
Risk assessment as a tool to explore sustainable development issues: lessons from the Australian coal industry

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Abstract: Risk assessment is a familiar tool in the minerals industry. Originally introduced to explore areas of safety and health in the workplace, the tool is now increasingly used by the industry in other areas such as environmental management. As the industry grapples with the concept of sustainable development, risk assessment represents a potentially useful methodology to engage operations with the broader range of issues involved. However, a limitation of the traditional risk mitigation approach is that it focuses on avoiding negative outcomes, whereas a sustainability focus requires consideration of positive impacts as well. This paper describes an initial attempt to use modified risk assessment methodologies to engage with three Australian coal mining operations on the subject of sustainable development. It describes the rationale for the project, the outcomes from the trials and the overall lessons from the exercise.

Keywords: risk assessment; sustainable development; coal mining; opportunity analysis; impact analysis.

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1 Introduction

Risk assessment is a familiar and well accepted tool within the Australian minerals industry. It is applied in many forms to address a wide range of issues. This was evidenced by the recent conference on 'Mining Risk Management' (AUSIMM, 2003) organised by the Australian Institute for Mining and Metallurgy, which saw the publication of 70 papers, addressing areas from geology to the environment. Risk has increasingly become an integrating framework for the evaluation of both new and existing projects within the industry, and corporate qualitative risk assessment procedures are being applied to a growing range of issues, from major capital investment to local operational decisions.

The concept of sustainable development as applied to the minerals sector is a more recent development, but one which has attracted much focus over the last few years. The publication of the 'Mining, Minerals and Sustainable Development' (IIED, 2002) report represented the culmination of a three year programme coordinated by the major global companies operating in the sector to review the impacts associated with mining and recommend a way forward for the industry. This effort sought to address concerns that the industry was losing its social 'licence to operate' due to negative public perception of the impacts of its activities, as observed by Peck and Sinding (2003):

The discovery, extraction and processing of mineral resources is widely regarded as one of the most environmentally and socially disruptive activities undertaken by humankind.

While there remains a vigorous debate within the industry on appropriate definitions and principles of sustainable development and relevant indicators (e.g., Humphreys, 2001), the concept has become a central focus at the corporate level for many organisations in the sector. However, challenges remain in making the concept meaningful at the site level where traditional operational performance targets still dominate management attention.

The theme of risk occurs frequently throughout the MMSD reports, and the framework for sustainable development subsequently released by the industry organisation, the International Council on Mining and Metals (ICMM) includes a principle which states:

Implement risk management strategies based on valid data and sound science

The Minerals Council of Australia (MCA) has provided additional guidance to the local industry on the implementation of the full set of ten principles using its 'Enduring Value' framework (MCA, 2004), and opposite this particular area include the following advice:

Use appropriate risk assessment methods to identify the potential social, health, safety, environmental and economic impacts of the intended operations.

In many cases, risk has become a dominant paradigm from which companies review the concept of sustainable development.

This paper seeks to explore the potential to use typical risk assessment processes to explore issues of sustainable development at the operational level. It is based on an industry funded project undertaken to develop an operational tool capable of being used at the level of an individual mine. The paper is divided into three parts. The first section defines the context for the project, exploring the literature which links the themes of risk assessment and sustainable development both broadly and as applied to the minerals sector. The development of the project and associated trial applications is then described, including a summary of the project outcomes. Finally, some conclusions are drawn as to the suitability of the approach and further opportunities for research in this area.

2 The broader context

2.1 Risk and sustainable development

In the context of the broader debate regarding the business case for sustainable development, many authors have identified risk as a key driver of behaviour (e.g., Reinhardt, 1999). Risk mitigation and the avoidance of future contingent liabilities are commonly identified as reasons for adopting 'Beyond Compliance' policies that are not readily justified using simple economic valuation processes. The World Business Council for Sustainable Development argued for a strategic approach in their publication 'Running the risk' (WBCSD, 2004). In the minerals sector, a current and relevant Australian initiative is the Mining Certification Evaluation Project (MCEP) being coordinated by a group including the environmental NGO, the Worldwide Fund for Nature (WWF), local research organisation CSIRO and several Australia based companies. The aim of this project is to generate a certification protocol similar in concept to that managed by the Forest Stewardship Council. One of the criteria for the assessment procedure, currently in draft form, reads as follows:

The mine site operator has a risk management system that takes account of social, cultural, health, safety, environmental and economic risks throughout the mine life cycle.

