CHAPTER 2.2

Community and Social Issues

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The index of the *SME Mineral Processing Handbook* (Weiss 1985) does not contain the words *sustainability* or *social responsibility*. More than three decades have passed since its publication, and today these words, and the underlying concerns about mining's environmental and social challenges, have taken on heightened importance in industry and business, especially in the minerals industry.

This chapter seeks to address community and social issues in the context of the interaction between the minerals industry and nearby communities and social stakeholders. It begins by reviewing the ideas behind social engagement and sustainability in a broad sense, and then goes into their implications for the minerals industry and discusses aspects specific to mining companies and communities. It also reviews the leading best practices standards in mining and extractive metallurgy sectors and their role in social acceptance. Finally, the community impacts and social risks resulting from mining and metallurgical activities through their life cycle are analyzed in the context of sustainable development.

SOCIAL ENGAGEMENT FOR SUSTAINABILITY IN THE MINERALS INDUSTRY

In business, the term *social engagement* refers to the interaction of companies with their employees, communities, and other stakeholders to address economic and social issues to achieve business objectives and stakeholder expectations. Social engagement is an important issue in every industrial sector, but in the minerals industry, where the social and political environments are fixed by the location of mineral resources, social engagement becomes critical.

In the context of the minerals industry, the broader concepts of sustainability, sustainable mining, responsible mining, and corporate social responsibility (CSR) are used to describe the social and environmental contributions and consequences of business activity. These concepts are tridimensional and refer to integrating environmental, economic, and social aspects of mining business activity. A notable reference to this concept was made in 2002 by the United Nations Environment Programme in a publication titled *Berlin II: Guidelines for Mining and Sustainable Development* (UN 2002). *Berlin II* stated:

> If sustainable development is defined as the integration of social, economic and environmental considerations, then a mining project that is developed, operated and closed in an environmentally and socially acceptable manner could be seen as contributing to sustainable development. Critical to this goal is ensuring that benefits of the project are employed to develop the region in a way that will survive long after the mine is closed.

Later in this section, the stakeholders of a mining company will be identified, and the different concepts related to social engagement in the minerals industry will be analyzed, including CSR, sustainability, the social license to operate (SLO), and the modern concepts of value sharing and the business case on sustainability.

Stakeholders

The key strategic issue for social engagement is relationships with the stakeholders. In his landmark reference on stakeholders, Edward Freeman (1984) defined *stakeholder* as "a party which affects, or can be affected negatively or positively by the activities of the company." In the context of CSR, a proactive interaction between companies and stakeholders is always important, but in the minerals industry, an efficient and trustful interaction between a company and social stakeholders becomes of greatest strategic interest. This is due to the greater importance and magnitude of the social impacts (positive and negative) of the mining activity and the controversial legacy of mining throughout history.

There is ample literature on community participation and the impacts of mining activity on the community, but, with a few exceptions, literature prior to 2002 focuses on CSR concepts and issues rather than stakeholder engagement and "social license," which is gaining social acceptance. For early references to the subject, see Cragg (1998), Cragg and Greenbaum (2002), and Azinger (1998).

Probably the first systemic approach to a stakeholder-based corporate strategy in mining is presented in the publication *Breaking New Ground: The Report of the Mining,*

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Table 1 Typical minerals industry stakeholders

Business-Related Stakeholders
Stockholders
Employees
Financial and lending institutions
Market partners (suppliers, clients, contractors, etc.)
Social Stakeholders
Directly affected parties (hosting communities, landowners, etc.)
Indirectly affected parties (craftsmanship, farming, cultural, private business, etc.)
Social activists/nongovernmental organizations (environment, human rights, etc.)
Artisanal miners
Media (press and leaders of opinion)
Political groups
Labor unions
Minorities and other historically marginalized groups
Government-Related Stakeholders
National, regional, and local authorities
Judicial authorities
Government agencies

Adapted from Ovejero Zappino 2009

Minerals, and Sustainable Development Project (IIED 2002). Later in 2007, the International Finance Corporation published *Stakeholder Engagement: A Good Practice IIandbook for Doing Business in Emerging Markets* (IFC 2007). Also worth noting is the *Stakeholder Research Toolkit* published by the International Council on Mining and Metals (ICMM 2007), which provides tools to quantify the reputation of a mining company among its stakeholders.

No hard rules exist to identify critical stakeholders, but the World Bank (1996) suggests that a good way to start the identification process is by asking the following questions:

- Who are the "voiceless" for whom special efforts may have to be made?
- Who are the representatives of those likely to be affected?
- Who is likely to mobilize for or against what is intended?
- Who can make what is intended more effective through their participation or less effective by their non-participation or outright opposition?
- Who can contribute financial and technical resources?
- Whose behavior has to change for the effort to succeed?

A complete analysis of the interactions between mining companies and stakeholders is presented in the book *Sustainable Management of Mining Operations* (Botin 2009). Table 1 lists typical mining company stakeholders (Ovejero Zappino 2009). The first group of stakeholders listed in the table is the business-related stakeholders who are part of the business structure, and therefore, their interest is economic. In this group, stakeholders of special significance are the employees. They represent the interests of both the company and the community, and therefore, their position is critical for social engagement. Companies tend to view employees as a resource necessary to achieve economic objectives; however, community perspective is based on value systems, and in many cases, the values of a mining company are attested and measured through the actions of its employees. It follows that the needs of the community are only understood to the degree that employees understand and can communicate these needs to the company in such a way that management can take action. As such, the ability of a company to achieve and retain its social license largely rests on the actions, knowledge, and perceptions of its employees.

Just as important to social engagement are contractors and suppliers whom, to a large degree, are managed by local people. Besides, they are a leading force and a major source of information during feasibility and construction stages of mining projects. A local focus is therefore important in the selection and management of contractors and suppliers.

Engagement with local industry managers and entrepreneurs is also important to social engagement since, depending on their perception or their role as potential business partners with the company, they are likely to mobilize for or against the company objectives. Furthermore, contact with local industry leaders and entrepreneurs, seeking for shared professional and business interests, can provide important management and cost advantages.

The second group in Table 1 is the social stakeholders. This group is comprised of social parties whose interests and concerns are varied, difficult to assess, and potentially conflicting with other parties and with the mining company. Regarding the engagement with the hosting communities, the focus should be placed on reconciling corporate and community views of the advantages and disadvantages of mining operations.

Landowners are important stakeholders of a mining project. Land acquisition is often challenging, since it implies negotiation with several types of landowners (e.g., private, corporate, municipal, communal) and sometimes reaching separate deals with land leases (e.g., timber, fishing/hunting, tourism). In countries where mining regulations are based on Roman law, mineral resources are state owned, and therefore, the holder of a mining concession may claim the right of expropriation when the exploitation of mineral resource is declared of "public utility" by the government. However, expropriation is an act of force that may generate social conflict and project delays. Therefore, every reasonable effort must be made to reach negotiated agreements with landowners to buy or rent the affected properties.

Interacting with social activists and nongovernmental organizations (NGOs) may be an important part of a mining business strategy. NGOs are geared toward a cause rather than a profit. The cause of an NGO may combine geography (e.g., local, national, or international) and a subject (social development, ecology, human rights, etc.), and its positions on mining can range from pro-engagement to antimining. Some of these groups maintain a close scrutiny of the mining company and government regulators, which is often constructive and beneficial but sometimes obstructive and unfair.

Dealing with the media involves providing information on corporate issues, projects and operations, environmental performance, safety, and so on, and responding (silence is not an option) to arising issues. Ideally, a personal relationship with media management and journalists should be maintained. Mining organizations should establish different levels for media interaction: (1) media specializing in business and economy; (2) local or provincial information sections in the general media, used by the general public; (3) editors, managers, and owners of the primary media (press, TV, radio, etc.); and (4) regional and local media present in the municipalities where the project or mine is sited.

