Chapter 15
Mining and Sustainable Development

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Abstract This aim of this chapter is to introduce the reader to the key elements of sustainable development. To achieve this aim, the chapter is subdivided into the following sections. Section one offers a short history of sustainable development in the mining industry. In the following section, an overview of sustainable development principles and frameworks are examined. The following three sections examine the relationship between a social licence to operate and sustainable development, and issues surrounding implementation and measurement. In the penultimate section, a case study of the Philippines is covered. The paper concludes that sustainable development is becoming increasingly central to the future of the mining industry in the region.

Abbreviations

4QA	Four Quadrant Analysis
ASM	Artisanal and small-scale Mining
GMI	Global Mining Initiative
GRI	Global Reporting Initiative
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
MMSD	Mining, Minerals and Sustainable Development
MMSS	Mining and Metals Sector Supplement
PNG	Papua New Guinea
SOHO	Sustainability Opportunities and Hazards Overview
SPeAR	Sustainable Project Appraisal Routine
UN	United Nations

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Introduction

The concept of sustainable development has emerged in the mining industry over the past three decades. Although sustainable development can cover a wide range of definitions and interpretations, it is viewed here as responsible development and growth, rather than one that refers to sustaining the industry itself. While I employ the term *sustainable development* in this chapter, the term *sustainability* is also used within the mining industry. It is also commonplace to see it used in other sectors as well, especially in the forestry and chemical industries. The difference between the two terms is debatable, but here 'sustainability' is regarded as the end goal of 'sustainable development' (Dunphy et al. 2000). Based on this distinction, the contemporary mining industry should focus on the sustainable development of the industry, as its contribution to the end goal is the sustainability of the planet's resources.

Since the industry began grappling with the concept of sustainable development, its perception has evolved from a broadly philosophical approach, promoted by senior corporate managers, to relevant initiatives at an operational level. Moreover, the motive for embracing sustainable development has changed and matured with time: from a philanthropic approach (it is the right thing to do) to a sound business strategy (shared value between industry and its stakeholders), although different companies and different parts of the industry are at various stages on this journey.

The most common definition of sustainable development is the Brundtland definition: 'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations 1987). This high-level definition of sustainable development is helpful from a global—and even a corporate—perspective. Yet for those working within the industry the definition generally is considered too abstract and removed from their day-to-day activities to be useful. Other definitions of sustainable development are similar in intent and do not effectively bridge this gap. Consequently, the mining industry over several years has attempted to develop frameworks and tools that will help deliver outcomes that support the aims of sustainable development and which can be measured with various indicators.

Approaches for generating sound and long-lasting sustainable development credentials are dependent on the region(s) in which the mining operations are situated. For instance, mining operations that are situated in dry, sparse, and remote regions have to deal with different sustainability issues compared with operations that are situated in wet, bio-diverse regions, surrounded by local communities. This contextual element means that solutions to address sustainable development issues need to be customised from site-to-site, requiring various degrees of innovation rather than a 'one size fits all' approach. Balancing these differing aspects for site-to-site, region-to-region, and country-to-country contexts requires multi-disciplinary and holistic approaches, which draw together people with technical, environmental, social, and financial expertise.

This aim of this chapter is to introduce the reader to the key elements of sustainable development. To achieve this aim, the chapter is subdivided into the following

sections: (1) a short history of sustainable development in the mining industry, (2) an overview of sustainable development principles and frameworks, (3) the relationship between a social licence to operate and sustainable development, (4) implementation of sustainable development, (5) measuring sustainable development, (6) a case study of mining activity in the Philippines, and, (7) the increasing importance of sustainable development for the mining industry.

Short History of Sustainable Development in the Mining Industry

While the ideals of sustainable development have been broadly articulated, promoted and applied by various sectors of society for at least half a century, the terms *sustainable development* and *sustainability* only really have gained significant traction with industrial organisations over the last quarter of a century. Seminal documents include:

- The Club of Rome's *Limits to Growth* (Meadows and The Club of Rome 1972),
- *Our Common Future* (often referred to as the Brundtland Report),
- International Union for the Conservation of Nature, and
- The United Nations World Charter for Nature.

These, and other documents, laid the foundations for a broader acceptance of sustainable development across civil society, government, academia, and industry. In particular, *Our Common Future* was a critical trigger for the 1992 Earth Summit, formally known as the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil. This conference produced the *Rio Declaration on the Environment and Development* (UNEP 1992) and *Agenda 21* (United Nations 1992), both of which aimed at fostering and guiding sustainable development across the globe (Dresner 2008).

