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Optioneering for Closure

Why options assessment are important in closure studies

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Conference 2024

PRESENTATION OUTLINE

1. Closure context
2. Options assessment
3. Evaluation criteria
4. Identifying options
5. Optioneering tools – MCA
6. Reporting
7. Conclusions

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RECAP ON CLOSURE...

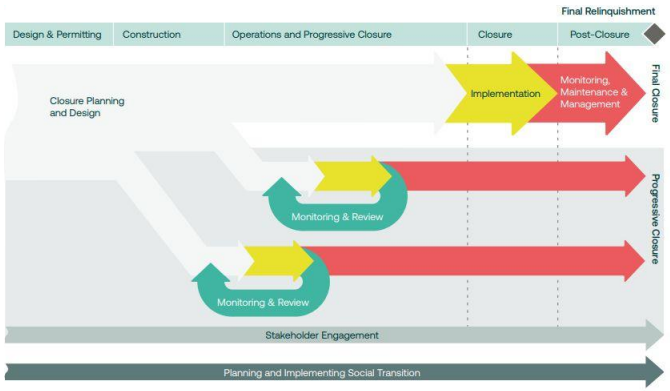

Figure 1: ICMM (2019) Mine Closure framework

Integrated mine closure needs to be dynamic, iterative and consider ESG throughout the lifecycle (ICMM, 2019).

Closure is multi-disciplinary, as such it benefits from early setting of vision, principles and objectives (ICMM, 2019).

Technical and 'soft skills' required to ensure alignment and to incorporate stakeholder expectations, risks and opportunities.

Closure historically has been an afterthought (legacy issues) - doing it better is critical for the sustainability of the industry.

One way to do this is through better articulation, assessment and selection of options – how we ensure we're shaping the future of the resource sector!

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WHAT IS OPTIONEERING?

- Optioneering: comparing all alternative solutions and selecting the most appropriate option
- Divergent thinking – ensure all options are documented, regardless of how unlikely they may be.
  - Things change over time, removes the wasted time of rehashing options.
  - Fatally flawed options are still important – consider what will be critical to know in 5-10 years' time (future proof).
- Agreeing on 'best option' becomes difficult if criteria is not established (i.e. vision, principles and objectives).
- Agreeing on scope (inclusions and exclusions (e.g. domain based)) and levels of analysis (often driven by the definition required during the study phase).

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IMPORTANCE OF OPTIONS ASSESSMENTS

Why are options assessments important?

- Document and capture options
- Understand scope
- Business case development
- Consider outcomes and linkages

When should we do options assessments?

- As early as possible (during mine development studies)
- At every study stage?
- When anything changes (significance of change)?

Why categorise?

- Quick way to identify preferences (importance of language)
  - E.g. Central (Base) / Downside / Upside
  - Value engineering / Preferred investment alternative
  - Low regret option
- Trade off studies

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Key inputs:

- Viability of options
- Evaluation criteria

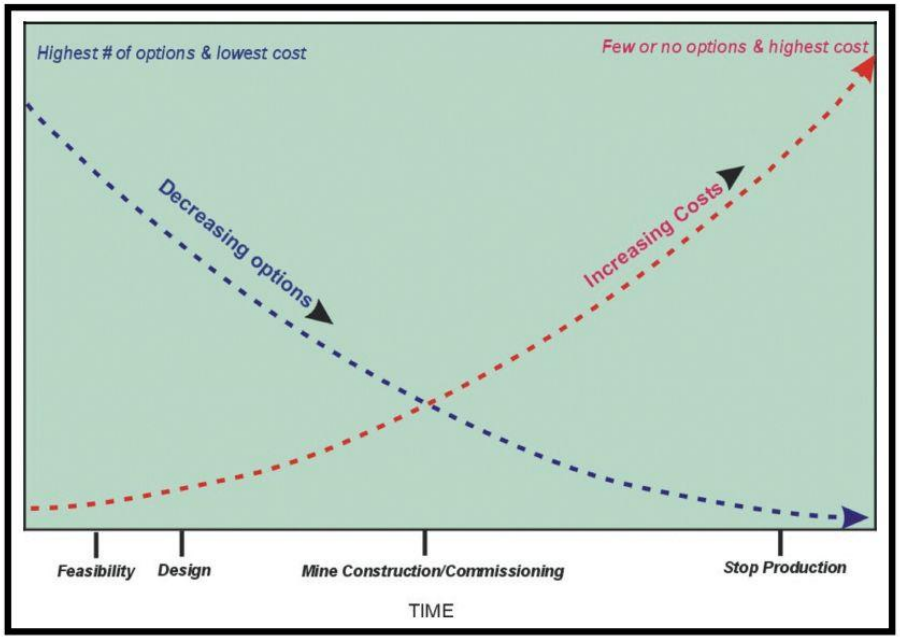


Figure 2: Relationship between options available and costs through time (Northern Territory Minerals Council and the Mines and Petroleum Division of the Northern Territory Government, 2004)

WHAT TOOLS ARE AVAILABLE?

As with most other things in mine closure – there are numerous different tools in use:

- Pairwise assessment
  - Compares one option against one another and which is preferred
- Strategic merit test
  - High level test to assess strategic fit
- Complexity vs certainty analysis
  - High level analysis of option's complexity to execute vs certainty at closure (qualitative)
- Cost Benefit Analysis (CBA)
  - Focused on economic analysis, calculates the benefits of options in monetary terms
  - Usually rapid cost benefit analysis is used in early stages
- Multi Criteria Assessment (MCA)
  - Scores options across different criteria (which may or may not be weighted and combined into a single score)
  - Mostly used in studies, including variables to approach (e.g. hybrid)

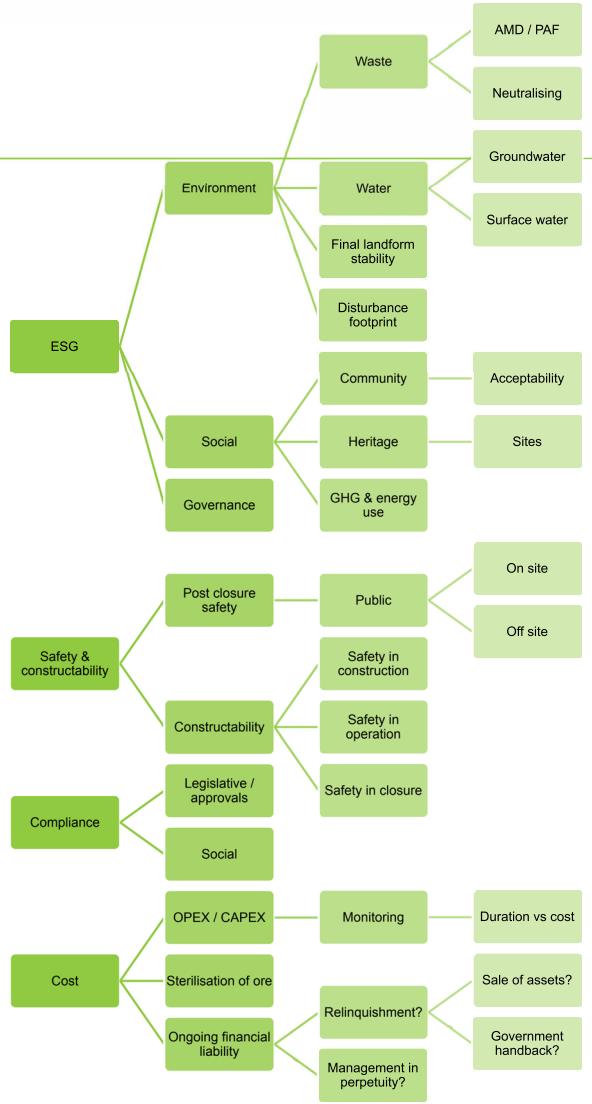
SETTING EVALUATION CRITERIA

How to set Evaluation Criteria?

- Based on vision, principles and objectives set for closure?
- Based on the company values?
- SMART (specific, measurable, achievable, relevant, time-bound)?
- Collaborative / agreed democratically or set by the study lead?
  - E.g. Pairwise assessment
- High level vs detailed?