Corporate Social Responsibility

A generally accepted definition of CSR comes from the International Organization for Standardization (ISO 26000):

> Social responsibility [is the] responsibility of an organization for the impacts of its decisions and activities on society and the environment that, through transparent and ethical behavior, contributes to sustainable development, including the health and the welfare of society, takes into account the expectations of stakeholders, is in compliance with applicable law and consistent with international norms of behavior, and is integrated throughout the organization and practiced in its relationships.

The concept of CSR, considered as a business's concern for society, can be traced back to the late 1800s during the Industrial Revolution, when industrial corporations developed welfare systems to provide for hospitals, bathhouses, and other facilities for employees, focusing on preventing labor problems and improving performance. However, the notion of CSR as an integrated, socially focused corporate strategy is a product of the 20th century, from the early 1950s to the present.

The late 1950s and 1960s saw a growing interest in the concept of CSR. One of the leading writers in this period was Keith Davis. Davis was the first to debate the "business case of CSR" when he asserted that some socially responsible business decisions can be justified by their potential to bring long-term economic gain to the company, a debate that is very alive today (Davis 1960, 1967). Another key contributor to the concept of CSR in the 1960s was Clarence Walton, who stated that the essential ingredient of CSR actions is voluntarism, as opposed to coercion, a concept that is at the core of CSR today (Walton 1967).

The 1970s were marked by the introduction of the "stakeholder approach" to CSR, a key aspect in today's definition of CSR. Along this line, Steiner (1971), in his book *Business and Society*, discusses specific spheres in which CSR might be applied and the criteria for determining the social responsibilities of business. Opposed to the stakeholder approach, Friedman, in a landmark article, stated that in a free society, "there is one and only one Corporate Social Responsibility of business—to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game" (Friedman 1970). Obviously, Friedman did not think it was inappropriate for corporations to do all they could to be socially responsible, but he was arguing that applying a shareholder's profit-maximizing strategy allied with an appropriate framework of law would be more likely to produce social good than exhortations that firms be socially responsible.

In a different line of thinking, Davis (1973) maintained that "CSR refers to the firm's consideration of, and response to, issues beyond the narrow economic, technical, and legal requirements of the firm," a definition that, in line with Walton's (1967), implies that voluntarism is an essential ingredient of CSR actions. Another significant contribution to previous definitions of CSR was a publication by the Committee for Economic Development (CED 1971), which related CSR to a "social contract between business and society," a concept that may be considered a precursor of SLO, a core aspect of today's approach to CSR.

In the 1980s and thereafter, the understanding of CSR as the voluntary acceptance by corporations of a certain obligation to stakeholders beyond that required by law had become commonplace. A key development in that decade was the book *Strategic Management: A Stakeholder Approach* (Freeman 1984). In the book, Freeman stated that business can be understood as a system to create value for stakeholders, considered as those who affect or are affected by the business. Another significant feature in this period was the increasing evidence of the relationship between corporate social performance and financial performance (Griffin and Mahon 1997), anticipating today's central problem of the "business case on sustainability." A major book cataloging best CSR practices was written by Kotler and Lee (2005). The authors set out to characterize a new way of doing business that combines the success and the creation of value with a respectful and proactive attitude toward stakeholders.

In the minerals industry, CSR takes the form of voluntary, nonregulated actions by mining companies intended to gain the acceptance of the nearby communities; that is, to gain SLO. The voluntary actions are carried out through the implementation of environmental and social best practices and standards. Therefore, the concept of CSR in mining integrates the concepts of "sustainable mining" and "responsible mining."

Typical legal and voluntary frameworks for mining are presented in Figure 1 (Botin 2009). The voluntary framework for sustainability refers to the company's voluntary adherence to international sustainable development frameworks and standards. Some of these standards are listed in the figure and described in detail later in this chapter.

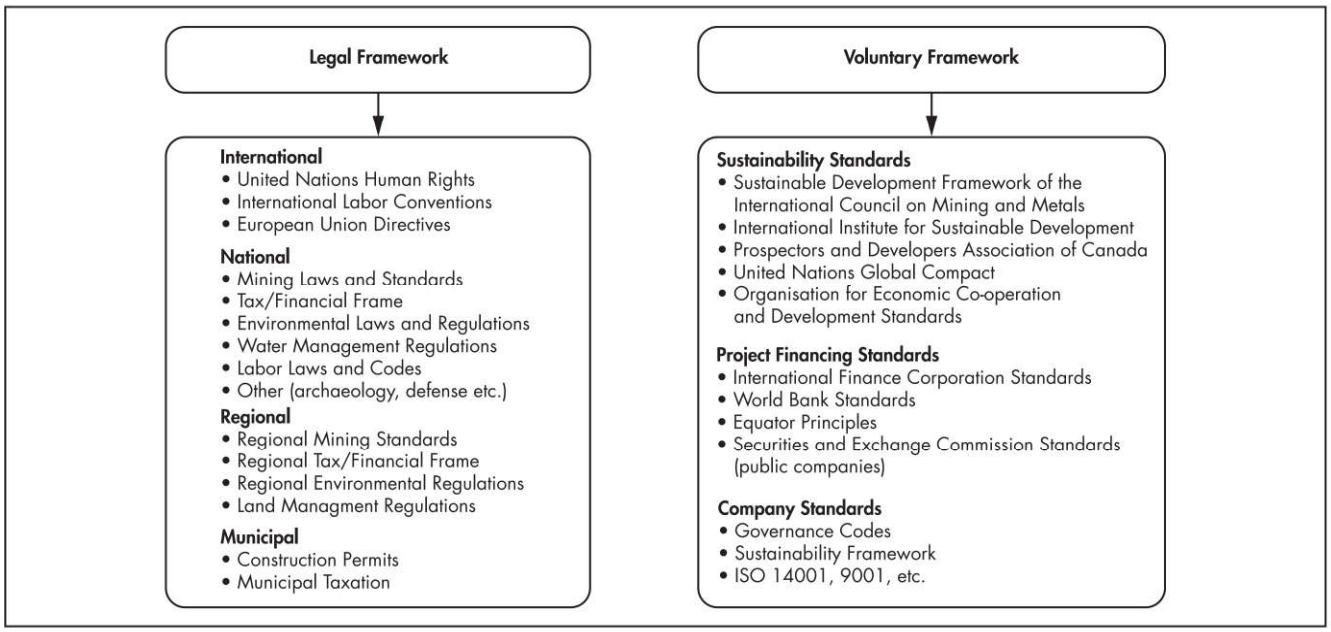
The legal framework refers to the body of international, national, regional, and local regulations that any mining project must comply with to receive the necessary permits. The process to achieve all necessary permits is referred to as permitting and is a complex management process, sometimes taking several years to complete. The permitting requirements vary widely for different countries, regions, and local governments. Table 2 list some of the most frequently required permits.

Business Case for Sustainability

Although CSR standards are voluntary, market pressures and stakeholders' demands are gradually leading to a situation where noncompliance with international CSR frameworks may bear an increasing social and economic risk. On the other hand, there is ample evidence of the link between environmental and social performance and financial performance (Salzmann et al. 2005). However, the benefits of sustainability are sometimes subjective and difficult to quantify.

As an example, Figure 2 shows a business case matrix proposed by the IFC (2002) that presents the business benefits and risks from social and environmental improvements based on 240 cases from Africa, Asia, Latin America, and Central and Eastern Europe, some of them relating to the minerals industry.