These initiatives, and their respective outcomes, were instrumental in the mining industry's embrace of sustainable development principles. A milestone in heightening the acceptance of sustainable development in the mining industry was the Global Mining Initiative (GMI). The GMI was borne from a recognition by several mining industry Chief Executives that the industry needed to rethink the way in which it argued its case, and that sustainable development was an appropriate vehicle to achieve this (Littlewood 2000). The GMI led to a major study of mining and sustainability: *Mining, Minerals and Sustainable Development* (MMSD) (Littlewood 2000). Over forty companies and organisations contributed to the GMI and MMSD, with the aim of identifying the main challenges and possible strategies to foster a more sustainable future for the industry (Azapagic 2004). The MMSD offered an independent review of how the mining industry performed in relation to broad-ranging sustainable development issues and produced a final report called *Breaking New Ground*. This drew on the MMSD's two-year process of consultation and

research. At the time of publication in 2002, it described the industry's activities through the concept of sustainable development, and offered a detailed plan for immediate action on the environment (IIED 2002).

A key development catalysed by the GMI and the MMSD project was the creation of the International Council on Mining and Metals (ICMM), which in fact was a transformation of the International Council on Metals and the Environment through the broadening of the antecedent organisation's mandate. At the conclusion of the GMI, a major global conference, *Resourcing the Future*, was held in Toronto in 2002, and the ICMM member companies signed the *Toronto Declaration* committing the ICMM to continue the work started by the MMSD project and to engage in constructive dialogue with key stakeholders (ICMM 2015c).

Since the early part of this century, there has been a wide range of organisations assisting and/or working with the industry in operating and growing in a responsible and sustainable manner. In 2016, the ICMM has 23 mining and metals companies and 34 national and regional mining and commodity associations focused on addressing core sustainable development challenges, and is now an important institution for sustainable development in the mining industry (ICMM 2015a). Other national and industry bodies (for example, the Minerals Council of Australia and the World Gold Council), non-government organisations (for example, Oxfam), and research institutions (for example, the Sustainable Minerals Institute at The University of Queensland) are helping to deliver sustainable development outcomes across the mining industry.

Sustainable Development Principles and Frameworks

Sustainable development principles and frameworks have provided the catalyst for driving better overall industry performance. An important step for the ICMM in addressing the aforementioned challenges at the conclusion of the GMI was the adoption of ten guiding principles, which would become the first element of the ICMM's Sustainable Development Framework (Table 15.1).

The ten principles, and each principle's supporting statements, form the cornerstone of the ICMM's Sustainable Development Framework. The principles are well accepted by mining companies, and often corporate-level policies are aligned with the principles.

While the ICMM's work on sustainable development has been the flagship of the mining industry, other sets of principles, frameworks and standards have influenced the sustainable development performance of the industry. These include: *The Equator Principles*, *the United Nations (UN) Global Compact*, the International Finance Corporation's (IFC) *Performance Standards*, *the Dow Jones Sustainability World Index*, and the *Global Reporting Initiative* (GRI). A brief summary of each of these is presented in Table 15.2

Table 15.1 The ICMM's 10 guiding principles

1	Implement and maintain ethical business practices and sound systems of corporate governance
2	Integrate sustainable development considerations within the corporate decision-making process
3	Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities
4	Implement risk management strategies based on valid data and sound science
5	Seek continual improvement of our health and safety performance
6	Seek continual improvement of our environmental performance
7	Contribute to conservation of biodiversity and integrated approaches to land use planning
8	Facilitate and encourage responsible product design, use, reuse, recycling and disposal of our products
9	Contribute to the social, economic and institutional development of the communities in which we operate
10	Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders

Source: ICMM (2016)

Table 15.2 Relevant sustainability principles, frameworks, and standards

The Equator Principles	Risk management framework adopted by financial institutions for determining, assessing, and managing environmental and social risk in projects
The UN Global Compact	A strategic policy initiative for businesses committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labour, environment, and anti-corruption
IFC Performance Standards	Defines IFC clients' responsibilities for managing their environmental and social risks
The Dow Jones Sustainability World Index	Tracks the stock performance of the world's leading companies in terms of economic, environmental, and social criteria
The Global Reporting Initiative	A framework providing metrics and methods for measuring and reporting sustainability-related impacts and performance within organisations

