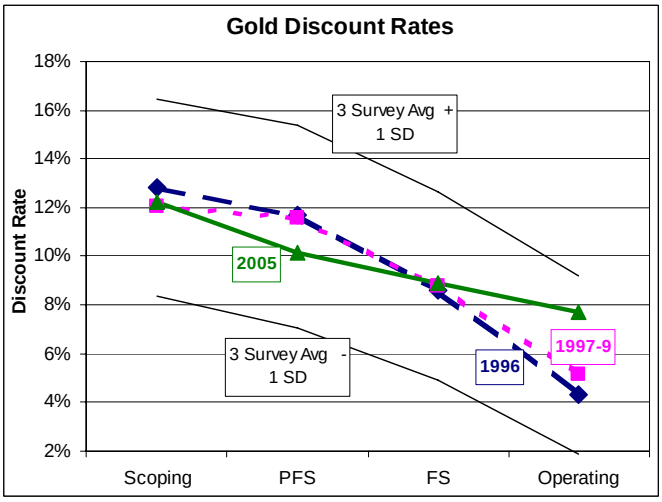


Figure 6 – Importance of evaluation issues

This figure provides a ranking of significant evaluation issues in order of significance to the respondents. The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).

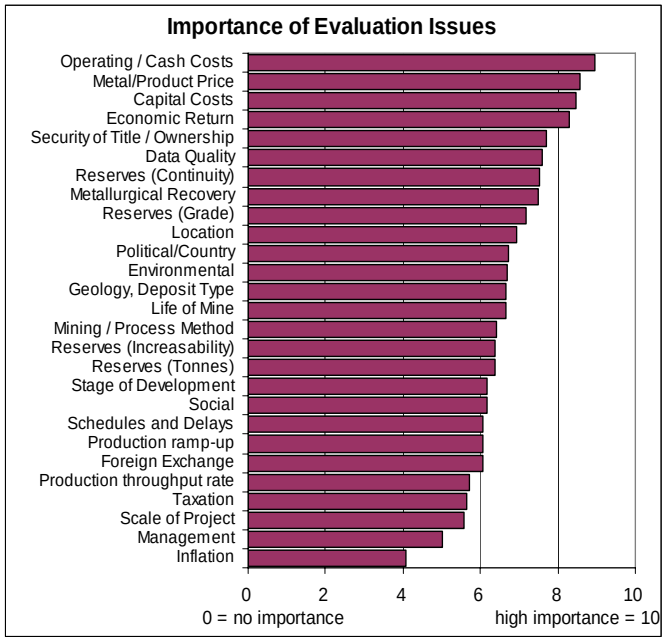


Figure 7 – Value of metal in the ground for evaluations

This figure addresses the use of the value of metal in the ground as a valuation method. The results suggest that at this approach is of low importance in operating and advanced projects but of some importance at the exploration stage. When it is used, there is little differentiation between contained and recovered metal. Similarly, there is little differentiation between using reserves plus resources or reserves only. The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).

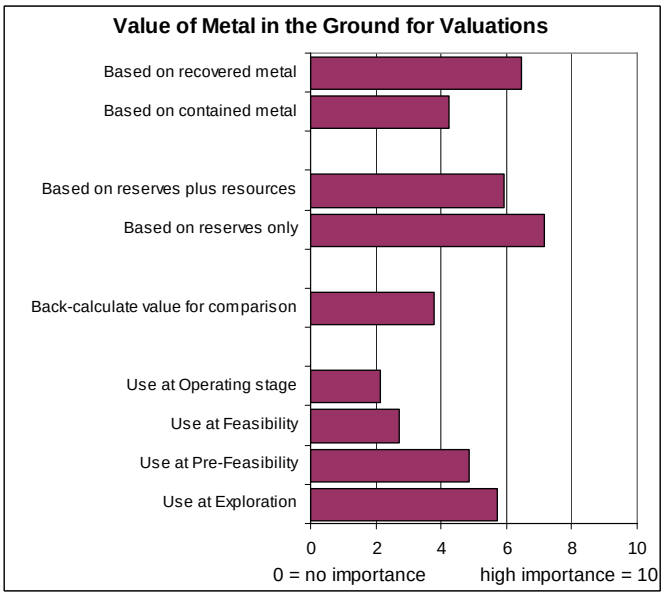


Figure 8 – Addressing Risk – Adjusting for Risk

This figure summarizes the use of various methods that practitioners use to adjust for increased risk in a project. The results suggest that practitioners use a number of approaches and ,while none are dominant, some (factoring NPV and shortening payback criteria) are not used to any degree. The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).

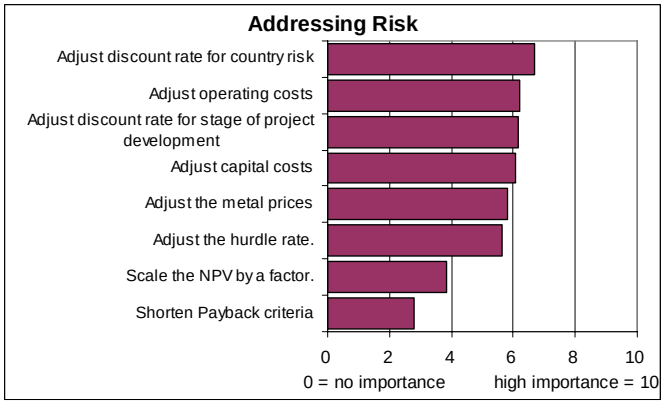


Figure 9 – Assessing Risk

This figure summarizes the use of various methods that practitioners use to assess risk in an evaluation. The results suggest that practitioners have a strong preferences for sensitivity and scenario analysis (including best/worst case) but do not make much use of decision trees. Monte Carlo methods are used but do not appear to be the favoured methodology. The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).