In the context of the mining, the business case for sustainability has also been studied by McKinsey and Company (Bonini and Gorner 2012). The study concluded that companies from the extractive sectors (mining, oil and gas) expect to add significant value from their sustainability activities,



Source: Botin 2009

Figure 1 Typical legal and voluntary frameworks for mining projects

especially from those related to resources development, environmental operations, and regulatory management. Also, intangible assets, such as reputation, were identified to account for a substantial and growing portion of the value of companies in the minerals industry.

Social License to Operate

In general, a SLO refers to a business gaining social acceptance. The term is often attributed to Jim Cooney (1997), a Placer Dome executive, who used it at the Roundtable on Mining: The Next 25 Years, a meeting organized by the World Bank in 1989. Today, the term *social license to operate* has been widely adopted by the minerals sector and civil society in general. However, what constitutes a social license and the underlying processes to obtain one are less well understood, and limited research has been conducted on what factors contribute toward and/or undermine acceptance of mining developments by hosting communities.

Gaining a SLO is about "going beyond legal compliance." In the context of mining, Parsons et al. (2014) find that the SLO may be understood as a set of "best practices" aiming to legitimize mining activity in the minds of local community. SLO may involve listening to, and engaging with, community members, and perhaps allowing them to participate in some company decision-making processes. Furthermore, Moffat and Zhang's (2014) investigation on the critical elements for social license concluded that the key factors in securing and holding a social license are mutual trust and high-quality engagement of mining companies with communities, alongside mitigation of operational impacts.

Any management approach to the SLO must be based on the engagement of social stakeholders in an appropriate process to identify and balance business objectives and the expectations of the community and local stakeholders. The challenge of this process (Botin 2010), illustrated in Figure 3, lies in the need to reconcile corporate and community views

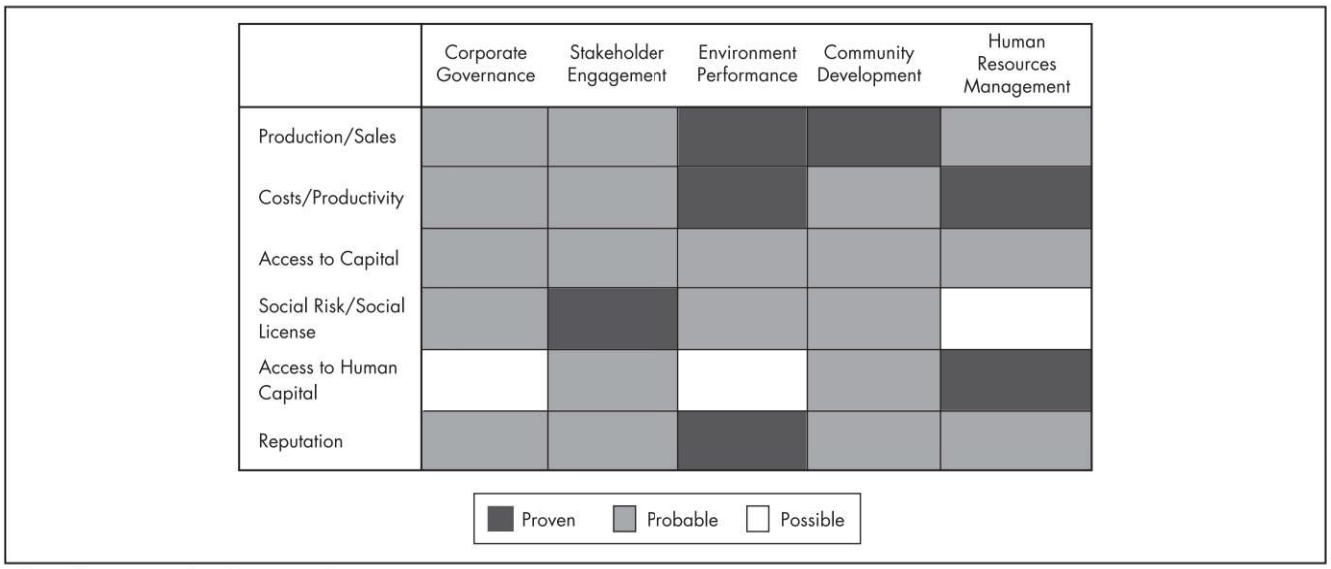
Table 2 Main project areas requiring permits

Environment	Mining	Water
Environmental (environmental impact assessment)	Exploration permit	Water concession
	Mining concession/ project	Water management
		Streams diversions
Effluent discharges	Health and safety plan	Water reservoirs, ponds
Air emissions	Emergency plan	Effluent recycling
Solid residues disposal	Explosives	
Noise	Yearly work plans	
Hazardous materials		
Tree-cutting permits		
Infrastructures	**Others**	**Municipal Permits**
Power lines and substations	Public domains	Town zoning plans
	Streams, roads, public paths, etc.	Construction permits
Ancillary installations	Archaeological permits	Activity permits
Mining camps/towns	Construction permits	Opening permits
Access roads	Construction materials	
Railways		
Pipelines		
Ports		
Telecommunications		

Adapted from Ovejero Zappino 2009

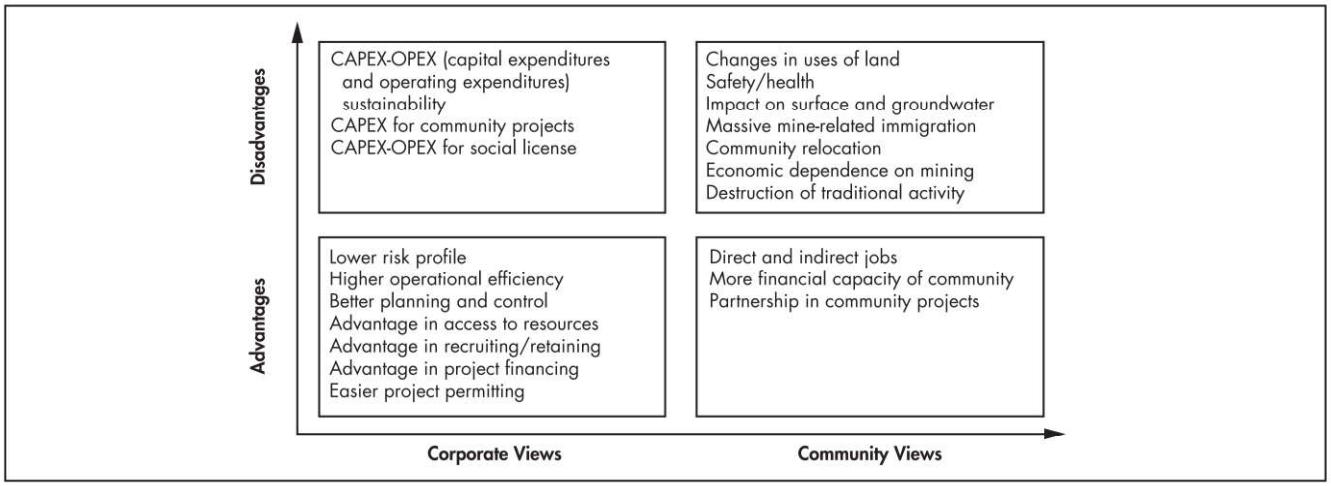
of the advantages and disadvantages of mining operations. In fact, a company's view mainly focuses on long-term potential benefits derived from public reputation, positive risk profile, and the economic benefits resulting from improved operational efficiency, trouble-free permitting, and privileged access to debt financing, ore resources, and human capital. On the other hand, a community's perception of environmental and social impacts of mining are generally negative, and the benefits derived from job creation and the contribution of the company to fund community projects are generally undervalued.

A practical approach to this challenging process is the Seven Questions for Sustainability, a methodological framework for community engagement developed by the International Institute for Sustainable Development (IISD



Adapted from Van Heel et al. 2001 and IFC 2002

Figure 2 Business case matrix



Source: Botin 2010

Figure 3 Corporate and community views of CSR and the social license

2002; Hodge 2004) as part of the Mining, Minerals and Sustainable Development Project (MMSD; IISD 2002). This framework was successfully applied to the experience of the Tahltan First Nation (British Columbia, Canada) with mining, where several gold mines have operated in the last 60 years (Tahltan First Nation 2003).