The risk mitigation approach to sustainable development is generally well accepted in the corporate environment. It has been used for some time to address safety and environmental issues, and is increasingly being applied to the full range of 'Triple Bottom Line' areas of social, environmental and economic performance.

Risk also has a prominent role in related public processes such as Environmental Impact Assessments (EIAs), where risks borne by stakeholders other than the project proponent are the main focus. Increasingly, environmental risk management is being formally used within such processes to analyse the impacts of projects and identify suitable controls, and the area of social risks has been explored, although to a less formal extent (e.g., Davis, 1999). Interestingly, however, the field of impact analysis has recently thrown up a challenge to the risk mitigation approach to sustainable development. Literature on the trend towards sustainability assessments highlights the need to identify and consider controls for positive as well as negative impacts. This is best expressed in a paper from Canada (Gibson, 2001) which reviews the evolution of the sustainable development debate and its relevance to the process of impact assessment for large projects, including two mining examples. Gibson observes:

... an expansion of central concern from avoidance of significant adverse effects to expectation of positive contribution to the achievement of sustainability objectives.

He also highlights some of the difficulties involved, including the question of compromises and tradeoffs where negative impacts are considered inevitable. A practical example from the resources sector can be seen in the approval process undertaken by the West Australian State Government for the Gorgon Gas development, where a 'net conservation benefit' was identified as a criterion.

In theory, risk management processes allow for the consideration of positive outcomes. For example, the current Australian Standard AS4360 for Risk Management (Standards Australia, 1999) states that:

Risk management is as much about identifying opportunities as avoiding or mitigating losses.

In practice, however, experience suggests that most risk assessment processes continue to be focused squarely on the avoidance or mitigation of negative impacts.

2.2 Risk assessment in the Australian minerals industry

The minerals industry in Australia has a significant history of applying risk management techniques over recent years, as evidenced by the range of papers presented at the recent conference. In 2001, the Minerals Council of Australia commissioned a national project to derive 'good practice' guidelines for the application of risk assessment. Several large mining companies and government agencies provided input and guidance to the project, the outcomes of which were generally consistent with the process model described in AS4360. The most recent version of the guideline was published in January 2005 (MISHC, 2005), and reviews in detail the various types of risk assessment methods and their applicability to different situations. The rapid growth in this area was driven originally by a focus on the need to improve health and safety performance, but the techniques have increasingly been applied to other specific issues such as environmental performance and broader aspects of business risk.

Whilst companies utilise many different risk assessment tools such as fault tree analysis, failure mode effects analysis etc. according to the context, by far the most ubiquitous approach at the operational level is the use of simple qualitative risk assessment based on the application of descriptive scales for consequence, probability and (sometimes) exposure. These techniques can be traced back to original work published by Fine (1971). Many companies use a series of qualitative consequence scales, reflecting different dimensions of concern such as health and safety, environmental, social and financial impacts. Table 1 shows a typical scale for injury and disease outcomes for one major mining company operating in Australia.

Table 1 Qualitative consequence scale for site level safety and health outcomes used by one major Australian minerals company

Low	No medical treatment Low level short term subjective inconvenience or symptoms No measurable physical effects
Minor	Objective but reversible disability or impairment Medical treatment injuries requiring hospitalisation
Moderate	Moderate irreversible disability or impairment to one or more persons
Major	Single fatality Severe irreversible disability or impairment to one or more persons
Critical	Short or long term health effects leading to multiple fatalities or significant irreversible human health effects to >50 persons

Source: Adapted from MISHC (2004)

At their simplest, such systems consider consequences in three or four key areas of business impact, typically considering financial, safety and environmental outcomes. Recent years have seen the generation of more complex, enterprise-wide risk assessment procedures with many more definitions of consequence in areas of impact for both the business and other stakeholders. This trend aligns well with the broadening of the industry's approach to the issue of sustainable development.

However, the application of such a wide range of scales increases the complexity of application for individual operations. A number of challenges arise when using such systems to consider broader issues of sustainable development, including the following:

- experience in some areas, e.g., social risk analysis, is limited compared with more common applications such as safety
- the culture of conducting such assessments is focused almost exclusively on the mitigation of negative impacts
- the areas under consideration cut across a range of disciplines and existing management systems.