	ESG	Safety & constructability	Compliance	Cost	Sum	Weighting
ESG	N/A	6	5	4	15	25%
Safety & constructability	4	N/A	5	6	15	25%
Compliance	5	5	N/A	5	15	25%
Cost	6	4	5	N/A	15	25%

	ESG	Safety & constructability	Compliance	Cost	Sum	Weighting
ESG	N/A	3	5	4	12	20%
Safety & constructability	7	N/A	8	6	21	35%
Compliance	5	2	N/A	5	12	20%
Cost	6	4	5	N/A	15	25%



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IDENTIFYING OPTIONS

- Document everything.
- Divergent thinking (cannot be underestimated).
- Use fatally flawed analysis to converge the options.
- Consider known knowns vs unknown unknowns vs known unknowns etc.
- Understand and manage risks and opportunities of options.
- E.g. Waste Dump rehabilitation options:
    - Concave, convex, berm and batter 7m, berm and batter 10m, berm and batter 20m, linear slope, scree slope, remove landform (backfill pit), do nothing (walk away option), care and maintenance, store and release cover.

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MULTI CRITERIA ASSESSMENT (MCA)

	Weighting	1. Concave	2. Berm and batter	3. Linear batter	4. Remove	5. Do nothing
ESG	0.25	6	6	3	10	1
Safety & constructability	0.25	7	5	6	4	9
Compliance	0.25	7	6	5	10	1
Cost	0.25	6	5	7	3	8
Weighted average score	**1.00**	**6.5**	**5.5**	**5.25**	**6.75**	**4.75**
Rank		2	3	4	1	5

Even weighting – Remove landform is ranked #1
Remove landform may be base case, and concave and berm and batter carried forward – linear batter and do nothing discounted.

	Weighting	1. Concave	2. Berm and batter	3. Linear batter	4. Remove	5. Do nothing
ESG	0.20	6	6	3	10	1
Safety & constructability	0.35	7	5	6	4	9
Compliance	0.20	7	6	5	10	1
Cost	0.25	6	5	7	3	8
Weighted average score	**1.00**	**6.55**	**5.4**	**5.45**	**6.15**	**5.55**
Rank		1	5	4	2	3

Different weighting results in different options:
Concave is now base, remove and do nothing carried forward.

	Weighting	1. Concave	2. Berm and batter	3. Linear batter	4. Remove	5. Do nothing
ESG	0.15	6	6	3	10	1
Safety & constructability	0.25	7	5	6	4	9
Compliance	0.10	7	6	5	10	1
Cost	0.50	6	5	7	3	8
Weighted average score	**1.00**	**6.35**	**5.25**	**5.95**	**5**	**6.5**
Rank		2	4	3	5	1

Skewed weighting can lead to different results and priorities – Do Nothing is now base case, with concave being carried through and others potentially discounted.

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REPORTING

- Document everything (scope, criteria, options etc.).
- Reporting can be as simple as inclusion of the MCA tables in the overall reports.
    - More complex reporting would involve stand alone reports and presentations.
- Importance of language – key terms understood by all stakeholders.
- Evidence / justification.
- Change management based on risks, stakeholder inputs, cultural / industry shifts.
- Empower decision makers.
- Track actions and forward work plans, inclusive of updating knowledge bases.

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CONCLUSIONS

- Option analysis can be a simple process and should be used throughout a lifecycle of a mine site / project.
- Agree and implement framework as early as practicable and when things change.
- Document everything (what options were identified, why was criteria set, why options were discounted, what was not considered etc.).
- Report in a language decision makers will understand and buy into.
- Have fun shaping the future of our industry!

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- ICMM. 2019. *Integrated Mine Closure – Good Practice Guide*. 2nd Edition. https://www.icmm.com/website/publications/pdfs/environmental-stewardship/2019/guidance_integrated-mine-closure.pdf?cb=60008
- Northern Territory Minerals Council (Inc.) and the Mines and Petroleum Management Division of the Northern Territory Government. 2004. *TEAM NT: Technologies for Environmental Advancement of Mining in the Northern Territory Toolkit*. D.R. Jones and M. Fawcett, principal authors. Posted on the Northern Territory Minerals Council webpage at: https://nt.gov.au/__data/assets/pdf_file/0019/203419/team-nt-toolkit.pdf

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