The Seven Questions framework aims to determine whether the mining project or operation generates a net positive contribution to sustainability over the longer term. Each broad question serves as a starting point for a management process, including project-specific objectives, indicators and metrics, dispute resolution mechanisms, reporting, and verification. The Seven Questions include the four major items that are commonly referred to in all sustainable development considerations—community, environment, economics, and governance—and other topics that are significant in a mining context. The following paragraphs describe some of the aspects associated with each of the questions/themes.

1. **Engagement: Are engagement processes in place and working effectively?** The engagement process includes the identification of stakeholders and active participation in discussions with them, leading to better implementation of local expectations in the project design, development, operations, and closure. Engagement is not a "one-way street" public relations exercise; rather it is the willingness to listen and respond with actions based on expectations. It can result in some loss of the power of independent decision making, but the outcomes will be better appreciated and accepted. Besides, stakeholder engagement is never a static process. Ongoing communications, reporting, verification, and other activities are necessary.
2. **People: Will people's well-being be maintained or improved?** This includes all the people who come into contact with the project, whether directly or indirectly. Workers' health and safety is regulated in most

jurisdictions; however, it is important to go beyond regulatory compliance and be proactive rather than reactive to all issues affecting the well-being of nearby communities, such as wind-blown dust from a tailings impoundment or potential impacts on the availability or the quality of drinking water. The Millennium Ecosystem Assessment (2005) lists the following components of human well-being: security, basic material for good life, health, good social relations, and freedom of choice and actions. It further identifies the role of ecosystem services as supporting (e.g., nutrient cycling), provisioning (e.g., food), regulating (e.g., climate), and cultural (e.g., recreation). These aspects are part of all human interaction with the earth, including mining activities.

3. **Environment: Is integrity of the environment assured over the longer term?** Extensive regulatory regimes have been developed to protect the environment affected by mining operations. However, going beyond the regulatory requirements by implementing concurrent reclamation and other activities meant to enhance the well-being of the environment should be "on the radar" of mining operations. Sometimes this includes a better understanding of the local ecosystem by funding research.
4. **Economy: Is the economic viability of the project or operation assured, and will the economy of the community and beyond be better off as a result?** All mining projects must make money; this is essential in the positive contribution of the mine to local and regional sustainability. The economic successes of a mine are shared through employment, local taxes, and so forth. Ongoing operational reviews to improve efficiencies at a mine are a big part of this theme. Many mining companies are also regular contributors to local activities such as schools, libraries, and universities. Contributions to sustainable causes must be a consideration; multigenerational thinking is an essential part of sustainable development.
5. **Traditional and nonmarket activities: Are traditional and nonmarket activities in the community and surrounding area accounted for in a way that is acceptable to the local people?** Understanding the traditions and customs of local indigenous people must take high priority at all mines. Having access to certain plants or places at a mine site may be essential to local indigenous people. There are also many other nonmarket issues associated with mines, such as volunteerism associated with local fire departments, emergency medical activities, churches, or other social activities such as search and rescue. Mining operations are usually very aware of the need to participate in such activities.
6. **Institutional arrangements and governance: Are rules, incentives, programs, and capacities in place to address project or operational consequences?** Mining companies operate in well-regulated environments, and regulations for land ownership, corporate financial management and reporting, taxes, labor relations, safety, and so forth are typically well developed in most jurisdictions. Regulatory compliance is the first order of business for all companies. However, many companies now have corporate policies and requirements for sustainable development, environment, health and safety, and many other aspects. Many of these policies go well beyond the governmental and regulatory frameworks.
7. **Synthesis and continuous learning: Does a full synthesis show that the net result will be positive or negative in the long term, and will there be periodic reassessments?** Ongoing review and continuous improvement is part of the culture of most mining operations. Regular synthesis of all aspects of the sustainability policies and applications at a mine site should be done to review whether the contribution to people and the environment will be net positive in the long term. This theme also includes the ongoing review of project and activity alternatives to improve operational efficiencies and overall project performance with respect to the six other themes.

Concept of Shared Value

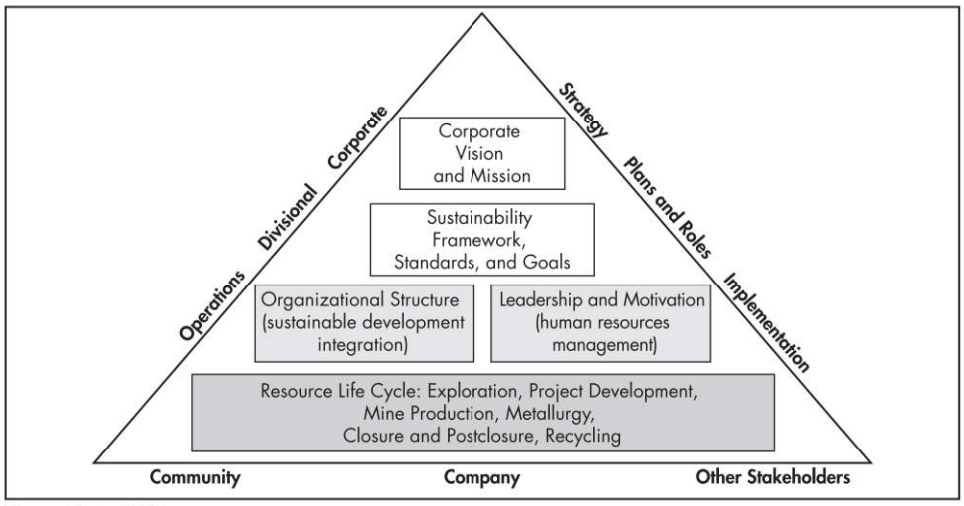
Porter and Kramer (2011) studied the apparent contradiction of "shared value" and concluded that, in most cases, companies remained stuck in a wrong (philanthropic) approach to CSR, in which societal issues are not part of core business strategy. Porter and Kramer make a point that shared value is not about "sharing" the value already created by firms, but about expanding the total pool of economic and social value by reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the company's locations. Each of these is part of the virtuous circle of shared value; improving value in one area gives rise to opportunities in the others. In this line of thinking, Porter and Kramer state that the concept of creating shared value supersedes CSR in guiding the investments of companies in their communities. Although CSR focuses mostly on reputation and has only a limited connection to the business, making it hard to justify and maintain over the long run, creating shared value is integral to a company's profitability and competitive position.

In recent years, several international platforms have been created to promote the shared value concepts. The Shared Value Initiative is a nonprofit community funded in 2012 with the sponsorship of several mineral resource companies. In the report *Extracting with Purpose* (Hidalgo et al. 2014), the authors present several case studies describing specific programs incorporating the application of the shared value concepts in mineral resources companies and geographies. However, they conclude that today, the creation of shared value is deterred by (1) inadequate organizational structures and behaviors; (2) incomplete measurement of cost and benefit; (3) low levels of motivation; and (4) the role of governments in incorporating shared value principles into concession agreements, becoming operating partners for shared value strategies, incentivizing shared value investments, and so on.

Also in 2012, Engineers Without Borders Canada created Mining Shared Value, a framework to promote increased engagement between community providers and the international mining sector (EWB Canada 2012). The framework ensures the relationships between local communities and global corporations are reciprocal and mutually beneficial, meaning both parties share in the value generated from mining.