The following sections outline a project that was designed to explore this area, using industry case studies from the Australian coal sector, providing some learning opposite these challenges and other issues identified during the course of the project.

3 The sustainability opportunity and threat analysis (SOTA) project

3.1 Project background and rationale

In 2002, the University of Queensland's Sustainable Minerals Institute (SMI) commenced a project under the guidance of its industry sponsors to investigate the issue of sustainability metrics for the mineral industry, with a particular focus on how these could be developed and applied at the site level. It was agreed at an early stage to adopt a risk management approach, with a view to facilitating the identification of relevant site issues prior to developing metrics to assess performance against them. There were several reasons for adopting this approach.

Firstly, as previously indicated, risk management techniques are now widely employed within the mining industry and most people in the sector understand, and are comfortable with, the associated concepts and language. By contrast, the language of sustainable development is still foreign to many operational personnel in the industry and, in some cases, may be perceived as threatening.

Second, the workshop format, which is widely used in risk management exercises, is a good means of engaging with operational personnel. Experiences from the Occupational Health and Safety (OHS) and environmental areas indicate that most participants find workshops interesting and challenging. Moreover, the participatory style of the workshops helps to give participants a sense of ownership over the outcomes of the process. By contrast, the standard corporate practice of 'bringing in a consultant' tends to exclude site-level personnel from meaningful involvement and makes it easier for these personnel to divorce themselves from responsibility for findings and outcomes.

Third, risk assessment provides a proven methodology for prioritising issues that require attention; it encourages sites to focus on what is important to them and to think about strategies for managing these risks. By comparison, 'top down' organisational processes, such as reporting requirements and audits, can require sites to expend effort on addressing issues that may be perceived as being of only marginal relevance at the local level. This often promotes defensive behaviour by sites, rather than a positive emphasis on improving performance.

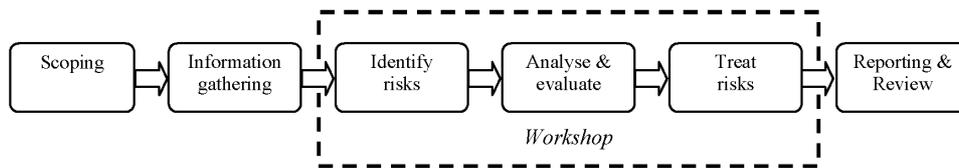
The initial qualitative risk assessment approach taken, evolved into the Sustainability Opportunity and Threat Analysis (SOTA) project (CSRM, 2003). As the name suggests, this project focussed on identifying opportunities as well as threats, and on addressing the social, economic and environmental dimensions of the issues under consideration. In essence, the project aimed to blend the themes of risk assessment and sustainable development into a simple operational tool. Integral to this objective was the requirement to build an opportunity focus into existing industry approaches.

3.2 Focusing on sustainability issues

The basic steps involved in the process were modelled on a standard risk management flowchart, and are outlined in Figure 1. Feedback loops for communication and ongoing monitoring have been omitted from the above diagram for the sake of simplicity, but are clearly also important elements in the overall process. The main risk analysis tasks are carried out in a workshop involving operational personnel with knowledge of the issues under consideration. This represents a common qualitative risk assessment approach. What is distinctive about the process considered in this paper is that it seeks to apply

these well established techniques to a broad array of issues organised within a sustainable development framework, and also aims to consider positive as well as negative impacts. Given the very wide range of areas to be covered, it is clearly not possible to review every aspect in detail, and many areas (for example workplace health and safety) will have been extensively covered by other reviews and management processes and systems. An important part of the scoping stage is therefore to identify the boundaries of the exercise and the key areas of focus, to avoid duplication and maximise the use of resources.

Figure 1 The SOTA process



In the information gathering and risk identification stages, the emphasis is on identifying as many potential impact areas as possible, including those beyond the perimeter of the mine. This helps to ensure that the workshop pays attention to broader sustainability issues. We have found it useful in this regard to use the overlapping circle image (a common representation of sustainable development in the literature and corporate publications) combined with some general impact categories which broadly align with the three pillars of the ‘triple bottom line’ and the main dimensions of sustainable development (see Figure 2). This model also provides a convenient framework for organising the discussion of ‘hazards’ and specific events during the risk assessment process.