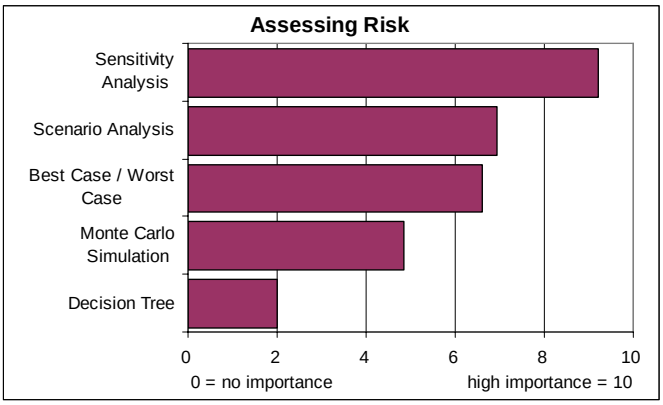
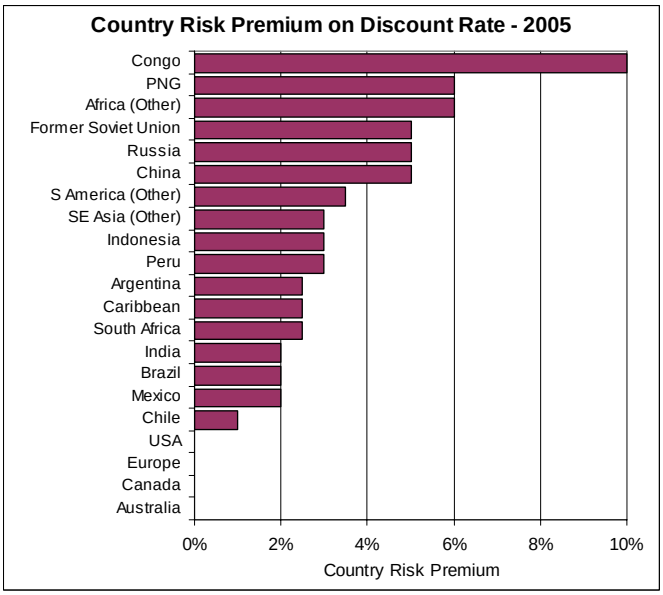


Figure 10 – Country Risk Premium

This figure summarizes the opinions of the respondents as to the percentage sovereign risk premium they would add to their discount rate for a suite of countries where mining investments are currently being made. The zero risk premiums for USA, Canada, Europe, and Australia indicate that the respondents perceive these to be low risk countries, as opposed to the Congo or PNG which are perceived to have high sovereign risk premium. The bars on the graph show the average of all respondents. The rankings range from no importance (0) to high importance (10).



The survey posed the question "Is the availability of capital an investment restraint?" The results suggest that while availability of capital is a noticeable restraint, it does not appear to be a significant restraint for a good project. (The values show average of all respondents in the 2005 survey.) The rankings range from "never" (0) to "significant restraint" (10).

Table 5 - Capital availability as a restraint (2005)

Level of restraint	Replies
Never a restraint	4
Minor restraint	3
Moderate to high restraint	8
Significant restraint	2

The survey inquired as to how much of the mineralization is used for internal studies. The results indicate that proven and probable reserves are always used and measured and indicated resources are often included as well. Inferred resources are sometimes included but the tendency is to not include exploration information.

Table 6 - Use of reserves, resources & other material in internal studies (2005)

Category	Always	Sometimes	Never
Reserves (Proven +Probable)	16	1	0
Resources – Measured	11	6	0
Resources – Indicated	9	8	0
Resources – Inferred	5	11	2
Exploration information	0	6	8

The survey inquired as to the determination of cut-off grade. The results indicate that the calculation always includes the cash operating costs and sometimes the sustaining capital. The initial capital costs are not included in the calculation (either as cash capital values or as depreciation).

Table 7 - Costs included in determination of cut-off grade (2005)

Level of restraint	Always	Sometimes	Never
Cash Operating Costs	8	3	0
Cash + Sustaining Capital	6	8	2
Cash + Sustaining + Initial Capital	0	3	7

The survey inquired about spreadsheet programming techniques and found that most practitioners try to avoid the use of circular references and that they are not adverse to linking to outside files to draw data into their calculations.

Table 8 - Spreadsheet programming techniques (2005)

Technique	Always	Sometimes	Never
Use circular references	2	4	8
Use links to other files	7	10	1

The reader is cautioned that the results are a snapshot of industry practice at a point in time as represented by a small sampling of the industry's practitioners. These results should be viewed as indicative values.