

Exploring the issues in mine closure planning: A holistic review of socio-technological and environmental approaches in mine closure and relinquishment

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BACKGROUND

As the mining and metals industry matures, increasing pressure has been placed on companies to implement mine closure and develop achievable relinquishment plans. While the industry has made great progress in integrating environmental and technical processes that support mine closure activities, the relinquishment of mine tenure remains a challenge. Of 1800 mines self-reported as 'closed' in the 2019 S&P Global Intelligence Market database in, only one has been relinquished¹. Moreover, there are unclear definitions of what constitutes a closed mine², or examples where a clear pathway to relinquishment can be identified³. Differing priorities exist around the world. While Australian mine closure policies focus heavily on environmental outcomes, international mine closure policies, especially in developing countries, emphasise socio-economic and technical impacts that benefit the mining employees and the wider community⁴. This highlights the difference in requirements for successful relinquishment on a global scale.

For mining to make a greater contribution to sustainable development, relinquishment and post mining land uses need to incorporate the combination of social, technical, and environmental factors. Successful closure solutions should be technically feasible, economically viable, and socially acceptable. Likewise, frameworks and indicators for a successful relinquishment should be fully integrated across those domains, rather than addressing them as separate areas of expertise and policy.

This paper investigates mine closure from a holistic perspective, combining a study of currently available socio-techno-environmental elements within closure frameworks and exploring how institutional frameworks (policy and regulatory) affect the integration of different aspects of sustainability. This perspective aims to provide a better balance to inform decision making in the selection of closure solutions, and in theory allow industries an opportunity to demonstrate commitment to sustainable development in the field⁵. This paper presents the first phase of examining closure frameworks for opportunities to integrate social and technological indicators in mine closure and relinquishment.

¹ S&P (2019), 'S&P Global Market Intelligence.', Available at: <https://www.spglobal.com/>.

² Rod Campbell et al. (2017), 'Dark Side of the Boom', <https://australiainstitute.org.au/wp-content/uploads/2020/12/P192-Dark-side-of-the-boom-web.pdf>.

³ Department of Industry, Innovation and Science (DIIS) (2016), 'Mine Closure: Leading Practice Sustainable Development Program for the Mining Industry', <https://www.industry.gov.au/sites/default/files/2019-05/lpsdp-mine-closure-handbook-english.pdf>.

⁴ David Lamb, Peter D. Erskine, and Andrew Fletcher (2015), 'Widening Gap between Expectations and Practice in Australian Minesite Rehabilitation', *Ecological Management & Restoration* 16, no. 3 (2015): 186–95, <https://doi.org/10.1111/emr.12179010>.

⁵ Kamila Svobodova et al.(2019), 'Thinking beyond Closure: Toward a Mine Closure Database', 9th International Conference on Sustainable Development in the Minerals Industry.

Mine Closure Frameworks

Frameworks are basic conceptual structures underlying a system and enabling the organisation of ideas, data and processes. Mine closure frameworks facilitate a systematic approach to evaluating criteria for closure and relinquishment, and enable multiple stakeholders to gain a shared understanding of the objectives and methods of the evaluation process⁶. A range of evaluation frameworks have been published by collective international organisations such as the International Council on Mining and Metals (Planning for Integrated Mine Closure Toolkit) and International Institute for Environment and Development (Mining, Minerals and Sustainable Development), national entities such as the Minerals Council of Australia (Enduring Value), Mining Association of Canada (Towards Sustainable Mining), and corporate bodies such as Anglo American (Mine Closure Toolbox) and BHP (Our Requirements).

Methods

We evaluated how well social, technical and environmental considerations have been covered in a selection of 13 frameworks originating from four international organisations, two national entities, one industry-specific research body and two corporations.

We note that there are wide varieties of terminologies, formats, and usage contexts in which frameworks are developed. While some frameworks were developed for process evaluation, others may only focus on outcome evaluation. For the purpose of this study, frameworks were selected based on their intended use for mine closure planning, or for containing elements alluding to mine closure and relinquishment.

The frameworks reviewed in this study were identified through previous studies by Worden (2020)⁷ and readily available grey literature. International and national examples were readily accessible. As it was more challenging to publicly access frameworks from specific companies, the national and international guidelines dominate the review.

Each framework was reviewed in terms of the robustness with which they provide guidance on addressing processes and outcomes from a social, technical and environmental perspective. We extracted information from relevant sections of the frameworks and classified the data, qualitatively assessing the level of coverage and guidance provided.

Findings and Discussion

From the cases reviewed, we found that international and national frameworks provide more generic guidance compared to the more process and outcome driven guidance of the corporate frameworks. Higher level frameworks tend to be comprehensive yet general due to their intended nature of serving as a template applicable across a variety of situations. However, this generic nature also implies that a key purpose of such frameworks is to provide guidance to organisations rather than distinct implementation steps.

The differences observed in our review of corporate and industry research frameworks highlight the importance of situational context. Each mine site comes with a unique set of challenges that change over time. Currently, there is an increasing focus on community and societal inclusion, therefore the frameworks have evolved over time to more collaborative development modalities. As context continues to transform throughout the process of mine closure, it is important that industry frameworks remain process driven and evolve accordingly in response.

Our overall assessment of the frameworks showcased that the three dimensions of social, technical, and environmental are largely treated separately. While environmental and technical concerns are highly elaborated and occasionally overlap, social considerations remain a separate entity with guidance generally pertaining to 'who' should be consulted and 'what' may be discussed. This is reminiscent of

⁶ Judith F. Fynn et al. (2020), 'A Scoping Review of Evaluation Frameworks and Their Applicability to Real-World Physical Activity and Dietary Change Programme Evaluation', *BMC Public Health* 20, no. 1 (26 June 2020): 1000, <https://doi.org/10.1186/s12889-020-09062-0>.

⁷ Sandy Worden (2020), 'Integrated Mine Closure Planning: A Rapid Scan of Innovations in Corporate Practice', <https://www.mineclosure.net/media/resources/349/intmineclosfinal20200315.pdf>.

early “triple bottom line” frameworks following the publication of “Our Common Future” in 1987⁸ and with subsequent sustainable development analysis, in the late 1990s, being developed separately as social *or* environmental *or* economic⁹.

The need for a socio-economic, technical and environmental spotlight on the global mining industry has been developing since the end of the last century. As current and future solutions need to be technically feasible, economically viable, and socially acceptable, continued research is necessary to elicit the best ways to holistically achieve these three criteria. Our future research will include a historical review of the effectiveness of institutional settings (policy and regulatory frameworks) in promoting integration.



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Prior to joining the University of Queensland, she worked as a consultant in nuclear emergency preparedness and remediation for food and agriculture at the International Atomic Energy Agency (IAEA), and a REDD+ safeguards consultant at the Malaysian Ministry of Energy and Natural Resources under the UN Environment Programme (UNEP). She attained her Masters in Environmental Sciences from the University of Tokyo, Japan (2015), and Bachelors in Geology from Bryn Mawr College, USA (2013).

⁸ United Nations. (1987). Report of the World Commission on Environment and Development: Our Common Future. Retrieved from General Assembly Resolution 42/187, 11 December 1987:

⁹ Shi, Longyu, Linwei Han, Fengmei Yang, and Lijie Gao. (2019). "The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects" *Sustainability* 11, no. 24: 7158. <https://doi.org/10.3390/su11247158>

