Innovating your way to sustainability in the mining and mineral processing industries

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Sustainability principles generally accept that human society should use our finite natural resources in a productive and beneficial way. Provided, of course, that the use does not negatively affect either present or future users of that resource, nor affectt any ecological systems. There is a debate about the approach to take and this article seeks to ask: is there a new sustainability perspective for mining? Can innovative systems thinking replace a largely compliance-orientated approach?

Contemporary society demands extraction of metals as useful (perhaps necessary) materials of construction and manufacture while, conversely, demanding 'no harm' behaviour in the extraction operations. Herein lies the crux of the problem from the traditional view of the persecuted miners who argue, 'You can only have one or the other'.

Such an historical perspective elicits memories of the old 'them and us', miner vs. environmentalist attitudes of the not-too-distant past. Today, it is generally the case that (with some suspicion) the two sides approach each other in a curious and conciliatory mood—a little like a first dance. They want to get along, but are not sure what the dance steps are. For the industry, it is still a struggle to interact effectively when it is that attitude from the past that ties us to a compliance point of view.

By 'compliance point of view' we mean that the thinking is deeply seated in the expectation that meeting a standard is what we have to do (or all that we have to do). These are standards of environmental performance, social performance or corporate ethical behaviour. In other words' obtaining a 'licence to operate'. Not only this, but the 'compliance' view locks us into thinking that the environment 'costs money'. There is a knee-jerk reaction that having a 'nice' environment will suppress profit and therefore should be resisted. This, of course, is not restricted to the mining sector.

The last 2–5 years have seen tremendous leaps in mining company attitudes and behaviours—probably not visible enough to be appreciated publicly. However, it could be argued that this welcome progress has been made almost entirely in a compliance framework. There are dozens of sustainability reports in circulation now and a reader will struggle to find one that has anything other than compliance orientated reporting. The reports tend to suffer another affliction too: 'conformance-think' or a cookie-cutter approach that the GRI 'Global Reporting Initiative' has helped create and is consequently relied upon to assuage fears of not measuring up in sustainability terms. This is also a necessary risk-reduction (compliance) strategy trying to insulate companies from community expectations that are changing at an accelerating rate.

What sort of opportunities are we missing by looking at it from only this compliance standpoint? Is there another perspective that can take us away from compliance-think?

A few colleagues at Hatch have developed the conviction that innovation might be the way to address the trade-off mentality that compliance-think means. We have begun using a 4-quadrant analysis methodology, inspired by an environmental impact versus cost, decision-making tool developed by BASF in Germany (Saling, 2002). The core principle is that we use innovation to drive initiatives that lower cost and impacts at the same time. The types of impact measured or assessed vary from project to project and study to study, but normally things like energy intensity, water intensity and social impact, among others, are used (and when combined for analysis, we call it an aggregated footprint measure). It is simple, but dramatic in its effect on decision-making. Primarily because the method is graphical (plotting cost vs. footprint) it can transform the single-dimension thinking of traditional NPV[1] -driven analysis into a two-dimensional assessment. This is wonderfully mind-expanding and thought provoking. It demotes trade-off type decisions around cost and footprint.

Having tools that encourage 'innovation-think' as opposed to 'compliance-think' are basic building blocks for bringing those sustainability concepts into the industry.

A significant thread running through this is eco-efficiency, which has inherent appeal within our sector. Reductions in waste, water intensity and energy intensity are common practice already (inherited from the compliance-think regime) and are suited to innovation driven eco-efficiency guidelines as well.

At best though, eco-efficiency is a halfway house: we need more. A set of operational principles that encapsulates the concepts is an important grounding, and some suggest the four system conditions of The Natural Step[2] as the

[1]Net Present Value

[2]In the sustainable society, nature is not subject to systematically increasing… (1) …concentrations of substances extracted from the Earth's crust; (2) …concentrations of substances produced by society; (3) …degradation by physical means; (4) and people are not subject to conditions that systematically… …undermine their capacity to meet their needs.

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structure to use in forming strategies. It is amazing how the type of footprint measures needed for each study/project become obvious, when viewed from this framework. And if eco-efficiency is just one thread, we can add, one-by-one, additional sustainability concepts.

