PROMOTING SUSTAINABLE DEVELOPMENT IN THE MINERALS INDUSTRY: A MULTI-DISCIPLINARY APPROACH*

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**INTRODUCTION**

In the last few years, most of the key players in the Australian and international minerals industry have formally embraced the objective of sustainable development. In May 2003 the global peak association for the industry, the International Council on Mining and Metals (ICMM), released a sustainable development framework setting out 10 broad operating principles for the industry (ICMM 2003). To date, 15 major companies have undertaken to measure corporate performance against these principles. Within Australia, a process is underway through the Minerals Council of Australia (MCA) to convert the existing Australian Minerals Industry Code for Environmental Management into a vehicle that will facilitate implementation of the ICMM Principles. In addition, a group of leading companies has combined with WWF Australia to develop and trial a process for certifying individual mining operations, based on their compliance with these principles (Rae, Rouse and Solomon 2002).

The University of Queensland’s Sustainable Minerals Institute (SMI) has been established with the explicit purpose of assisting the minerals industry to respond to this emerging agenda. In this paper, I identify the main challenges that the industry faces in translating broad principles and policies relating to sustainable development into improved practices at the operational level, and describe how the SMI, through its research and educational activities, is working with the industry to address these challenges. The paper focuses particularly on the SMI’s efforts to address sustainability issues from a multi-disciplinary perspective.

**WHAT DOES SUSTAINABLE DEVELOPMENT MEAN FOR THE MINERALS INDUSTRY?**

Although the term sustainable development is now widely used within government, business and the wider community, there continues to be much debate about the scope and practical application of the concept. The generally accepted starting point for any discussion is the Brundtland Commission statement that sustainable development is:

> Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987: 43)

However, this ‘is a deceptively simple formulation … [that] has multiple layers of meaning and some profound implications’ (International Institute for Environment and Development, 2002: 21). Indeed, the very broadness and ambiguity of the definition, which allows sustainability to mean different things to different actors, is undoubtedly one of the keys to its popularity.

There are some who argue that mining is fundamentally incompatible with sustainable development, because it involves the extraction of non-renewable resources. From this perspective, the best that the industry can hope to do is to minimise its ‘footprint’ and improve resource efficiency. The alternative view is that mining can actually contribute positively to sustainable development by transforming physical resources (which would otherwise not be utilised) into new forms of economic and human capital, and by leaving a positive legacy in the areas where mining has taken place. These divergent perspectives
reflect two different approaches to operationalising sustainable development: the ‘narrow’ model which focuses on protecting the stock of natural capital (that is, the physical and biological environment) and the ‘broader’ model, which argues that sustaining communities and building the stock of human and social capital are equally important objectives.

The mining industry, not surprisingly, has been more comfortable with the broader conceptualisation of sustainable development than the narrower, ecologically-focused, version. Within these parameters, sustainable development has been used as a shorthand term to describe a range of good practices in managing health and safety, environment and community (HSEC) issues. Foremost amongst these practices are:

- adoption of a ‘beyond compliance’ philosophy by companies and individual sites
- a strong focus on resource use efficiency and waste minimisation (that is, ‘eco efficiency’)
- responsible stewardship of the natural environment
- mine closure policies that aim to leave a positive long-term legacy – both environmentally and socially
- responsible and safe workforce management practices
- sensitivity to local community concerns, combined with a commitment to advancing the long-term social and economic well-being of communities affected by mining
- integration of economic, social and environmental considerations into corporate decision-making processes.2

Companies that are committed to sustainable development need to be able to find ways of achieving ongoing improvement in all of these areas, while remaining profitable, continuing to build value, and coping with the vagaries of the global market for minerals.

