DECISIONS, DECISIONS, DECISIONS
DECISION ANALYSIS PROCESS FOR MINE CLOSURE

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ABSTRACT

Decisions are part of everyday life. Some decisions require more structured processes to produce a rational and auditable methodology to support a choice between alternatives. This is especially true for closure planning and design, where there can be many alternatives with competing objectives. A decision analysis process brings together specialists from many fields, such as social, environmental, technical, and costing. Their fields of interest often have competing requirements and different risk profiles. A decision analysis process can describe the issues and objectives in plain language and effectively capture the different stakeholder viewpoints.

Klohn Crippen Berger utilizes a decision analysis process that works well with the updated process and tools described in the 2019 International Council on Mining & Metals (ICMM) Integrated Mine Closure Guide[1]. This process builds on the Kepner-Tregoe method (K-T), a decision-making process designed to build consensus among stakeholders, consider a wide range of alternatives, identify potential risks, and develop a plan with specific actions.

The closure planning decision analysis process starts with establishing the knowledge base/problem definition (e.g., site characteristics, inventory, etc.). The closure vision, situational appraisal, principles, and objectives can be developed from that base of understanding. The objectives associated with post-closure land use are integrated in this step as well. The risks and opportunities for closure can be identified once the objectives are set and the site characteristics are known. This review leads into the development of the closure concepts and activities/alternatives, and the evaluation of these concepts against the success criteria developed based on the closure vision and end land use.

Making decisions about closure with involved, informed people and the right level of analyses applied at the right time can be the difference between successful mine closure and unforeseen long-term costs and risks.

Keywords: mine closure, decision analysis, Kepner-Tregoe

INTRODUCTION

In 2019, the International Council on Mining & Metals (ICMM) released the second edition of its Integrated Mine Closure Good Practice Guide (the Guide). The Guide provides a good practice process and tools to

[1] 2019 International Council on Mining & Metals (ICMM) Integrated Mine Closure Good Practice Guide 2nd Edition.

develop an integrated mine closure plan. The Guide was followed by the ICMMs Closure Maturity Framework (the Framework), a tool that allows mine owners and consultants to implement good closure practices at an operational level throughout the mine life cycle. One of the intended key outcomes of the Framework is to operationalize the Guide by integrating closure into business planning and decision analysis.

This paper continues with:

- a description of the goals and the basis for the KCB decision analysis process;
- a demonstration of how it integrates well with the goals of the Guide and Framework;
- a description of the steps that KCB uses for the decision analysis process;
- a case study that illustrates the process; and,
- a listing of benefits of this process for decision analysis.

GOALS OF DECISION ANALYSIS AND DECISION ANALYSIS PROCESS

The goal of decision analysis may seem simple: to come to a decision. However, a decision can be difficult to achieve, especially with multiple stakeholders and complex goals. A decision analysis process should meet the following goals:

- positive interaction among stakeholders;
- consensus building (or agreement);
- trust and credibility;
- reduce misunderstandings;
- consideration of stakeholders;
- create an atmosphere where opinions and efforts are valued; and,
- pride in the decision.

In meeting these goals, the decision analysis process leads to balanced decision analysis, integrates structured common sense, and manages to keep stakeholders engaged and, eventually, united.

The importance of a decision-making process is to provide a transparent framework that:

- considers key aspects of a project and potential impacts;
- involves key multi-stakeholders and subject matter experts;
- reflects the values of the multi-stakeholders;
- is flexible to meet the needs of the project and the group; and,
- adequately documents the process.

The Kepner-Tregoe decision analysis tool is a structured methodology for gathering information and then prioritizing and evaluating the information. The K-T method is the basis for the decision analysis process used by KCB. KCB has also integrated aspects of guidance on alternatives assessment and multiple accounts analysis published by Environment Canada in its guidelines for the assessment of alternatives for mine waste disposal (EC 2011)[2].

A key strength of the KCB decision analysis process is that it focuses a group of people, with potentially different goals and desired outcomes, on one item at a time. The semi-quantitative method of using a criteria rating system and weighted scoring allows decision makers to come to consensus while reducing the potential for conflict.

STEPS OF KCB DECISION ANALYSIS PROCESS

There are seven steps in the decision-making analysis process used by KCB. Typically, these steps are undertaken in a workshop setting with participants engaging in the decision analysis together as a group. Stage-gates are set after key steps to ensure consensus is reached among the core team of stakeholders before proceeding to the next step.