There are also examples of sustainable frameworks that, although applicable to the mining industry across the world, have been developed by regional organisations. For example, the Minerals Council of Australia developed the framework, *Enduring Value*, which builds on the Australian Minerals Industry Code for Environmental Management, to provide implementation guidance on the ICMM's ten Principles and their application at the operational level (MCA 2005). Another example, which emerged from North American regional activity associated with the MMSD, is the *Seven Questions to Sustainability* framework. The aim of this framework is to provide a guide for the assessment of whether or not the net contribution of a project to sustainability is positive over the long-term (International Institute for Sustainable Development et al. 2002).

Table 15.3 Features of the Five Capitals

Natural Capital	Refers to the natural resources (matter and energy) and processes that produce and deliver goods and services. They include renewable and non-renewable resources, sinks that absorb, neutralise or recycle wastes, and processes, such as climate regulation, which maintain life. Natural capital forms the foundation for all other capitals
Human Capital	Consists of people's health, knowledge, skills, motivation and capacity For relationships. These facets are required for productive work, and the creation of a better quality of life. Human capital can be fostered through improving opportunities for learning, creativity, stimulation and enhanced health
Social Capital	Concerns the institutions that help societies maintain and develop human capital in partnership with others. It includes such institutions as families, communities, businesses, trade unions, schools, and voluntary organisations. A critical component of social capital is the development of trust
Manufactured Capital	Comprises material goods, or fixed assets, that contribute to the production process or the provision of services, rather than being part of the output itself. It includes, for example, tools, machinery, buildings and infrastructure
Financial Capital	Plays a critical role in our economy, enabling the other types of capital to be owned and traded, for example, through shares, bonds or banknotes. Financial capital is the traditional primary measure—the 'single bottom line' of business performance and success

More recently, Moran and Kunz (2014) developed a hierarchical framework to assess the progress of mining, minerals and energy supply and demand networks toward sustainable development. The framework begins at the global level and ends with the unit level. The novelty of this framework lies in the phrase 'operating sustainably', rather than simply 'sustainable mining', as 'it is more inclusive that mining *per se* and addresses more of the value chain and commodity use and re-use' (Moran and Kunz 2014).

A more general sustainable development framework that has gained a growing degree of traction in the mining industry is the Five Capitals Model. It provides a helpful basis for conceptualising sustainability/sustainable development and uses the concept of capitals—natural, human, social, manufactured and financial—to encompass the dimensions of sustainability (Forum for the Future n.d.). An important understanding is that financial capital is a function of the other four capitals and has no intrinsic value on its own, but rather is a mechanism for trade between the other capitals. Descriptions of each capital are provided in Table 15.3.

The Five Capitals model can be extended to include a sixth capital, Intellectual Capital, which comprises organisational, knowledge-based intangibles, including intellectual property—patents, copyrights, software, rights, and licences (Corder et al. 2014)—with this model having now been adopted by some mining companies (Exxaro.com 2015).

Social Licence to Operate

While sustainable development principles and frameworks typically are focussed on the developers and operators of mining projects, the concept of the 'Social Licence to Operate' is associated with stakeholders' acceptance of, or acquiescence in, mining activities. The term has become entrenched in the language of the mining industry, even though as a concept it can have a range of interpretations, which often are dependent on one's perspective. From a sustainability perspective, it is a highly relevant concept, as it reflects the relationship and influence that critical stakeholders have with mining operations, projects, and companies. While the term, 'licence to operate', means, in general, acquiring the necessary approvals from the relevant regulatory authorities and is clearly defined in one or more formal outputs, social licence to operate is less tangible. However, it does encompass local, regional, and national interests associated with mining developments, and if stakeholders believe that these interests are compromised, mining operations can lose their social licence (Corder et al. 2014). An operation could consider to have a social licence to operate when it achieves ongoing acceptance or approval from the local community and other stakeholders who can affect its profitability; without this social licence, it is difficult for a mine to operate effectively or profitably.

The connections between the concepts of social licence to operate and sustainable development are palpable. Most of the sustainable development principles presented earlier relate to the benefits and impacts on affected stakeholders who, directly or indirectly, influence social licence. In fact, personnel working for the mining industry either have viewed sustainable development as interchangeable with social licence to operate, or as an umbrella under which social licence to operate is described as the product of social sustainable development (Lacey et al. 2012).