**IMPLEMENTING SUSTAINABLE DEVELOPMENT PRINCIPLES IN THE MINERALS INDUSTRY**

The mining industry has been a pacesetter in addressing issues arising from the new sustainable development agenda. As noted at the outset of this paper, in recent years there has been a strong focus on developing industry wide codes of conduct and engaging with external critics through initiatives such as the Mining, Minerals and Sustainable Development (MMSD) project (International Institute for Environment and Development, 2002). In addition, most of the larger players in the industry, and several of the smaller ones, have publicly embraced sustainable development principles and are now attempting to incorporate these into their policy frameworks and management and control systems (Brereton, 2003). It is now commonplace, for example, for companies to report publicly on their social, environmental and health and safety performance, as well as their economic performance.

2 The ICMM’s Sustainable Development framework focuses on similar themes (ICMM 2003).
Although significant headway has been made, major challenges and obstacles remain, particularly at the operational levels of the industry. There is still a tension in many companies between the stated commitment to improving environmental and social performance and the traditional focus on production, profit and cost minimisation. Senior management may talk about the need to embrace environmental and social objectives, but much of the day-to-day focus, particularly at the level of individual sites and business units, continues to be on increasing production and containing costs – ‘the dig and deliver’ model. Thus in most cases managers are still more likely to lose their jobs because of cost overruns or poor production numbers than because of their failure to progress sustainable development objectives (with the possible exception of the area of workplace health and safety).

Despite the best efforts of advocates within and outside the industry, many industry personnel – especially at site level – remain sceptical about whether there is a strong business case for the industry to adopt a ‘beyond compliance’ approach to social and environmental performance. This is particularly true for established sites, which are often ‘locked-in’ to particular technologies, and have entrenched patterns of working and ways of relating with local communities. Also, outside of a few places such as Kwinana in Western Australia, it is difficult to find examples of operations actively pursuing opportunities to cooperate with other companies in developing resource use synergies. Similarly, the idea of product stewardship – which involves active collaboration between different operations in the same product chain around issues such as product design and re-cycling – is still much more talked about than acted on.

**WHAT IS NEEDED?**

Narrowing the gap between policy and practice is a critical challenge for the minerals industry, because its performance will ultimately be judged by what is happening ‘on-the-ground’, not by words and formal policies. Meeting this challenge will require action on a number of different fronts, more or less simultaneously.

Needless to say, there must be a concerted effort to develop new technologies that are capable of delivering not simply incremental gains in eco-efficiency, but ‘Factor X’ improvements. From a technological standpoint the industry has to be able to change the direction in which it is heading, rather than just continuing in the wrong direction more slowly. At the same time, however, it must be recognised that improving sustainability performance is not simply a technical problem. Often, the obstacles to achieving improved eco-efficiency outcomes and creating regional and supply change synergies are organisational and cultural, rather than technical: the technology exists, but for one reason for another sites and companies are reluctant to adopt it. Another reason for not seeing sustainable development as just a technical problem is that, as discussed earlier, the ‘broad’ model of sustainable development is concerned not only with the sphere of natural capital (that is, ensuring that physical resources are managed in a sustainable manner) but the management of social and human capital. These types of issues can rarely be resolved by resort to technological solutions.

So what else is needed, apart from technological innovation, to drive the sustainable development agenda forward?
First, substantial changes will have to be made in how organisations are designed and managed. It needs to be made clear to companies, and the people working in them, that it is in their interest to devote resources, time and attention to improving sustainability performance. This will require the creation of stronger external and internal drivers of change, such as stricter project approval requirements, additional performance indicators and tighter accountability requirements for managers.

Second, new analytical tools and metrics are needed to support decision-making processes around sustainability issues; in particular, decision-making frameworks (such as life cycle analysis) that will enable greater integration of economic, social and environmental considerations, and which can assist in the analysis of whole systems. Relatedly, new organisational forms will have to be developed which facilitate the integration, rather than compartmentalisation, of different disciplines within organisations.

Last, and arguably most importantly, different skill sets and mindsets have to be developed amongst those currently working in the industry, and those who will be entering it in the future. Foremost amongst these ‘new competencies’ are:

- A ‘tolerance for dissonance and ambiguity’ (Batterham, 2003: 2175-2176). Industry personnel – and professionals in particular - have to recognise that problems and tasks cannot always be clearly defined in advance and that not everything that is important can be measured (or vice versa). They must be willing to contemplate and explore alternative scenarios, rather than following fixed pathways.