BEST PRACTICES FOR SUSTAINABLE DEVELOPMENT

Referring to sustainable development in a mining context, the concept of best practices for sustainable development is particularly difficult to grasp. In fact, it refers to a management practice aiming to legitimize mining activity in the minds of local community and stakeholders. In this view, the general



Source: Botin 2009

Figure 4 An integrated model for sustainable management of mineral resource companies

concept of best practice fits in the scope of SLO, where the desired output is stakeholders' acceptance rather than sustainable development.

In this line of thinking, a best practice for sustainable development must aim for the effective integration of sustainability into a company's strategy and structure from the chief executive officer (CEO) down to the lowest operational levels. In addition, integration should be efficient and therefore must lead to improved profitability and added value to shareholders.

Integrating Sustainability into Corporate Strategy

In the author's vision, integrating sustainability into corporate strategy refers to the management process of achieving top-down implementation of sustainable development principles and values at all levels in the organization. The author proposed the model in Figure 4 (Botin 2009), where sustainability is vertically integrated at three organizational levels (corporate, divisional, and operations) and three functional levels (strategy, planning, and implementation). Sustainability goals are integrated throughout the resource life cycle (exploration, project development, production, etc.). In addition, integration requires an organizational structure with adequate integration mechanisms and a business culture where sustainability is a high professional and business value.

This integration process, often difficult and challenging, requires an organizational structure with integration mechanisms, management roles, plans, and systems ensuring proper communication, coordination, and control. Integration roles are individual positions or ad hoc committees with accountability for the integration of sustainable development values and objectives. The integration plans and systems are the policies, standards, and management tools that are required to carry out sustainable management at the operations level.

As an example, a typical organizational structure for a large minerals corporation where several integration mechanisms are present is shown in Figure 5 (Botin 2009). This model would also be valid for medium and small companies, but in those cases, the divisional level would not exist.

At corporate level, three roles are key to sustainable management:

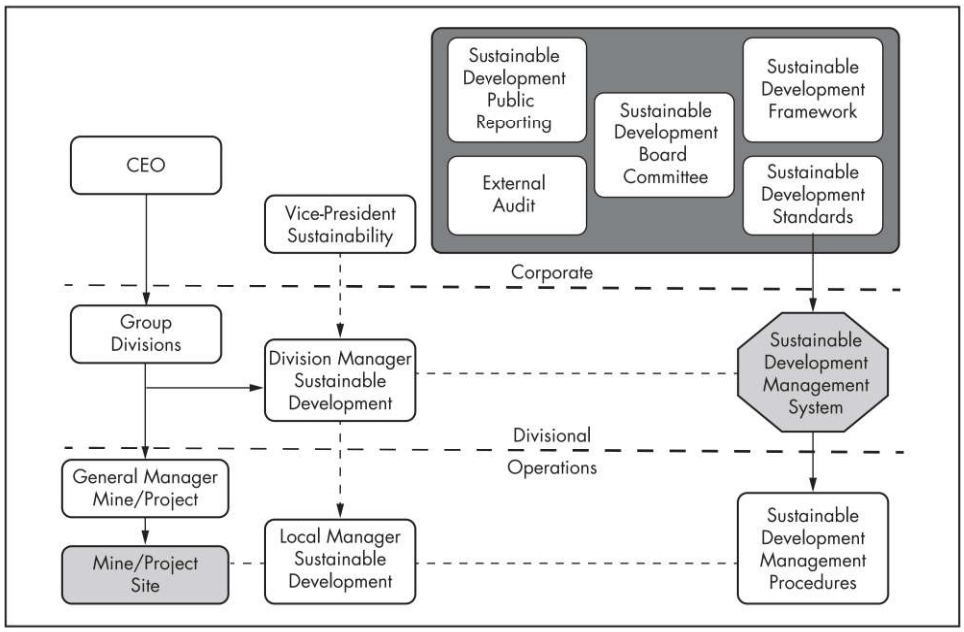
- The CEO role, developing a business vision, formulating challenging goals, and reinforcing motivation toward the values of ethics and sustainability.
- The sustainable development committee, assisting the board in overseeing the sustainable development framework and standards, and evaluating performance, public reporting, and external auditing.
- The vice president of sustainability, a key leader who typically is on the CEO's staff and is accountable for setting strategy, establishing goals, and integrating sustainability down and across the organization. Among other tasks, the vice president of sustainability assists the human resources department in developing sustainability values in employees.

At the divisional level, divisional managers' roles are related to the efficient integration of sustainability standards, the implementation of management systems for planning and control of sustainable development goals, and the reporting system. At operational levels, the site manager of sustainability reports to the operations general managers with overall accountability for the implementation of sustainability procedures at the operational level.

The sustainable development standards are a set of best practices, policies, and planning and control systems at all management levels. In most cases, sustainable development standards are designed in alignment with international frameworks (ICMM, Global Compact, etc.).

The sustainable development public reporting systems are often designed in alignment with international reporting standards. The most widely used minerals industry reporting standard is the Global Reporting Initiative. GRI, in cooperation with the ICMM, has published a public reporting guide (G3) specifically designed for the minerals industry (ICMM 2010).

External auditing and independent assurance systems are the last steps in integrating sustainable development in corporate strategy. Only publicly listed companies are legally required to issue an independently assured public report. However, many non-listed mining companies seek independent assurance considering the positive effect on reputation and credibility.



Source: Botin 2009

Figure 5 Process of integrating sustainability in the company structure

Regarding business culture, the integration of sustainability requires of business standards and codes in which sustainable development values are regarded as key to the professional success of company employees, so that sustainability performance may rely on personal commitment rather than compliance with policy and regulations. The integration of sustainability as a business value is critical since it allows for maximum decentralization of decision making in sustainability issues. In this context, a business culture based on personal conviction and commitment is critical to corporate reputation and how the company is perceived by local communities.

Best Practice Initiatives for Sustainable Mining

The *Cambridge Dictionary* (2018) defines *best practice* as "a working method or set of working methods that is officially accepted as being the best to use in a particular business or industry, usually described formally and in detail." Best practice may refer to a technique, a methodology, or a process (operating, management, manufacturing, etc.) and, in a broad sense, to a specific way of accomplishing a task. The only requirement is that it must be based on repeatable procedures that have proven to be more effective at delivering a particular outcome than any other. The desired outcome of a best practice may be effectiveness, efficiency, quality, low risk, or other outcome.

In line with *Berlin II: Guidelines for Mining and Sustainable Development* (UN 2002), a best practice for sustainable mining may be defined as "the management approach which efficiently integrates economic, environmental and social issues into operations, aiming to create long-term benefits to stakeholders, including shareholders, and to secure the support, cooperation, and trust of the local community in which the company operates."

Broad, Site-Based, Multi-Participant Initiatives

In 2002, Anglo American plc (United Kingdom), BHP Billiton (Australia), Rio Tinto (United Kingdom), and other global mining companies created the Global Mining Initiative to launch the MMSD project, an independent review of the key issues to understanding the relationship between sustainable development and mining. The MMSD's report led to the creation of International Institute for Environment and Development, which started workshops and expert-group meetings with more than 150 commissioned studies to produce the *Breaking New Ground* report (IIED 2002). The GMI and MMSD gave rise to the creation in 2001 of the ICMM, an international organization dedicated to a safe, fair, and sustainable mining industry (ICMM n.d.). Today, ICMM is composed of 23 mining and metals companies and more than 30 regional and commodities associations. In 2003, ICMM developed the 10 Principles of Sustainable Development, a framework for best practices on sustainable mining (ICMM 2015). Over the years, a series of position statements were developed to accompany and strengthen the 10 principles.

Between 2001 and 2003, the World Bank commissioned the Extractive Industries Review (World Bank 2004), a comprehensive assessment of its activities and its role in the extractive industries. The review concluded that the World Bank does have a role to play in the extractive sectors, but only if its activities promote sustainable development and poverty alleviation. The detailed findings of the review are available at the World Bank website (www.worldbank.org), and the World Bank's response can be viewed at the IFC website (www.ifc.org).