The growing importance of the concept of the social licence to operate has been well documented by scholars studying the social aspects of the mining industry (Owen and Kemp 2013; Prno 2013; Prno and Slocombe 2012; Solomon et al. 2008). The social dimensions of the mining industry now are becoming critical to business success, yet in many ways these aspects are the most challenging in terms of the business concept of sustainable development (Solomon et al. 2008). The traditional approaches to extractive developments no longer suffice for local communities and affected stakeholders. They are now demanding a greater share of benefits and increased involvement in decision-making, with these demands aligning closely with the sustainable development principles and policies espoused by the mining industry.

In a similar vein, Prno and Slocombe (2012) concluded that it is widely recognised that mining companies need to gain a social licence to operate from local communities in order to avoid potentially costly conflict and exposure to social risks. In a later article, Prno (2013) conducted a comparative case study of four international mining operations: Red Dog Mine in Alaska; Minto Mine in the Yukon, Canada; the proposed Tambogrande Mine in Peru; and the Ok Tedi Mine in Papua New Guinea (PNG)—in an effort to identify the key determinants of social licence

to operate outcomes in the mining industry. Five lessons for earning a social licence to operate emerged from this analysis: (1) context is key, (2) a social licence to operate is built on relationships, (3) sustainability is a dominant concern for communities, (4) local benefits provision and public participation play a crucial role, and, (5) adaptability is needed to confront complexity. Again these lessons align closely to core principles of sustainable development discussed earlier in this chapter.

Owen and Kemp (2013) claim that, while the social licence to operate as a concept has highlighted in a positive fashion the profile of social issues within the industry, it has not been able to articulate a collaborative developmental agenda or a pathway forward for restoring the lost confidence of affected communities, stakeholders, and pressure groups. They argue that the industry needs a less defensive and more constructive approach to stakeholder engagement and collaboration and, as a first step, should reconcile its internal risk-orientation with the expectations of external stakeholders. This exemplifies the potential for a breakdown in communication between the industry and affected stakeholders, due to the inability collectively to adopt a common language for developing a shared agenda.

These findings show that social licence to operate is inextricably linked to sustainable development. While the concept of the social licence to operate is not easily defined and is even harder to acquire, it is not possible to imagine that an individual mining operation, a new mining project, or a mining company will be able to gain and maintain a social licence to operate without meeting the ideals of sustainable development. In addition, a mining operation, a new project, or a mining company needs a social licence to operate to ensure a long-lasting and successful business to reduce the likelihood of project delays and/or production stoppages, which quickly and seriously can affect revenue and, accordingly, profits. What this means is that setting and delivering on a sound and thorough sustainable development agenda is critical for business success in the mining industry today. Key to this success is the idea that sustainable development is based on mutual benefit and robust relationships between the industry and affected stakeholders, as opposed to a solely philanthropic approach, typified by one-off financial payments for institutions, such as hospitals, schools, and public amenities and services.

Implementing Sustainable Development

An important challenge for the mining industry concerns how to implement systematically and rigorously initiatives that satisfy the core aims of sustainable development and, in so doing, achieve a social licence to operate. Since the turn of the century, and in some cases earlier, a range of approaches have been developed by industry that aim to incorporate into, and/or assess, sustainability aspects of the project design process and management systems. Several engineering companies and consultancy firms have developed their own tools and methodologies for assessing or incorporating sustainability into their projects (Table 15.4).

Table 15.4 A sample of sustainability tools utilised by industry

Tool name	Description
Sustainable Project Appraisal Routine (SPeAR®)—ARUP	SPeAR®, originally developed for the built-environment and infrastructure project business sectors, but which now has been applied more widely, appraises projects based on key themes (e.g., transport, biodiversity, culture, employment, and skills) and utilises a traffic light system graphically to indicate performance in each area (ARUP 2013)
GoldSET—Golder Associates	GoldSET is a set of web-based tools to evaluate alternatives, or to monitor on-going projects based on geospatial information management, forecasted project performance, and utilising multi-criteria analysis (Golder Associates 2014)
Four-quadrant analysis (4QA), sustainability opportunities and hazards overview (SOHO), FutureWatch™—Hatch Associates	A suite of tools, utilising a range of workshop programs, for identifying opportunities and hazards, as well as assessing sustainability performance using contemporary thinking around sustainability (Medveçka and Bangerter 2007)
EcoNomics™—WorleyParsons	EcoNomics™ comprises three components—sustainable decisions, sustainable project delivery, and sustainable operations—as well as a carbon management service, Carbon EcoNomics™, and is aimed at enhancing risk management and improving sustainability performance across the asset life-cycle (WorleyParsons 2014)