Step 1: Identify Stakeholders

The first step is to identify a skilled facilitator to guide the process and identify the key stakeholders. Stakeholders are people that could be affected by the decision, could have input to the decision, those who have to approve the decision and also those who could block the decision. A list of stakeholders is developed and from that list a core team of stakeholders is identified to contribute directly to the process. For mine closure decisions, there should be contribution from a variety of aspects such as, mine owners, environmental scientists, finance, geotechnical engineers, reclamation/remediation specialists, construction/operations, community, Indigenous groups and regulators, etc. At this point a Responsible, Accountable, Support, Consulted, Informed (RASCI) matrix may be developed to establish participant roles and responsibilities, as well as a schedule, and communication protocols.

This Step is in line with the guidance on engagement for closure plan development in the Guide and closure element 5, engagement for closure, in the Framework.

Step 2: Establish Decision Context and Battery Limits

The fundamental purpose of the decision should be specified in a single statement. The decision statement should clearly and concisely describe the goal and include action and object words. It is a restrictive statement to guide the process but, as slight differences in thought or opinion can alter the narrative during the process, is mutable and can be revisited throughout the process. A situation analysis is conducted via detailed review of the site to determine what needs to be addressed as part of the decision analysis. Domains are identified and grouped based on their geographic location, similar features or similar closure elements. Domains with only one closure alternative are removed from the decision analysis process. This defines the battery limits for the decision analysis process.

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[2] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal.html

Typically, there are several alternatives that have been considered or developed previously. They are discussed during this Step but not developed in detail. The alternatives are placed in a "parking lot" for detailed examination at a later Step. The "parking lot" can be updated as the process proceeds.

Planning scenarios are also established at this stage. Mine operations frequently change over the life of a mine due to many factors such as volume or quality of ore reserves, market demands, and changes in information related to the knowledge base (geochemical, hydrotechnical, and geotechnical, etc.). Utilizing the scenario approach provides the opportunity to account for the "unknown" or "what if" and evaluate whether the recommended alternative(s) will be fundamentally different based on the scenarios. A base case is defined and then other scenarios are considered to see how the alternatives may differ from the base case. Examples of planning scenarios include:

- Life of mine is 30 years; 35 million tonnes (Mt) of tailings and 250,000 cubic metres (m^3) of waste rock will be produced and stored on surface; the life of mine could be extended by 15 years and generate an additional 15 Mt of tailings and 150,000 m^3 of waste rock.
- Regulatory criteria for sediment, soils and water quality, such as Canadian Council of Ministers of the Environment (CCME) criteria versus site specific human health risk assessment (HHRA) or ecological health risk assessment (ERA) criteria (CCME 2016).

The outcomes may indicate there are no fundamental differences in the alternatives or there may be differences that will require consideration of how best to proceed. Risk and/or opportunities may become evident, and data gaps may need to be addressed to further develop and assess alternatives.

Consensus must be reached after Step 2 before proceeding.

<u>Step 3: Establish Objectives and Rating Criteria to Evaluate Alternatives</u>

The core stakeholders identify the design criteria, success criteria, account structure (social, environmental, technical, costing, etc.) and governing assumptions. The Guide describes effective success criteria to be specific, measurable, achievable, relevant, and timely (SMART). Additionally, these success criteria are "agreed": criteria that do not have agreement from stakeholders are not meaningful (ICMM 2019).

The agreed upon objectives will be used in Step 6 for the alternative scoring. The objectives are based on the understanding of the issues and overall project objective. The objectives are subdivided into "musts" and "wants". "Must" objectives are criteria that must be met for an alternative to be successful (e.g., regulatory criteria, design criteria (e.g., stability)) and are typically developed from policies, regulations, and corporate requirements. The "must" objectives may be stated as fatal flaws. Alternatives that do not fulfill the requirements of all the "must" objectives are screened out from further analysis. "Want" objectives provide the means of differentiating between alternatives (e.g., achieve passive care); they are phrased as a comparison statement and do not need to be met for an alternative to succeed. The "want" objectives are grouped into categories such as technical/operational, environmental and socio-economic/sustainability (this is an extension to Environment Canada's multiple accounts analysis

(Environment Canada 2011). The Guide's objective setting tool (Tool 3) provides guidance on common mining related aspects that can be used to assist with site-specific objectives development.