The Global Compact (GC), initiated in 2000, is a voluntary network of businesses and other organizations committing to adhere to appropriate corporate behavior in the areas of human rights, labor practices, the environment, and corruption reduction and prevention (UN 2004).

The Equator Principles (EP) are a voluntary set of guidelines for banks and other financial institutions to use in managing environmental and social issues that arise in lending to investment projects (Equator Principles Association 2013). The principles were developed in 2003 and revised in 2006

(EP-II) and 2013 (EP-III). Currently, 91 financial institutions in 37 countries have officially adopted the EP, covering more than 70% of international project finance debt in emerging markets.

The Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) was created in 2002 as a voluntary initiative for national governments with an interest in advancing the priorities identified in the Johannesburg Plan of Implementation and—more recently—the United Nation's Sustainable Development Goals and Agenda 2030 (UN 2015). Today, the IGF supports 60 nations committed to leveraging mining for sustainable development (IGF 2017). The IISD has served as secretariat for the IGF since October 2015. The IGF's flagship work is the Mining Policy Framework, a best-practice framework that sets out objectives and includes guidance reports for governments on key sustainable development issues. The last IGF guidance report for governments, *Managing Artisanal and Small-Scale Mining*, was presented in early 2017.

Assurance, Auditing, and Reporting Initiatives

Besides the broad sustainability frameworks (ICMM, GC, etc.), many mining companies are joining broad-based assurance, auditing, and reporting systems, offering independent, third-party auditing and assurance to enable companies to obtain certification. Some examples follow.

The GRI was founded in 1998 as voluntary public reporting standard for sustainability reporting. Although GRI provides multisector reporting standards, it has published a *Mining and Metals Sector Supplement* (G3) in cooperation with the ICMM (2010). Today the GRI is probably the most widely used standard worldwide.

The AccountAbility AA1000 assurance standards were created in 2008 (AccountAbility 2008). AA1000 is a standard for assessing, attesting to, and strengthening the credibility and quality of organizations' sustainability reporting and their underlying processes, systems, and competencies. AccountAbility has also launched *The SIGMA Guidelines*, consisting of a set of guiding principles that help organizations understand sustainability and their contribution to it, and a management framework that integrates sustainability issues into core processes and mainstream decision making (AccountAbility 1999).

The International Standard for Integrated Sustainability offers a single certificate to verify a commitment to conserving natural resources and respecting social, environmental, and occupational safety issues (ISIS 2018).

Several international institutions for standardization have developed voluntary standards for auditable third-party verification on sustainability and social responsibility. The best-known standards are ISO 26000:2010 (social responsibility), ISO 14001:2015 (environmental management), SA8000:2014 (social accountability), and OHSAS 18001:2007 (occupational health and safety). Other well-known, issue-focused initiatives include the United Nations Voluntary Principles on Security and Human Rights and initiatives of the Alliance for Responsible Mining, the Public–Private Alliance for Responsible Minerals Trade, and the World Gold Council.

Issue-Focused Initiatives

In addition to the broad initiatives, there are many initiatives for best practice standards that focus on a single issue (operating stage, a management process, a technology, etc.). The following refer to those directly or indirectly related to the minerals industry.

In 2009, the Prospectors and Developers Association of Canada (PDAC 2018) launched E3 Plus, an online information resource focusing on minerals exploration. E3 Plus is designed to help companies improve their social, environmental, and health and safety performance in their exploration projects. More recently, PDAC has launched toolkits for environmental stewardship, health and safety, and social responsibility.

The Extractive Industries Transparency Initiative promotes full disclosure and independent verification of company payments and government revenues from oil, gas, and mining. Launched in 2003, the initiative aims to improve private and public governance in resource-rich nations by making it more difficult for companies and governments to undertake activities that the public at large finds inappropriate (EITI 2017).

The Responsive Minerals Initiative and its flagship, the Conflict-Free Smelter Program (CFSP), were founded in 2008 to help companies make informed choices about conflict minerals in their supply chains (RMI 2018). The CFSP uses an independent third-party audit of smelter/refinery management systems and sourcing practices to validate compliance with CFSP protocols and current global standards. The audit employs a risk-based approach to validate smelters' company-level management processes for responsible mineral procurement. Companies can then use this information to inform their sourcing choices.

The Responsible Jewellery Council is a not-for-profit, standards setting and certification organization. It has more than 1,000 member companies that span the jewelry supply chain from mine to retail. The council was founded to focus on supply chain assurance for minerals in jewelry, to develop a voluntary system of standards and site-based assurance. The RJC's Chain-of-Custody Certification for precious metals supports these initiatives and can be used as a tool to deliver broader member and stakeholder benefits (RJC 2018).

The International Cyanide Management Code, launched in 2002, is a voluntary initiative for the gold and silver mining industries and the producers and transporters of the cyanide used in gold and silver mining (ICMC 2018). The code focuses exclusively on the safe management of cyanide that is produced, transported, and used for the recovery of gold and silver, and on mill tailings and leach solutions.

The ISEAL Codes of Good Practice (ISEAL Alliance 2018) cover all steps in the standards and certification process, including standard-setting, impact evaluation, and assurance (certification and accreditation). Through membership in ISEAL, standards systems show a commitment to supporting a unified movement of sustainability standards.

The European Union, through the Institute for Prospective Technological Studies (IPTS 2018), has developed several best available techniques (BATs). The BATs are good practice standards of industrial processes with a focus on air pollution and compliance with the Industrial Emissions Directive, major environmental legislation that regulates approximately 50,000 installations in the European Union dealing with a wide range of industrial and agricultural activities.

The European Commission's guidance on the practical arrangements for the exchange of information under the Industrial Emissions Directive (2010/75/EU), including the collection of data, the drawing up of BAT reference

documents, and their quality assurance as required by Article 13(3)(c) and (d) of the directive, can be found in the *Official Journal of the European Union*. BATs on mineral processing of ferrous metals, iron and steel production, nonferrous metals and cement, and lime and magnesium oxide, among others, are available online.

The International Atomic Energy Agency (IAEA) was created in 1957 under U.S. President Dwight Eisenhower's "Atoms for Peace" address to the United Nations on December 8, 1953. IAEA has developed many best practice guides and standards with focus on safety engineering and management. For detailed information on the resources offered, visit the IAEA website at www.iaea.org/. Also see the *Guidebook on Good Practice in the Management of Uranium Mining and Mill Operations and the Preparation for Their Closure* (IAEA 1998).

Commodity-Focused Initiatives

A group of international multi-sectorial voluntary initiatives focus on best-practice standards and certification of sustainability of the mine-to-retail value chain of specific commodities.

In the early 2000s, downstream jewelry companies joined with civil society organizations to promote the idea of responsible sourcing and certification for diamonds and then gold, known as the Kimberley Process. Today, the Kimberley Process unites administrations, civil societies, and industry in 80 countries in reducing the flow of conflict diamonds ("rough diamonds used to finance wars against governments") around the world (Kimberley Process 2018).

The Aluminium Stewardship Initiative (ASI), created in 2009, is a global, multi-stakeholder, nonprofit standards setting and certification organization (ASI 2018). ASI standards are applicable to all stages of aluminum production and transformation, specifically bauxite mining, alumina refining, primary aluminum production, semi-fabrication (rolling, extrusion, forging, and foundry), material conversion, and refining and remelting of recycled scrap, as well as material stewardship criteria relevant to downstream users of aluminum.

The Swiss Better Gold Association (SBGA), created in 2013, is a not-for-profit association created by Swiss players of the gold supply chain, from refiners to retailers (SBGA 2018). SBGA's aim is to create a simple market-driven mechanism that enables formalized gold mining entities to adopt more socially inclusive and better environmental practices.