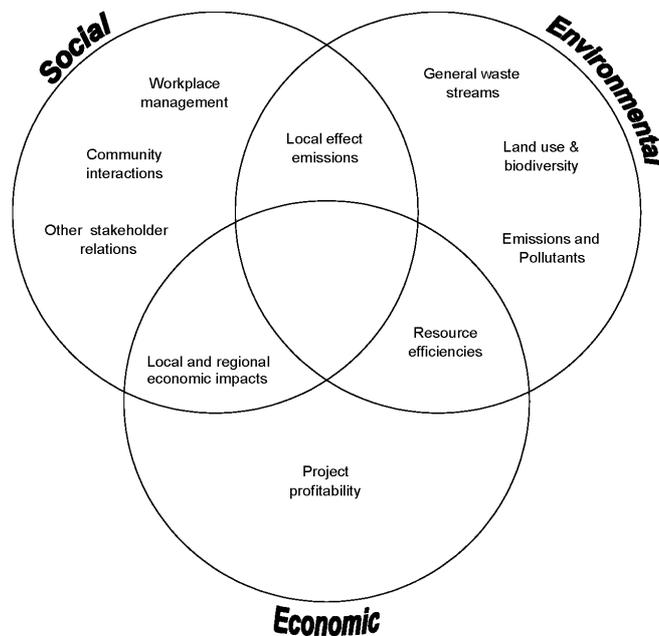
The various impact categories in the diagram can be summarised as follows.

- *Resource efficiencies.* How well are we conserving scarce resources and making our processes more efficient? What are the implications of current consumption patterns?
- *Emissions and pollutants.* What are the main emissions from the site that have the potential to cause environmental damage both locally and globally?
- *Land use and biodiversity.* What are the impacts of the mine on local land use and biodiversity? How can the operation make a positive impact? What risks exist in the rehabilitation processes?
- *General waste streams.* What are the main types of waste from mining and processing? What are the impacts of waste disposal practices? What opportunities exist to reduce the amount of waste, and reuse or recycle more?
- *Local effect emissions.* What environmental issues directly affect neighbouring communities? What changes has the operation caused?
- *Workplace management.* How does the operation impact on the people who work there? Are there specific health and safety impacts? What opportunities exist to assist employees in managing work/home conflict issues?

- *Community interactions.* How does the mine affect the community, local and otherwise? Are there any health and safety concerns? What benefits have arisen from the presence of the operation?
- *Other stakeholder impacts.* What impacts arise from interactions with other stakeholders? How has the operation engaged with stakeholders in the broader community?
- *Local and regional economic impacts.* What are the impacts of the economic activity associated with the mining operation at a local and regional level?

As can be seen from this list, there is a strong emphasis in the process on recognising the range of stakeholders involved and incorporating their viewpoints into the process in some form. Impacts that affect neighbours and local communities are clearly part of the sustainable development equation, as are interactions with other groups such as regulators.

Figure 2 An impact based description of sustainable development issues



There are various means of obtaining this external input. The minimalist approach is to ask site based personnel with good local knowledge to identify relevant stakeholders and their likely concerns; however, there is a risk that some stakeholder views and interests may be misrepresented or overlooked, using this process. Another strategy is for an independent researcher to consult separately with relevant stakeholders and feed this information into the workshop, perhaps by acting as a stakeholder 'advocate'. A third strategy is to involve external stakeholders in the workshop itself. Which of these strategies is employed will be determined by the characteristics of the site where the review is being conducted and the extent to which local and corporate management feel comfortable about involving 'outsiders' in the workshop.

Another important feature is the emphasis placed on the identification of opportunities as well as threats. As noted earlier in this paper, the idea of sustainable development embraces a commitment to the continuous improvement of environmental and social performance. This can only be achieved if sites are prepared to 'think outside the square' and actively pursue opportunities to deliver better outcomes, rather than being preoccupied with avoiding negative consequences. As a way of promoting this approach, positive consequence scales can be constructed to balance the negative outcomes normally portrayed. Table 2 shows an example of such a scale, designed to be combined with the more typical scale shown previously in Table 1.

Table 2 Possible positive consequence scale for safety and health outcomes

Highly significant	Positive 'life-saving' impact on >100 lives Significant and sustained health improvements to >1000 persons
Major	Multiple 'lifesaving' impact Significant permanent positive health impacts on a large number of people
Moderate	Single 'life saving' impact Major positive impact on healthy lifestyle behaviours Major improvement in safety performance
Minor	Positive impact on health of several people
Low	Some positive impact on individual injury/health

At first glance these outcomes might seem to be an unlikely area of focus. However, there are numerous examples where mining companies are actively involved in projects to deliver such benefits. For example:

- major disease eradication programmes in regions surrounding mining operations
- provision of community health facilities in remote areas which result in measurable improvements to infant mortality rates and life expectancy
- the extension of healthy lifestyle programmes to include families and communities associated with mining operations.