The outcome of Step 3 is a list of objectives subdivided into "musts" and "wants" agreed to by the core team. Individual objectives are assigned weighting factors (1 to 10) based on their relative importance compared to other objectives. For example, managing site water during closure such that clean water remains clean is highly desirable and would be given a weighting factor of 10, whereas establishing recreational trails post-closure is only given a weighting factor of 3.

Each stakeholder engaged in the decision analysis process assigns a weighting factor. Individual weightings are discussed amongst the stakeholders and a consensus is achieved as shown in Table 1. This Step engages different perspectives and often screens out alternatives. Sensitivity analyses can be conducted after alternative scoring (Step 6) to assess if there is an overall change in the scores.

Table 1 Example of Objectives Weightings

Objective (Want)	Description	Average Weighting	Alain	Dianne	Natalia	Sunjit	Sarah
Passive Care	Maximize opportunity to achieve passive care.	8	6	7	10	9	9

Rating criteria are required to determine how a specific alternative meets an objective. Typically, a rating of 10 would be assigned to alternatives that meet or exceed the objective (best) and 0 to alternatives that do not meet the objective (worst).[3] Each objective will be given at least two rating criteria (best and worst) and may have more criteria between the high and low criteria as shown in Table 2. A discussion of these ratings among the stakeholders provides additional clarity.

Table 2 Example of Rating Criteria for Objectives to Achieve Passive Care at Closure

Wants	Objective	10	8	6	5	4	2	0
Technical/Operational Objectives								
Passive Care	Maximize opportunity to achieve passive care	Achieve passive care in <25 years after end of operations		Achieve passive care in 50 to 100 years		Achieve passive care in > 100 years		Never achieve passive care

Step 4: Establish Cost Metrics

Objectives that specifically reflect costs are not included in the objective list in order to remove bias or double counting toward project costs (i.e., cost of an alternative or travel distance for construction materials).

[3] The range of the rating scale is determined by the core team of stakeholders.

Financial assessment does not occur until the final Step in the process. Before moving to Step 5, it is important to identify the metrics by which costs will be evaluated and have a bearing on the decision. These metrics may include capital cost, operating cost, cash flow and Net Present Value.

Step 5: Develop Alternatives

Alternatives are developed in detail sufficient to support cost metrics identified in Step 4. The process begins by identifying elements that could form part of the solution. Elements are individual items required to meet an objective. This process is encouraged to be open and imaginative. Alternates are developed from a compilation of elements to address various issues often based on domains, such as:

- mine voids
- mine waste (tailings and waste rock)
- water management
- water treatment

Alternative A may include constructing a vegetative cover over a large waste rock pile, surface and seepage water collection system and a large-scale water treatment plant to treat water in perpetuity. Alternative B may include relocation of a waste rock pile into an open pit, flooding the pit and utilizing an in-pit water treatment system.

The Guide's Tool 4 for screening alternatives promotes ideas for potential repurposing of a mine site to provide a productive economic activity or other beneficial post-closure land use; it may be of assistance during this Step.

Costs are developed for each element to determine an overall alternative cost based on the defined metrics. These high-level (conceptual) costs may be based on experience, general cost ranges or more detailed based on the stage of alternative development and goal of the decision. The outcome is a cost for each alternative.

A consensus on the alternatives is required before proceeding to score the alternatives. Typically, there will be some alternatives that are screened out at this Step because it is apparent that the alternative will not meet the objectives, or the costs are orders of magnitude higher than the other alternatives.

Step 6: Score Alternatives

Each alternative is assessed against each objective to achieve a ranking. Each objective is assigned a rating based on how well the alternative meets the objective, resulting in a quantitative score for each alternative. The rating is multiplied by the objective's weighting factor to calculate a weighted score for each objective.

$$Alternative\ Objective\ Weighted\ Score = (Alternative\ Objective\ Score) \times (Objective\ Weighting)$$

The weighted scores are summed by technical, environmental, and socio-economic/sustainability (i.e., TBL analysis) and then totaled for an overall technical merit score.

$$Alternative\ Overall\ Score\ = \sum(Alternative\ Objective\ Score\ \times Objective\ Weighting)$$

Scoring is subjective, therefore scores within +/- 10% are generally considered equal. A case study is included in this paper to illustrate the scoring process. The outcome of Step 6 is a ranking of the alternatives.