The RJC is a not-for-profit standards setting and certification organization, with more than 1,000 member companies that span the jewelry supply chain from mine to retail (RJC 2018). RJC members commit to and are independently audited against the *Responsible Jewellery Council Code of Practices*, an international standard on responsible business practices for diamonds, gold, and platinum group metals (RJC 2013). The *Code of Practices* addresses human rights, labor rights, environmental impact, mining practices, product disclosure, and other important topics in the jewelry supply chain.

The Green Lead initiative, created in 2004, is a commodity-focused stewardship program aimed at contributing to broader and better sustainable development outcomes for the lead industry through management of the lead product life cycle. Organizations that adhere to these procedures will be Green Lead certified, as will the lead products they produce or handle.

Table 3 Community Development Toolkit structure

Section	Key Points
Introduction	Background, objectives, and target audience for the toolkit.
Mining and community development	Definition of community development, key principles for sustainable community development phases of the mining and metals project cycle, and stakeholder roles and responsibilities.
Community development tools • Relationships tools • Planning tools • Assessment tools • Management tools • Monitoring and evaluation tools	Twenty practical tools for community development supported by step-by-step guidance to assist in using them.
Glossary and references	Glossary and a list of referenced sources.

Source: ICMM 2012

Sustainable Development Toolkits and Handbooks

A toolkit may be defined as a structured set of tools (procedures, guidelines, criteria, etc.) prepared for a specific purpose to ensure a desired or required result or prevent oversights. A handbook is a collection of reference works, instructions, case studies, and other material that is intended to provide ready reference on a subject or area of knowledge. Unlike toolkits, handbooks are not oriented to any specific objective, other than providing ready reference.

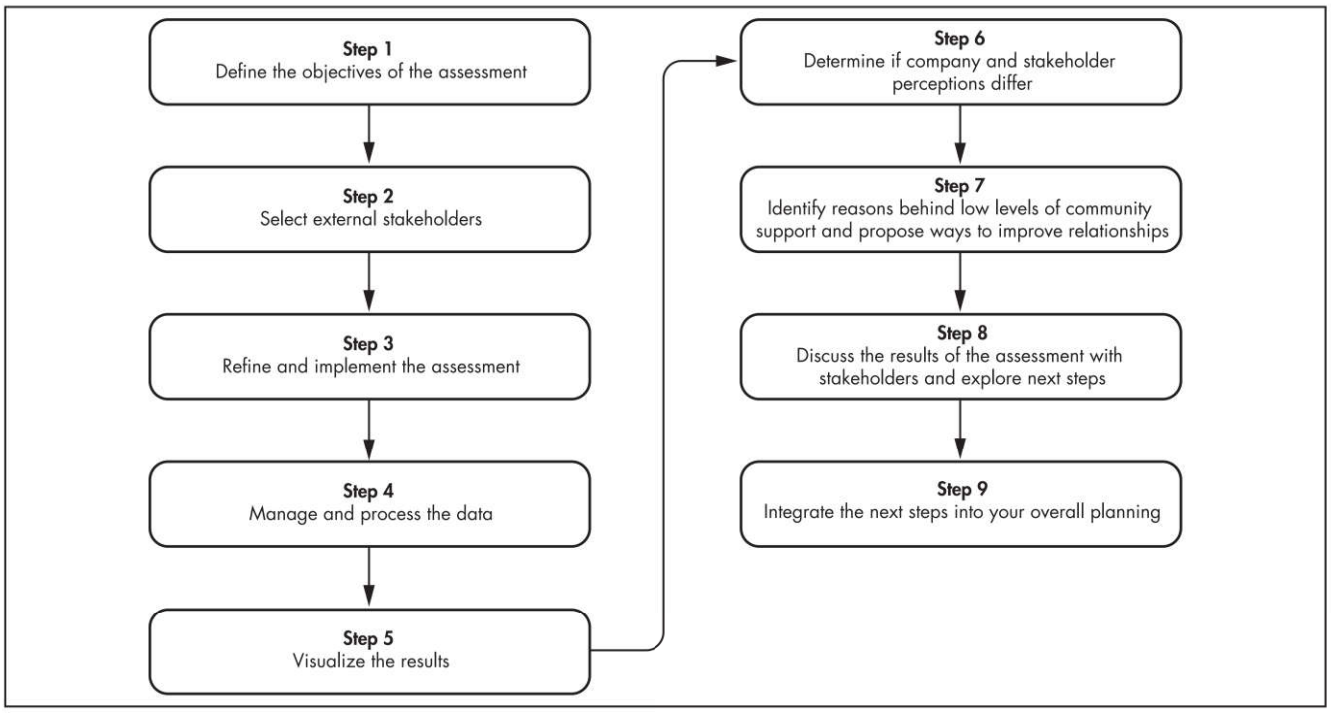
In the context of mining, these types of documents are provided by many sources, but the three leading sources are (1) broad, multi-participant initiatives focusing on the minerals industry, mainly those referred to earlier in this chapter; and (2) government sources from leading mining countries, especially the United States, Canada, and Australia.

The intent of this chapter is not to provide a comprehensive reference to all available toolkits and handbooks on the subject but to give an example of each type of document from two well-established, easy-access sources: (1) ICMM and (2) handbooks on leading practices on sustainable mining from the Australian Government (n.d.[a]).

Community Development Toolkit. Developed by the ICMM, this toolkit consists of a set of 20 tools aimed at a constructive engagement between mining companies and communities (ICMM 2012). The objective is to build capacity and improve opportunities for the sustainable development of communities around mining and metals operations.

The toolkit is structured in five groups depending on the scope and objective (see Table 3):

1. Relationship tools (tools 1–5) include guidelines and detailed methodology for the characterization of all stakeholders, consultation, and community engagement.
2. Planning tools (tools 6–10) are intended for the design, resource evaluation, and implementation of development programs and policies.
3. Assessment tools (tools 11–13) contain comprehensive information and methodologies for the identification, characterization, and evaluation of impacts (positive and negative) generated by the mining activity on the nearby communities. Also, they provide guidance on mitigation methods and potential opportunities for partnership with stakeholders.



Source: ICMM 2015b

Figure 6 Understanding Company–Community Relations Toolkit

4. Management tools (tools 14–18) are designed for the management of development programs.
5. Monitoring and evaluation tools (tools 19 and 20) are included for measuring progress toward program goals.

Understanding Company–Community Relations Toolkit. This ICMM toolkit was developed in 2015 to address a fundamental drawback in most company–community engagement processes in the past: the lack of a positive and resilient relationships with host communities (ICMM 2015b). The toolkit focuses on three key objectives:

1. To help companies understand the factors that influence community support and measure the level of community support for a project or operation.
2. To provide a tool to visualize the levels of community support that different stakeholders or stakeholder groups have for a project or operation.
3. To offer practical guidance on how this tool can be used to monitor and strengthen community support and, ultimately, community–company relationships.

The overall flow of the activities in this toolkit is shown in Figure 6. The process is stepwise and comprises two sections. The first section (steps 1–5) measures the current level of community support. The second section (steps 6–9) identifies and evaluates the factors influencing the current level of community support, and how it can be improved. The overall objective of the process is understanding the community support mechanisms and obtaining the information needed to plan for a continuous improvement process based on the plan-do-check-act cycle.

Handbooks on leading practice sustainable development in mining. The Leading Practice Sustainable Development Program (LPSDP), launched in 2006, is a program for the mining industry that promotes sustainable development and industry self-regulation. The program is administered by the Department of Industry, Innovation and Science of the Australian Government (n.d.[a]). LPSDP has developed 17 handbooks to address the key issues affecting sustainable development (Australian Government n.d.[b]). These handbooks are directed to mining and mineral processing operators, communities, and regulators and contain many methodologies, data, and case studies to assist all sectors of the mining industry in implementing good practice standards within and beyond the requirements set by legislation.