All of these could easily be aligned with outcomes in the table, and are obviously considered by the companies involved to be creating value in some form.

Finally, it needs to be stressed that the aim is not just to assist sites to identify risks and opportunities, but to help develop strategies for addressing these issues. Once issues have been prioritised, workshop participants are encouraged to suggest possible 'controls'. In the case of opportunities, the focus is on identifying activities and changes which will increase the likelihood of the opportunity being realised and/or maximise the benefit to be derived from this. In practical terms, this often involves assigning roles and responsibilities, undertaking project evaluations and monitoring progress. In the case of negative risks (threats), the focus is on possible mitigation strategies, such as eliminating the hazard, substituting it with some other process, imposing engineering and administrative controls, and so on. The aim here is not to come up with a detailed action plan, but rather, to identify a range of matters that can be taken further by site and corporate management.

4 Applications and outcomes

4.1 The trial environments

The approach described in the previous section has been trialed at three coal operations located within the Bowen Basin in Central Queensland. This region is one of Australia's main coal producing areas, exporting 129M tonnes of steaming and coking coal in the period 2002–2003. The region is sparsely populated, with small residential mining communities close to operations and occasional larger, more diverse, regional centres such as Emerald (approx. population 13,000). The introduction of 12-hour shifts by the mining industry in recent years has seen a population shift towards coastal centres such as Mackay where a large service sector has become established. The climate of the region is semiarid with many areas suffering prolonged drought conditions, the other main landuse being cattle grazing in a cleared bush landscape. Some irrigation farming of cotton and other crops has developed close to water supply reservoirs and along major rivers.

The three open cut mines chosen as trial sites were operated by different companies and featured a diverse range of issues, although they all shared the same overall context described above.

- At the first site, the focus of the exercise was specifically on the operation's water supply system. This included a major pipeline owned and operated by the mining company which extracted water from a significant regional river and distributed it to mines and communities over a length of several hundred kilometres. The exercise involved consideration of both how the company itself used and disposed of water at one of its minesites, as well as water usage by the graziers and mining communities that are connected to the pipeline. The prevailing drought conditions resulted in a strong focus on all impacts associated with water supply in the area.
- The second site was a smaller operation closer to the coast, operated as a 'drive in, drive out' mine. A small community located close to the mine was increasingly expressing concern at the impact of increasing mining activity in the area and the apparent lack of local benefit.
- The third site was a large operation with plans for major expansion which would see mining move closer to a major river and water supply for nearby irrigation industries. This mine also operated under 'drive in, drive out' conditions, even though it was located close to a major regional centre, and had previously maintained a very low profile with local communities.

At all three sites, the process outlined in the previous section was followed. In two cases, existing company risk assessment scales were modified to allow for consideration of opportunities; in the other case, a generic set was provided by the researchers. The first two trials involved searches of public domain information relating to external impacts but no direct communication with other stakeholders. In the final trial a series of interviews with various external personnel were conducted prior to the workshop and the feedback from these discussions was incorporated into the process.

4.2 *Assessment results*

In each case, a prompt list was prepared prior to the workshop, highlighting the sources (or 'hazards') of potential opportunities and threats, organised into the categories shown in Figure 2. Background information was provided where relevant. These documents proved to be an effective way of steering the group through the broad range of impacts under consideration. Without exception, opportunities and/or threats were identified under each category; the most commonly raised issues related to land use and rehabilitation processes followed by resource efficiencies of specific process operations.

The first application focussing on water issues was run over a total of three days with a range of site participants. A total of 158 specific outcomes were considered and evaluated, consisting of 27 opportunities and 131 threats. Of these, potential controls were discussed and recorded for 89 issues – the remaining issues fell below the cutoff level in the risk ranking table. The other two workshops were each run over the course of one day, identifying 55 and 65 outcomes respectively. In all cases site representation in the workshops consisted of management, technical and operational personnel.