Characteristics of the above approaches include the comparison of different sustainability impacts through schematic diagrams, sustainability opportunities and threats analyses, and economic valuation of sustainability impacts. In addition, individual mining companies also have produced their own tools to develop better sustainability outcomes.[1] Moreover, the ICMM has produced a range toolkits to assist with the implementation of good sustainability practice, covering community development, materials stewardship, partnerships and mine closure planning (ICMM, 2015b). For example, the Community Development Toolkit comprises a set of 20 tools providing guidance on the community development process, from exploration, through to closure and maintenance (ICMM 2012).

Furthermore, the Australian government has supported the development of the *Leading Practice Sustainable Development Program for the Mining Industry*, which aims to promote sustainable development and industry self-regulation through the adoption of leading practice principles. The outputs of the program, which are in the public domain, comprise 15 handbooks relating to sustainable development topics, such as biodiversity management, community engagement and development, mine closure and maintenance, stewardship, water management) in the mining industry, as well as a companion publication to the handbooks called the

[1] For example, Anglo American's Socio-Economic Assessment Toolbox (SEAT) (Anglo American 2014) and the company's Mine closure Toolbox (Anglo American 2013).

Social Responsibility in the Mining and Metals Sector in Developing Countries (Australian Government 2015).

Although there is a range of tools and methodologies that attempt to incorporate sustainability concepts at the design and operational level of mining projects, McLellan et al. (2009) have argued that there is no consistent, integrated approach to support the mining industry in incorporating a greater level of sustainability into the design process. As a result, many of the aforementioned approaches have not gained the necessary traction with the project management systems that drive the development of a new mining projects through the project phases (concept, prefeasibility, feasibility, etc.), nor have they been consistently applied on an industry-wide basis for improving the overall sustainability performance of an mining operation on a year-by-year basis. Since McLellan et al.'s (2009) article, there has been some progress in this area, for example, the *Initiative for Responsible Mining Assurance's Standard for Responsible Mining* (IRMA 2015).

In Australia, the *Cooperative Research Centre for Sustainable Resource Processing* developed the SUSOP (Sustainability Risks and Opportunity) framework through a collaborative research project with the aim of producing a sustainable development standard for project and operational engineering (Corder et al. 2012a). There were several reasons for its development, including the absence of an industry standard for sustainable design of industrial processing plants, government initiatives not focusing on a whole-systems approach, and the lack of sustainability objectives to guide project design and operational activities. While the SUSOP framework has been well documented elsewhere (2013; Corder et al. 2013, 2012a, b; Corder and Green 2011, 2012). A brief summary is provided here.

The SUSOP framework utilises the Five Capitals Model to facilitate a contribution to sustainability by the industrial facilities being studied, designed, built, or operated. It uses a multi-disciplinary study team of technical, environmental, social, and management practitioners, and comprises three major elements:

- Sustainability opportunities and risks identification,
- Preparation of action plans for conducting a detailed evaluation of the shortlisted or high-priority opportunities and risks, and
- Decision support for providing assistance with decision-making at the end of project phases.

The SUSOP Knowledge Base supports the framework and the main outputs are recorded in a sustainability register, which works in a similar manner to a conventional risk register, and includes sustainable development balance sheets to show schematically the positive and negative impacts across the Five Capitals Model.

In essence, all of the above approaches have an overriding aim of assisting the initiation, design, and delivery of enhanced sustainability outcomes in the mining industry. Even though there are numerous examples throughout the industry of good sustainable development initiatives, examining and evaluating potential initiatives has not become routine engineering practice in the same uncompromising way that safety is treated in the industry. Accordingly, many initiatives that have implemented and achieved sound sustainable development credentials have resulted in productive outcomes.

Measuring Sustainable Development

An important aspect of implementing sustainability in the mining industry, particularly for technically oriented personnel, is the ability to measure sustainability performance, both quantitatively and qualitatively. This can be for assessing the sustainability benefits of different project options, or for determining sustainability improvements of an operation on a regular (annual) basis. Sets of indicators and examples are presented below.