- An ability to communicate with and learn from other disciplines and to recognise that complex problems are best tackled from multiple perspectives.

- A capacity for systemic thinking and, in particular, the ability to identify and act on opportunities to build synergies across operations, companies and industries.

- The ability to engage with and persuade others, and to advocate effectively for sustainable development outcomes.

Addressing these diverse research and educational needs will require concerted effort not only by the industry itself, but also by universities and research organisations. In the remainder of the paper, I will focus on what one of these organisations, the SMI, is doing to equip the minerals industry to respond to these new challenges.

ABOUT THE SMI

The University of Queensland has an involvement with the minerals industry extending over 50 years, both in the role of educating mining and mineral processing professionals and in undertaking research to support the industry. Traditionally, there was a predominantly technical focus to the University’s involvement, but in recent years this has expanded to include a focus on environmental management, health and safety and corporate social responsibility.
In mid 2000 the Queensland Government announced a $10 million contribution to the University to support the establishment of the SMI. The Institute is an umbrella organisation which embraces all of the centres and divisions within the University that are active in research and education associated with the mining and minerals industry. The SMI’s function is to coordinate, and provide strategic direction to, the research and education activities of member centres and divisions, around the broad theme of sustainable development. (Please refer to Figure One at the end of this paper for a diagram showing the structure of the SMI).

The SMI framework is unique in that it accommodates a wide range of disciplines, including mining and minerals processing engineers, geologists, metallurgists, risk analysis specialists, and social scientists. In addition, individual centres link with other disciplines and centres within the University on specific projects and research themes. For example, the Centre for Social Responsibility in Mining is currently involved in collaborative initiatives with the School of Social Sciences, the School of Geographical Sciences and Planning, the Business School, the School of Economics, and the School of Social Work and Social Policy.

The SMI is also involved in four cooperative research centres (CRCs): the new CRC for Sustainable Resource Processing; the CRC for Coal and Sustainable Development; the CRC for Mining and the AJ Parker CRC for Hydrometallurgy.

A condition of the financial support from the Queensland Government is that the SMI must, over a period, match the Government contribution with funds from both the University and industry. Companies can become members of the SMI by paying an annual subscription, in return for which they participate in the shaping of the research program.

A Board comprising representatives from the minerals industry, the Queensland Government and The University of Queensland, oversees the work of the SMI. In addition, an external Sustainability Advisory Group has been established, with representation from community groups and non-government organisations, to provide advice on the direction of SMI’s programs and ensure that the SMI and the Board are kept abreast of current thinking in the area of sustainable development.

The bulk of the research and teaching activity within the SMI is undertaken by individual centres or divisions, focusing on themes which align with the particular expertise of these units. However, those of us involved in the SMI recognise that, if this is to be more than simply a re-badging exercise, the Institute must provide direction and coherence to these activities and ensure that they are aligned with broader sustainability objectives. This challenge is being tackled in a number of different ways.

- At the broadest level, centres and divisions are expected to develop their strategic plans using the SMI plan as a reference point.
- SMI funding has been used to stimulate collaboration between individual centres on projects that address sustainability issues. For example, the CSRM and the

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3 Current corporate members are Anglo Coal Australia Pty Ltd (a subsidiary of Anglo American), BHP Billiton (Stainless Steel Materials Division), BHP Billiton Mitsubishi Alliance, Ensham Resources Pty Limited, Pacific Coal Pty Ltd (a subsidiary of Rio Tinto), Placer Dome Asia Pacific, RAG Coal International, and Thiess Pty Ltd. More companies are expected to join in the near future.
Minerals Industry Safety and Health Centre (MISHC) have recently collaborated on a project on workforce turnover in remote mining operations, which is an important sustainability issue for the metalliferous sector. (Beach et al, 2003). Similarly, the Centre for Mined land Rehabilitation and the W.H. Bryan Geology Research Centre are currently involved in a joint project on ‘Quantifying risk to reduce and manage uncertainty in rehabilitation sign-off for closure’.