Step 7: Risk Assessment

Further assessment of the top alternatives to evaluate risks is conducted in this Step. Risk categories could include design, construction, long-term, health and safety, legal and regulatory, environmental, social, financial, and reputational (ICMM 2019). Cumulative impacts should be considered during the risk assessment as a risk in isolation may have a low consequence, but a greater impact in combination with other risks. The Guide provides tools for risk assessment.

If the risks are above "low", then modifications to the design to achieve a "low" risk may be suggested and may lead to a change in alternative cost. It may not be possible to change all risks to "low". The outcome of Step 7 is a ranking of alternatives in terms of risks.

Step 8: Make Decision

In many circumstances the most appropriate alternative will naturally present itself during discussions and the scoring process may not be required. In other situations, two or three alternatives may have similar scores, costs, and risks. In such cases, these alternatives are carried forward for additional design and engineering to be able to decide on the ultimate alternative.

The final step in the decision-making process is to rank each alternative by its technical score, risk index and cost to come to a decision. Table 5 in the next section is an example of an alternative scoring decision table.

CASE STUDY FOR LEGACY GOLD MINE

A Canadian provincial government has a legacy gold mine from the 1960s that requires a closure plan. Limited site information is available but there is a known area of exposed tailings and unknown distribution of tailings throughout a wetland. The wetland is largely submerged during high flow periods but also has open dry areas that can generate dust. Geochemical investigations have characterized the tailings with arsenic concentrations greater than 10,000 mg/kg with elevated arsenic concentrations exhibited in soils, surface water and groundwater in the downstream environment.

The decision statement is "to determine the best way to manage the site based on the government protocols".

The "must" objectives are to meet the CCME Tier I human and ecological health criteria and follow local, provincial, and federal occupational health and safety regulations during implementation of closure measures.

Table 3 presents examples of a few potential "want" objectives for a legacy mine closure project divided into three element groups: Technical/Operational, Environmental and Socio-Economic elements. The division element groups and elements are defined based on the project specific requirements. Table 4 presents an example of a rating criteria table for scoring each alternative. A weighted score, technical score and initial alternative score is calculated as shown in Table 5. As shown in Table 6, Alternative 2 had the highest technical score (all the three Alternatives scored the same (+/- 10%)). Alternative 1 was selected for this project once costs and risks were brought into the assessment.

Table 3 Example of Want Objectives for Legacy Mine Closure Project

Technical/Operational Elements	**Objective (Wants)**
Simplicity of closure alternative	Maximize simplicity of the closure alternative construction methodology.
Timeline for Significant Improvement	Minimize timeline to achieve significant improvement to the site conditions.
Timeline for Complete Implementation	Minimize timeline to complete implementation of overall site closure activities.
Long term maintenance requirements	Minimize maintenance (e.g., erosion structures, dams, fencing, vandalism).
Progressive reclamation	Maximize opportunity for progressive rehabilitation (proceed in stages) to meet cash flow requirements and allow for observational monitoring.
Environmental Elements	**Objective (Wants)**
Fish passage	Maximize fish passage opportunity (e.g., from upstream lake along local brook through site to downstream lake).
Wetland creation	Maximize the opportunity for wetland creation.
Socio-economic/Reputational Elements	**Objective (Wants)**
Reputation and Stakeholder Expectations	Minimize adverse public perception of the site closure.
Terrestrial green space	Maximize the development of terrestrial green space including recreational use.

Table 4 Example of an Objectives Rating Table Used to Score the Elements of Each Alternative

Element	Objective (Wants)	10	8	6	5	4	2	0
Technical/Operational								
Simplicity of closure alternative	Maximize simplicity of the closure alternative construction methodology	Very simple technology			Current conditions			Complex solution
Timeline for Significant Improvement	Minimize timeline to achieve significant improvement to the site conditions	Implement alternative by 2024	Implement alternative by 2025	Implement alternative by 2026	Implement alternative by 2027	Implement alternative by 2028	Implement alternative by 2029	Implement alternative followed 2030
Timeline for Complete Implementation	Minimize timeline to complete implementation of overall site closure activities	Inspections and maintenance required every 5 - 10 years			Annual inspections, minimal maintenance			Monthly inspections, frequent maintenance requirements
Long term maintenance requirements	Minimize maintenance (e.g., erosion structures, dams, fencing, vandalism)	Tax gain or facility use fees						No revenue generation
Progressive reclamation	Maximize opportunity for progressive rehabilitation (proceed in stages)	Adaptable to changes with staged or progressive reclamation		Moderate changes required to accommodate progressive reclamation		Significant changes required to accommodate progressive reclamation		Unable to accommodate progressive reclamation
Environmental								
Fish passage	Maximize fish passage opportunity (e.g., Trout Brook)	Significantly improve fish passage from Lake A through to the Lake B						Close fish passage from Lake A to Lake B
Wetland creation	Maximize the opportunity for wetland creation	No additional permitting required	Some permitting required but will take less than 1 -year to get a permit		More challenging permits		Extensive studies to support permitting may take several years to get a permit	Proving new approaches to tailings storage in relation to water quality