Shortly after the release of the outcomes of the MMSD project, Azapagic (2004) proposed a framework for sustainability indicators as a tool for performance assessment and improvement, specifically for use by the mining industry. The framework recognised that that the indicators, which covered economic, environmental, social, and integrated aspects, could be used both internally, for identification of problem areas, and externally, for sustainability reporting and stakeholder engagement. The framework was compatible with the Global Reporting Initiative (GRI) indicators, with the inclusion of several sector-specific indicators to reflect the industry's characteristics, such as closure and rehabilitation, mineral resources, resettlement, and fly-in and fly-out (Azapagic 2004).

This work was the forerunner for the development of the Mining and Metals Sector Supplement (MMSS). The MMSS was developed through a multi-stakeholder working group and is now used by organisations in the mining industry to cover key aspects of sustainability performance which are not sufficiently covered by GRI guidelines (ICMM 2015d). The current version, *Mining and Metals Sector Disclosures*, includes specific indicators for aspects such as materials, biodiversity, effluents and waste, labour/management relations, local communities, artisanal and small-scale mining, resettlement and closure planning (GRI 2013). The full set of indicators covers the following sustainability themes: economic, environmental, labour practices and decent work, society, and product responsibility (GRI 2012).

Mining, Sustainable Development and The Philippines: A Short Case Study

Mining has been an important part of the economy of the Asia-Pacific Region. Countries such as China, Indonesia, Malaysia, The Philippines and Papua New Guinea each have had a long history of mining. More recently, countries including Laos, Myanmar (Burma), Cambodia and Vietnam have seen the growth of their mining industries, or the potential for growth therein.

While there have been obvious traditional economic benefits from mining developments, including jobs, business activity, taxes and royalties, there also have been some negative impacts from mining, which adversely have affected the development of new and future mines. For example, the government of The Philippines estimates the country's mineral wealth is $1 trillion (comprising the second-largest

gold deposits after South Africa, one of the largest copper deposits in the world, and rich nickel, chromite, and zinc deposits) (Greenlees 2008). However, even though foreign ownership of mines is permitted in the country, the level of foreign investment is low as major mining companies have been cautious in developing new projects. A crucial reason for this is that mining suffers from a significant domestic image problem as a result of past serious environmental damage, which has antagonised local communities and powerful interest groups, including the Catholic Church (Greenlees 2008).

The most significant environmental incident was the Marcopper copper mine disaster in 1996, on the island of Marinduque. A fracture in the drainage tunnel of a large pit containing old mine tailings led to a discharge of toxic mine waste into the Makulapnit-Boac river system and caused flash floods in areas along the river. While the owners (including the Canadian company, Placer Dome) paid $70 million in compensation to affected villagers, the event led not only to a strong backlash against the mining industry by communities and environmentalists, but was followed by a legal challenge to the 1995 mining law that allowed foreign interests to wholly own a mining operation. This effectively stopped new foreign investment, and was not resolved until 2005, when the country's Supreme Court upheld the constitutional validity of the law (Greenlees 2008).

The Marcopper disaster illustrates the critical influence that such an event can have on future mining development in a locality, region, or at a national level, even when there is huge mineral wealth in geological terms. Although there have been few major mining projects since the mid-1990s (the Tampakan Copper-Gold Project in Mindanao (SMI Inc. 2015) being the main exception), a substantial artisanal and small-scale mining (ASM) industry has emerged in recent times, with many of the operations being performed illegally, and without the usual safety and environmental practices required by legal operations (Scholz in this volume). At the gold-rich Compestela Valley of the Philippines, 36 miners were killed on 5 January 2013 after heavy rainfall triggered a landslide, even though the government had previously ordered the miners off the land due to safety concerns. However, the miners had returned once they recognised that there was no enforcement of the order (GBR 2013). The lack of resources for enforcement of government orders, coupled with the economic circumstances of miners, produces a complex set of issues that in the longer-term is unsustainable.