Perhaps the most potent one is whole-systems thinking[3]. This concept is indeed powerful, as it introduces options not available by looking at things with a narrow perspective. The broader view considers the impact of possible improvements on all disciplines, plant areas or departments, where combined benefits may outweigh a marginal cost increase in one area. It is important to look at a package of improvements as a whole, where the combined effect of small savings in some components may add up to a large saving in others. In this way, one can see single design or operating initiatives acting to solve multiple problems[4].

Unfortunately, our contemporary reductionist approach to science and engineering has somewhat reduced our inventiveness in the engineering field, which is also bedevilled by a high-pressure, time-restricted and budget-restricted environment. 'Whole-systems thinking' is a great antidote to the loss of inventiveness.

At high levels at least, another thread can be the adoption of life cycle concepts, especially the oft-mooted use of life cycle analysis (LCA) methods for the mining sector[5]. Furthermore, looking at the life cycle of plant, equipment and materials (as distinct from the commodity itself) ensures that decisions made today will achieve the lowest cost and environmental impact over the full life of the operation. Too often a lack of information about the true performance and cost benefits of a better-engineered alternative leads to a poor investment in low quality equipment and systems (the 'easy option').

Other potential threads include bio-mimicry (and the related geo-mimicry) as well as the idea of delivering a user value and lower resource usage through ongoing services rather than a one-off product sale. They might find more widespread use and contribute to the innovation drive.

Finally, perhaps we can cite two examples where opportunities are there for the taking as illustrations of what can or might be achieved:

- Virotec International (www.virotec.com) have a recent example from trials of their new water treatment technology that is based on modified red-mud (a waste from alumina production) where considerable benefits were shown for a metallurgical plant at its water treatment facility that:
  - Produces an inert waste (in place of a toxic one), which will reduce disposal costs and considerably reduce environmental risks
  - Can eliminate three sludge-handling processes (settling/clarifying/filtration)
  - Can replace certain chemicals (lime, flocculent and others)
  - Has an AUSD 100-200k capital benefit (relocation of tankage)
  - Offers five per cent lower operating expenses than the existing plant
  - Uses someone else's (the alumina producer's) waste.
- The Fuel Cell Propulsion Institute (Canada) is experimenting with alternatives to diesel power for underground vehicles. A significant proportion of underground mining costs are attributable to the ventilation required to exhaust fumes, so if the vehicle emissions are now non-toxic a huge reduction in electrical power (for the exhaust fans) is realized. Significant capital cost savings also accrue from the reduction in the number/size of ventilation shafts, drives, tunnels and fans. Even allowing for hydrogen sourced from carbon-based sources, there are clear benefits for GHG emissions as well as benefits in costs, safety and health.

These are unmistakably examples where whole-systems-thinking can lead to significant benefits in both cost and footprint.

Becoming more sustainable is a particular challenge for an industry that depends on digging up non-renewable resources and turning them into window frames, car bodies and electricity. From inside the industry at least, we see a growing and genuine desire to be more profitable by designing and operating for sustainability. To do this, companies need the ability to adopt and demonstrate a process that conforms to the changing world paradigms.

Our industry, and its engineers in particular, must go beyond environmental planning and environmental engineering to develop a framework for delivering benefits that:

- Drive sustainability principles into the heart of the design and operation of mining enterprises
- Foster cross-disciplinary approaches to innovation
- Force decisions to be made with all technical, fiscal, environmental and social consequences clearly in mind
- Allow mining companies a methodology that demonstrates—to regulators, community, shareholders, financiers, and other stakeholders—a genuine commitment to sustainability.

Is there a new sustainability perspective for mining? Perhaps, but undoubtedly there is a different, alternative course and at the very least some of us should be breaking out of the compliance mould.

[3]For further information, the following link is useful: http://www.rmi.org/sitepages/pid153.php

[4]In some ways the concept is similar to that espoused in 'Permaculture' (see pp. 6–13 in Update 31 at www.bml.csiro.au/Snnewsletters.htm) where a useful principle is that 'The problem is the solution' – i.e., the circumstances of a problem always contain the seeds of its solution if looked at from the right direction.

[5]For more information on life cycle analysis with particular focus on mineral and metal commodities have a look at the following link: 'Tops at Recycling—Metals in Sustainable Development' on pp. 1–13 in Update 30 at www.bml.csiro.au/Snnewsletters.htm The article was written by Terry Norgate and John Rankin of CSIRO's Division of Minerals.

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