Element	Objective (Wants)	10	8	6	5	4	2	0
Socio-economic/Reputational								
Reputation and Stakeholder Expectations	Minimize adverse public perception of the site closure	Implementation of solution will enhance public perception and reputation			No change in public perception or reputation			High degree of adverse public reaction and harm to company reputation
Terrestrial green space	Maximize the development of terrestrial green space	Convert the waste areas into useable green space			Convert some of the waste areas into useable green space			Areas remain unusable and unsightly

Table 5 Example of a Legacy Gold Mine Closure Alternative Scoring

Option Number		Weighting Factor	0		1		2		3	
Option Description			Status Quo		Consolidate Exposed Tailings into a Cell and Cover with Low Permeable Cover		Consolidate Exposed and Buried Tailings into a Cell and Cover with Low Permeable Cover. Infill wetlands with granular fill and soil to create dry environment		Consolidate Exposed Tailings into a Cell and Apply a Soil Solidification Process	
Synopsis			Leave site as is		Do not disturb tailings within the wetland		Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits		Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits	
Scoring			Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Technical/ Operational Elements	**Objective (Wants)**									
Simplicity of closure option	Maximize simplicity of the closure option construction methodology	9	10	90	9	81	8	72	7	63
Timeline for Significant Improvement	Minimize timeline to achieve significant improvement to the site conditions	7	0	0	2	14	5	35	8	56
Timeline for Complete Implementation	Minimize timeline to complete implementation of overall site closure activities	5	10	53	8	42	6	32	6	32

Option Number		**Weighting Factor**	**0**		**1**		**2**		**3**	
Option Description			**Status Quo**		**Consolidate Exposed Tailings into a Cell and Cover with Low Permeable Cover**		**Consolidate Exposed and Buried Tailings into a Cell and Cover with Low Permeable Cover. Infill wetlands with granular fill and soil to create dry environment**		**Consolidate Exposed Tailings into a Cell and Apply a Soil Solidification Process**	
Synopsis			**Leave site as is**		**Do not disturb tailings within the wetland**		**Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits**		**Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits**	
Scoring			**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**
Long term maintenance requirements	Minimize maintenance (e.g., erosion structures, dams, fencing, vandalism)	8	2	15	7	53	8	60	9	68
Progressive reclamation	Maximize opportunity for progressive rehabilitation (proceed in stages)	7	0	0	4	26	9	59	4	26
Technical/Operational Score		**42**	**22**	**158**	**30**	**222**	**36**	**257**	**34**	**244**
Environmental Elements	**Objective (Wants)**									
Fish passage	Maximize fish passage opportunity (e.g., Trout Brook)	9	5	46	9	83	2	19	4	37
Wetland creation	Maximize the opportunity for wetland creation	5	0	0	5	25	0	0	5	25
Environmental Score		**14**	**5**	**46**	**14**	**108**	**2**	**19**	**9**	**62**
Socio-economic/ Reputational Elements	**Objective (Wants)**									
Reputation and Stakeholder Expectations	Minimize adverse public perception of the site closure	7	0	0	5	35	8	56	6	42
Terrestrial green space	Maximize the development of terrestrial green space	6	0	0	2	12	9	54	5	30
Socio-economic/Reputational Score		**13**	0	**0**	7	**47**	**17**	**110**	**11**	**72**