While other countries in the region have had similar concerns or issues with mining development (for example, Papua New Guinea as a result of riverine tailings disposal at Ok Tedi, or the unrest that precipitated the closure of the Bougainville Copper Mine in 1989, and similar issues at the Freeport mine in Indonesia's West Papua province), the issues in the Philippines touch on most, if not all, key sustainable development areas. Even with its large mineral wealth, it is the broad range of sustainable development issues that has over recent times prevented the Philippines from successfully developing the country's mineral resources for national economic and social benefit. This is supported by the Fraser Institute's annual Survey of Mining Companies 2015, in which the Philippines ranked 71 out

of 110 jurisdictions on the Investment Attractiveness Index, slipping from a ranking of 61 out of 112 in the equivalent survey in 2013 (Fraser Institute 2014).

Comparing the above mining issues in the Philippines with the sustainable development frameworks and principles mentioned earlier in this chapter, it is possible to identify a direct connection with each of the principles. Furthermore, it is feasible to state that if mining development in the Philippines were framed by these principles, the likelihood of detrimental events occurring would be reduced considerably.

The practices employed by the mining industry in developing new projects, the operation of existing mine sites, and during mine closure have improved over the last generation. This is a result of the heightened awareness of sustainable development principles, frameworks, and toolkits. Improved regulatory frameworks, aimed at better safeguarding the environment and affected host communities and stakeholders from unwanted negative impacts, has also been beneficial. Mining companies now have to balance the benefits to a mining development that transcends regulatory compliance requirements beyond what is required by law with the value of the deposit to the company, as well as balancing support for community development programs that allow for a more harmonious relationship with local communities, with the benefits in being seen as a good corporate citizen. This added value is becoming more critical, given the increasing influence that stakeholders and the wider civil society have on the mining industry.

To date, new mining operations have been routinely designed, built and run in a similar manner to existing operations. Tried and tested solutions that are perceived to have lower technical and financial risks continue to be chosen over more innovative initiatives that have better alignment with sustainable development principles. Commonly, such principles are used to ensure that the project or operation is at best compliant once all major decisions are made, leaving little scope for innovative initiatives that could improve environmental and social outcomes. Brewer (2007) argues this effect is exacerbated by business operational pressures:

> Lacking time, however, usually means that choices fall into one or a limited number of types: incrementalism, standard operating procedures, vacillation and indecision, and doing nothing at all. Creativity in any case is seldom sought or celebrated.

Key to driving sustainable development in the industry is to have proper consideration, analysis and assessment of innovative initiatives in the project development systems, so that new mining projects will not continue to imitate existing mining operations. Innovative initiatives that deliver benefits will help build and maintain a strengthened social licence to operate. A common misconception is that good sustainable development outcomes will come at a cost to the project compared to the corresponding conventional approach. In fact, sound initiatives, such as a smaller residue facility with water recycling, or a wetland compared with a reverse osmosis plant for effluent treatment, are not more expensive in terms of capital or operating costs, but may be perceived to be more risky and therefore are not considered in the usual engineering analysis. More commonly, project development processes routinely do not investigate options that could deliver strong sustainability benefits and satisfy technical and financial requirements, the opposite being more common practice

where sustainability benefits are considered too late in the development process. The potential for new and existing mining projects to engage local businesses and thereby build up robust relationships with local stakeholders is growing within the industry, and forward thinking leaders recognise that such initiatives strengthen their reputation and their social licence to operate. Creating a robust and transparent relationship with stakeholders also can help with misperceptions regarding potential environmental impacts (even if these impacts are not grounded by scientific evidence), which can create risk to the business (for example, the perceived impact of mining discharges on fish populations). Finally, technology has an increasing and vital part to play in managing social and environmental risks, as alternative technical solutions that may increase costs could also help to reduce the overall risk profile of an operation or project, thereby warranting additional investment.

Conclusion

In this chapter, I have presented an overview of sustainable development practice in the mining industry. The complexities facing the industry worldwide, and in the Asia-Pacific Region in particular, need to be underpinned by a sound and workable sustainable development agenda that aims to deliver benefits to all affected stakeholders, including project proponents. In so doing, extractive operations will acquire and maintain a stronger social licence to operate. However, to deliver on a sustainable development agenda requires holistic and systematic approaches that must be context and environment specific. To date, these have been lacking across the industry. Through the use of more sophisticated systematic and holistic approaches—some of which have been surveyed in this chapter—enhanced sustainable development outcomes, such as water and energy savings, integrated rehabilitation plans, enhanced capacity building in local communities, greater skills development, shared infrastructure, and the reduction of business risk, can be better incorporated into the design and operation of mining projects to deliver benefits to project proponents and critical stakeholders.

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