- Directors and heads of the individual work units meet regularly to review and plan the activities of the SMI and exchange information.
- Various events, such as an annual SMI research day and periodic seminars, have been organized to encourage interaction between staff of the different centres.
- Where appropriate, shared supervision arrangements have been established for postgraduate students.

The SMI is still some way off from having a fully integrated response to the challenges posed by sustainable development. The individual centres continue to operate within different disciplinary frameworks, obtain their funding from different sources, and interact with different external reference groups. However, the SMI structure has been successful in bringing about a greater alignment of the activities of these diverse organisational components and in encouraging cross-disciplinary dialogue and collaboration. We are confident that these processes will lead to further synergies in the future.

**RESEARCH ACTIVITIES**

Details about current SMI research activities can be readily obtained from the SMI website (www.smi.uq.edu.au) and, through it, the sites of the individual centres. In broad terms, the types of research activities carried out under the auspices of the SMI can be grouped under four headings.

1. Research to develop new technologies and processes (e.g. reduction in comminution energy use; integrating grinding capacity into mine planning)

2. Research to identify ‘good practice’ in sustainable development and how it can be achieved (e.g. grazing trials on rehabilitated mine land, management of workforce turnover, Indigenous employment in the mining industry)

3. Development of information resources for use by industry (e.g. the National Minerals Industry Safety and Health Risk Assessment Guidelines developed by MISHC, and CSRM’s Social Indicators database for mining communities)

4. Development of diagnostic tools for industry (e.g risk analysis techniques, sustainability opportunity and threat assessments, sustainability metrics)

In addition, through the SMI’s involvement with the new CRC for Sustainable Resource Processing, there is an emerging research focus on regional and supply chain synergies.

To date, the bulk of the research undertaken within the SMI has been conducted within individual centres or on a bi-lateral basis between centres and divisions, but broader
organising themes are beginning to emerge. One of these themes relates to the management of risk in the planning, management and closure of mining operation. Most centres within the SMI are already involved in addressing risk issues in some form or another, whether this relates to workplace health and safety, mine site rehabilitation, community relations, or the design of new production processes. We are currently exploring ways in which the expertise that different centres have in this area can be brought together into a comprehensive framework for assessing and managing key sustainability risks (both threats and opportunities) within the industry. Mine closure is another organising theme that is likely to involve several centres.

THE SMI’S EDUCATIONAL ROLE

At the undergraduate level the SMI, through the CSRM, has assumed responsibility for coordinating a first year elective course, entitled ‘Sustainable Development of Resources’, which is offered as part of the common first year in the Engineering program. Other staff teaching in this course come from the mining engineering, minerals processing, geological sciences and environmental science areas. The course covers topics such as basic principles of sustainable development, socio-economic aspects of minerals development, land use planning, Native Title and Indigenous issues, minerals resource extraction processes, and the environmental impacts of mining and minerals processing.

The course is a bit unwieldy because of the number of teachers involved and there could be better integration between the various sections. On the positive side, however, the students attracted to the subject have been enthusiastic about the subject matter, and have displayed a healthy willingness to think ‘socially’ as well as technically. The main drawback is that the course is still only an elective and enrolments have been relatively modest (around 40 students this year). Not surprisingly, the majority of students who enrol in the course self-select on the basis of a prior interest in the area. In addition, the course is only offered at first year: there is not yet space in the curriculum to present related courses in the later years of the mining engineering and minerals process engineering programs.

The other main point of connection between the SMI and the undergraduate program is through a mine planning course for final year mining engineering students. This course, which is coordinated by Professor Jim Joy of MISHC, requires students to work in teams to address a variety of problems and challenges relating to the running of a hypothetical mine. The skills that this course is seeking to develop - problem-solving, teamwork, the ability to analyse issues from multiple perspectives - are at the core of ‘sustainability thinking’. For example, in a recent exercise the students were required to consider the likely impact of a new roster structure and the establishment of a ‘drive-in drive-out’ camp on the adjoining community. As part of this exercise, the students had to identify the various stakeholders who were likely to be affected by these changes, indicate how they would engage with these stakeholders, and suggest strategies for minimising the adverse impacts of the proposed changes on the local community. This exercise proved to be extremely valuable in highlighting to students the need to think more broadly about the consequences of what, at first instance, might look like strictly operational decisions.