In all of the completed trials, the response of workshop participants has generally been positive. For example, one of the participants told us that the workshop had engendered more open and frank discussion than had previously taken place on site about sustainability issues. Another participant highlighted the opportunities identified during the workshop to work with other mines in the region on common community and environmental issues. The ultimate measure of success, of course, is not whether workshop participants feel good about the exercise, but whether it leads to improved practices at the site level. No followup exercises have yet been undertaken, but ultimately the monitoring and feedback processes must link into existing management processes. Reported progress at the sites involved is mixed, but some specific actions have occurred as a result of the workshops. The first trial – which focused on water management issues – has been instrumental in prompting the company concerned to significantly upgrade the water flow monitoring network at each of its mines. The company has also undertaken a similar review of other parts of its water supply system in the region, and canvassed for applying the approach to other specific areas such as mine closure. Another of the trials highlighted to one of the operations, the potential benefits of a more proactive engagement with local community groups on issues of mutual advantage, and actions have commenced to implement this type of activity.

In all trials the workshop proved to be very useful in identifying clusters of issues that would benefit from being managed holistically rather than continuing to be addressed in a piecemeal fashion. For example, at one of the sites the process highlighted several issues that were linked to the broader issue of mine closure and lease relinquishment, and emphasised to management the importance of having a comprehensive closure strategy in place. When considering all of the individual issues associated with management of water at another operation, it was apparent to the team involved in the exercise that there were a number of strategic themes emerging. This 'bottom-up' approach to strategy development has provided useful inputs to broader management processes within the organisations involved.

4.3 *Learning outcomes*

While the application of the SOTA technique has resulted in some positive outcomes, it has also highlighted some areas where the technique would benefit from further refinement.

First, the issue of stakeholder participation in this type of exercise warrants greater attention. The workshops for the three completed trials involved company and research group participants only, because of company concern that the inclusion of ‘outsiders’ could complicate the process. Whilst external stakeholder viewpoints were explicitly recognised and discussed, there was a tendency for those involved to revert to considerations of pure business risk rather than broader stakeholder outcomes. Our preferred approach is to include stakeholders in the actual workshop wherever possible, although this will require very careful facilitation if it is to be a productive exercise. If, for some reason, external involvement is deemed not to be desirable, or feasible, a possible alternative would be to have one of the attendees take on the role of stakeholder(s) advocate.

Second, the trials, to date, have highlighted the difficulty of developing and maintaining an opportunity focus. In the first trial, the number of threats identified outnumbered opportunities by a factor of almost five to one, despite the best efforts of the facilitator. A more even balance was obtained from the next two trials, but some difficulties in promoting an opportunity focus remain. We are currently considering whether the workshop format might be modified to ensure that opportunities receive greater attention (for example, by making this ‘the first item of business’). As noted previously, we also believe that involvement of external stakeholders would lead to more emphasis on the identification and development of opportunities.

Finally, we recognise that one of the limits – as well as the strengths – of the risk assessment approach is that it encourages a very pragmatic approach to sustainability issues. The focus of the exercise is on identifying how sites can benefit from giving greater priority to these issues, and only indirectly on broader issues of corporate responsibility and civic obligations. While too much emphasis on these factors will risk being interpreted as moralising, there could well be a benefit in incorporating a more explicit discussion of values and key principles into the workshop discussion.

5 **Conclusions**

In general, the approach of applying qualitative risk assessment techniques to a range of sustainability issues was well accepted by participants, enabled some prioritisation of areas for urgent focus, and also identified key strategic themes for the operations concerned. The incorporation of opportunities into the process posed some challenges which require further development. This is an essential area to focus on in order to move beyond the traditional risk mitigation approach towards a more proactive approach to positive impacts, which can be realised by mining operations.

The mining industry’s contribution to sustainable development will ultimately be judged not by what is written in policy documents and public reports, but by what is happening ‘on the ground’ at individual operations. A major challenge for companies, therefore, is to find productive ways of engaging with sites about sustainable development issues. Corporate policy directives, reporting requirements,

and auditing procedures, can help reduce variations in performance between sites and raise minimum standards. However, something more is required to encourage sites to actively seek out opportunities to improve their sustainability performance. In this short paper, we have presented a potentially promising technique for using and extending standard risk assessment techniques to engage with sites about sustainability issues. We do not claim that it provides a comprehensive response to the many challenges that confront the mining industry in its efforts to translate policy into practice, but employed in conjunction with other organisational change strategies it can make a useful contribution towards this outcome.

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