Option Number	Weighting Factor	0		1		2		3	
Option Description		Status Quo		Consolidate Exposed Tailings into a Cell and Cover with Low Permeable Cover		Consolidate Exposed and Buried Tailings into a Cell and Cover with Low Permeable Cover. Infill wetlands with granular fill and soil to create dry environment		Consolidate Exposed Tailings into a Cell and Apply a Soil Solidification Process	
Synopsis		Leave site as is		Do not disturb tailings within the wetland		Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits		Excavate tailings and soils with an arsenic concentration greater than CCME Tier I human and ecological health criteria limits	
Scoring		Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Maximum Technical Score			278		278		278		278
Maximum Environment Score			143		143		143		143
Maximum Socio-Economic Score			130		130		130		130
Maximum Total Score			550		550		550		550
Option Technical Score			143		169		197		177
Technical Score % of Maximum			51%		61%		71%		64%
Option Environment Score			46		108		19		62
Environmental Score % of Maximum			32%		76%		13%		44%
Option Socio-Economic Score			0		47		110		72
Socio-economic Score % of Maximum			0%		36%		85%		55%
Option Score			**189**		**324**		**326**		**311**
Percent of Maximum Score			**34%**		**59%**		**59%**		**56%**
Option Rank			**4**		**2**		**1**		**3**

Table 6 Example of a Summary Alternatives Table and Decision Analysis

Alternative No.	Alternative Description	Weighted Score	Percent of Top Technical Rank Alternative	Technical Rank	Costs (Millions $)	Risk Level	Risk factors	Final Rank
0	Status Quo with No Improvements	189	58%	4	0	High	On-going risks to human and ecological health.	4
1	Consolidate Exposed Tailings into a Cell and Cover with Low Permeable Cover	324	100%	2	$12.0	Low-Med	Low risk of mobilizing arsenic in higher concentrations into the surface water and groundwater, and into the downstream environment "make the immediate situation worse than it already is".	1
2	Consolidate Exposed and Buried Tailings into a Cell and Cover with Low Permeable Cover. Infill wetlands with granular fill and soil to create dry environment	326	100%	1	$25.0	Med-High	Risk of mobilizing arsenic in higher concentrations into the surface water and groundwater, and into the downstream environment "make the immediate situation worse than it already is".	2
3	Consolidate Exposed and Buried Tailings into a Cell and Utilize a Soil Solidification Process	311	95%	3	$30.0	Med-High	Risk of mobilizing arsenic in higher concentrations into the surface water and groundwater, and into the downstream environment "make the immediate situation worse than it already is".	3

COMPARISON WITH MULTIPLE ACCOUNTS ASSESSMENT

This decision analysis process is similar to and has the fundamental elements of the Environment Canada MAA process; however, the KCB process includes the following modifications.

- We focus on building consensus and achieving clarity throughout the process. Steps 1 and 2 in the KCB process are additions to the MAA process.
- We use the establishment of the weightings and ratings to achieve clarity. There are a number of projects where we have not advanced with scoring as the short list of preferred alternatives becomes evident after the decision statement and objectives are clearly established.
- We do not use the terms ledger, accounts, or sub-accounts.
- Project economics are included in the MAA process as part of the evaluation criteria. Costs are addressed when comparing the weighted scores and risks. With this approach, the comparison between two options that have similar weighted costs and risks quickly reduces to a cost decision.

BENEFITS OF THE KCB DECISION ANALYSIS PROCESS

Mine closure is an evolving process, especially with new mine development, and there are multiple perspectives on achieving the ultimate closure goal. The main benefit of this process is to provide every stakeholder a chance to be heard and promote open discussions on the various perspectives. Highlighting diverse perspectives helps the team understand the issues or concerns that they may not have previously understood, leading to a decision that is more likely to be accepted by various stakeholders. Another benefit is that once the decision analysis has been completed for a specific project, the framework is easily updated throughout the life of the mine. Finally, decision makers (i.e., company management) are kept informed and are invited to provide input and direction, improving the likelihood of gaining their support – a vital step for a successful decision.

CONCLUSIONS

The application of a structured decision analysis tool such as the process described above can be utilized to make any decision, large or small, conceptual through detailed, and applied to new, existing, or legacy mine closure projects. This process is well integrated with the Guide to provide a consistent framework, good practice guidance for integration, and a disciplined approach for mine closure, while allowing for project specific freedom.

The KCB decision analysis process is based on the K-T analysis, builds on the EC MAA process, and complements the Guide. With a skilled facilitator and the correct stakeholders, a preferred alternative for a closure plan can be developed that balances competing objectives, costs, and risks to make a well-informed decision.

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