At the postgraduate level, the SMI administers a flexible and modular Master of Mineral Resources program which leads to formal qualifications in the form of a Graduate
Certificate, Postgraduate Diploma or Masters Degree. This program can be taken at a number of different levels in different fields. Two fields of study are of particular relevance to the area of sustainable development - risk management and environmental management. In addition, the CSRM is currently offering a course in the environmental management program entitled ‘Community Aspects of Minerals Resource Development’.

Both the risk management and environmental management programs are offered on-line, to enable them to be accessed by industry personnel working ‘in-the field’. Unlike many other Web-based courses, which are little more than a set of reading materials accessible electronically, these courses have been designed to encourage students to engage actively with the material (Drinkwater and Kelly, 2003). The longer term strategy is to develop a suite of such courses addressing the different dimensions of sustainable development.

The SMI is also building an active postgraduate research program in the area, with several doctoral students now working on projects that explicitly address sustainability themes.

Finally, mention should be made of the work that has been carried out under the auspices of the Minerals Industry Tertiary Education Council (MTEC). Through MTEC, a consortium of institutions, including the University of Queensland, is being funded to develop a comprehensive set of undergraduate and professional development courses accessible to students throughout Australia, including via the Web. The University of Queensland is responsible for the design of several modules in this program, one of which addresses ‘external issues’ in mine planning and design. This module has a strong focus on environmental and community impacts of mining and will introduce undergraduate students to broader issues relating to sustainable development and corporate social responsibility.

Looking to the future, the main challenges for the SMI on the educational front are to:

- ensure that sustainable development themes become part of the core curriculum of the undergraduate mining-related programs offered at The University of Queensland
- continue to develop forms of teaching that convey not just content knowledge about sustainable development, but also build the skills and mind sets required to support sustainability thinking
- develop a broader range of professional education activities, such as workshops and short courses, for engaging with industry professionals – especially operational level personnel – around sustainable development themes
- achieve greater integration of different disciplinary perspectives within new and existing course offerings
- continue to build the postgraduate research program.

The SMI is also committed to maintaining the emphasis on flexible learning and remote delivery and to further developing the pedagogical strategies required to support this focus.
CONCLUSION

Increasingly the minerals industry is embracing sustainable development principles, but much of what has occurred to date has been focused on the level of language and policy, rather than on the operational sphere. If the momentum for change is to be maintained it is critical that these broad principles and commitments are translated into improved performance ‘on the ground’. This will require a concerted effort by the industry, supported by educational and research bodies, to develop new skills, new knowledge and new ways of doing business.

The SMI aims to contribute to this change process by undertaking applied research that addresses concrete problems, and by equipping students and industry personnel with the skills and knowledge required to progress the industry’s new sustainability agenda. Hopefully, this short paper has provided some useful insights into what the SMI has achieved to date in this regard, the directions in which it is heading, and the challenges that remain.

REFERENCES


Beach, R, Brereton, D and Cliff, D 2003, Workforce Turnover in FIFO Mining Operations in Australia: an Exploratory Study, Centre for Social Responsibility in Mining, St Lucia.


Figure One

Funds from The University of Queensland

Funds from Qld Government

SMI

Funds from industry

Funds for SMI projects controlled by SMI Board

Division of Mining and Minerals Process Engineering (DMPPE)
Division of Earth Sciences (DES)
Julian Kratzschinn Mineral Research Centre (JMKRC)
Centre for Mine Land Rehabilitation (CMLR)
WH Bryan Geology Research Centre (BRC)
Minerals Industry Safety and Health Centre (MISHC)
Centre for Social Responsibility in Mining (CSRMIN)
Centre for Water in the Minerals Industry (CWMI)

Funds from industry and other sources for Independent Centre/Division projects