IMPACT ON COMMUNITIES

Breaking New Ground defines a mining community as a community whose population is affected by nearby mining operations (IIED 2002). Regarding community impacts, one should consider three different categories of mining communities:

1. Occupational communities, which are generally villages whose population relies extensively on local mining for all or most of their income from mining.
2. Residential communities, preexisting or built as a result of mining, where households or families live within the geographical area affected by mining impacts (economic, social, or environmental), in close proximity to or far away from the mine.
3. Indigenous communities, a special category for households or families with an ancient and cultural attachment to the land where mining occurs or has an impact.

This classification is relevant with regard to impact mitigation priorities. In occupational communities, the leading social consideration is that people must have the means to survive and prosper, either in the same place or elsewhere, when mining ceases. In residential communities, however, the leading

Table 4 Environmental and social concerns during the production stage

Aspect	Ore Extraction and Processing Concerns	Comments
Land disturbance	Involves impact on landscape and groundwater	Larger in open pit than underground mining
Waste rock disposal	Involves trucking, runoff, and leachate management; dust and aesthetic considerations	Larger in open pit than underground mining
Tailings	Involves handling and storage of large volumes of mill tailings	Long-term risk control of stability and effluents
Acid drainage	May be associated with both mine and waste rock areas	Long-term risk control
Reclamation	Major concerns for mine, dumps, and tailings storage	Long-term risk control
Noise/vibrations/dust	Main concerns are for haul-truck traffic, waste dumps, and blasting	Potential impacts on community well-being
Water effluents	Ammonium from blasting, sediment loading, metal dissolution, low pH	Potential impacts on community well-being

Adapted from Environment Canada 2009

consideration is minimizing the environmental footprint of mining. Indigenous people present a special case of community. They have specific social needs and very distinct systems of decision making, social and political institutions, and systems of wealth generation and distribution, often closely associated with land and natural resources.

These categories are not mutually exclusive. Indigenous communities may work in a mine and therefore be occupational communities too, whereas faraway communities may be outside the geographical area affected by mining impacts but host fly-in, fly-out migrant labor.

Community Impacts Through the Mining Life Cycle

Mining's impacts on community are complex and are variable throughout the different stages of the mining life cycle. During exploration, social and environmental impacts are limited and have a positive effect on the local economy. During project evaluation and feasibility stages, a significant amount of fieldwork and studies are performed, including the social and environmental baseline studies and project planning and engineering. In this stage, company–community interaction and information sharing becomes intense and potentially conflicting. The construction stage is comparatively brief but may have great short-term impacts with long-term implications. It may bring a boom in jobs but can also cause considerable physical and social upheaval, opening up remote areas through the development of infrastructure and stimulating migration to the area. The production stage has the longest-term positive impacts (e.g., income and infrastructure) but also negative and often unintended repercussions. The environmental impacts in this stage are mainly associated with day-to-day operations. Shocks and vibrations as a result of blasting in connection with mining can lead to noise, dust, and collapse of structures in surrounding inhabited areas. Unless fully controlled, mining operations also may be a source of social impacts and potential conflict (MINEO Consortium 2000). The impact of the closure phase depends largely on the degree of forward planning and the available means to sustain benefits, such as institutional capacity and financial resources.

During the exploration stage, activities are relatively nonintrusive and have limited, short-term impacts on the community (Government of Canada 2017). Access is seldom intensive and supports a few people for short periods of time. In most cases, environmental concerns are associated with noise from airborne surveys (impacts on wildlife), land geophysics, and earthmoving for diamond drilling. Exploration activities may require access roads, site preparation, transportation and storage of fuels, operating materials and core samples, the establishment of campsites for exploration crews, and other temporary infrastructure.

The construction stage can have potentially important environmental implications. The activities for site preparation (clearing, stripping, and grading) and infrastructure construction (plants and plant services) may have significant impacts on air quality, water quality, aquatic ecosystems, soil quality, and terrestrial ecosystems. For the establishment of mine workings (mine construction phase), the main concerns are the management of waste rock and mine water, and the generation of dust, noise, and vibration from drilling and blasting activities.

During the production stage, the primary concerns for social impacts are the disposal of waste rock and mill tailings and the management of mine and mill effluents (Table 4). In addition, ore extraction can generate impacts on community from dust, noise, and vibration, which are mainly the result of drilling and blasting, and ore and waste haulage. Potential impacts are also associated with the risk of spills and accidents, which could result from tailings dam failures and the release of chemicals used in ore processing.

Mine reclamation may overlap with operations. Regarding open pit mining, large areas of land may be disturbed through ore extraction and other mining activities. Disturbed areas are susceptible to erosion caused by both wind and water, which can lead to dust generation and water quality problems. Therefore, landscape rehabilitation, including reshaping and restructuring of the landscape and erosion control measures, may occur during the operations stages. These early reclamation works may also include the restoring of stockpiled soils in preparation for revegetation.

The mine closure stage should mainly focus on safety and the reclamation of land, water, and ecosystems to ensure that the mine site is self-sustaining and to prevent or minimize long-term impacts (Table 5). Land reclamation aims to restore waste dumps and tailings dams to achieve long-term physical and chemical stability, and also to rehabilitate disturbed areas to their natural or other acceptable use. The safety objectives include the capping of the shaft, raises, declines, and adits to ensure public and wildlife safety.

Community Perception of Sustainability

The community perception of a mining and metallurgical project depends on the type of community and how the community generally perceives mining projects. Community perception can change through time because of poor community

Table 5 Main components to be addressed in the mine closure plan

Components	Aspects to Be Addressed
Mining	Sealing of shafts, tunnels, and raises to prevent unauthorized access
	Slope stability, security access and fencing, wildlife entrapment
	Groundwater and rainwater, drainage into and from pit, ice plugs
Processing	Removal of infrastructure and disposal of scrap and building material
	Cleanup of workshops, fuel and reagent, site reprofiling and revegetation
Waste dumps and tailings dams	Effluents from seepage of surface and groundwater, surface water, and rainfall discharge
	Dump and tailings dam stability, long-term physical and chemical stability and changes
	Visual impact, dust generation, with special consideration to EM radiating ore
	Access and security, wildlife entrapment
Water management facilities	Restoration or removal of water reservoirs, settling ponds, culverts, pipelines, and spillways no longer needed; maintenance of permanent water facilities.
	Surface drainage of the site and discharge of drainage waters
Other infrastructure and facilities	Disposal or removal from site of hazardous wastes
	Removal of sewage treatment plant and disposal/stability of treatment sludges
	Removal of roads, power and water supply
	Access security and prevention of illegal dumping and groundwater contamination

Adapted from Environment Canada 2009

engagement, unintended events such as accidents and social conflict, or changes external to the mining operation. In the following sections, community perceptions are analyzed from the three perspectives of sustainable development (economic, environmental, and social).

Economic Perspective

From an economic perspective, communities can expect to receive compensation and substantial flows of revenue from mining, which can transform the economic and social basis of the communities and contribute to sustainable development at the community level. In addition, mining often provides local communities with new jobs and better salaries. In some regions, mining provides the bulk of job opportunities. As an example, the Grasberg copper and gold mine in West Papua, Indonesia, which employs 14,000 people, generated 75,000 indirect jobs as a result of Freeport-McMoRan's mining activities (Freeport-McMoRan 2017). Elsewhere, with the exception of the construction phase, many mines no longer generate significant numbers of local jobs.

Another important source of economic benefits to communities is the input services provided to mining operations. Companies are increasingly required to assist local business development, outsource services, and give preference to local businesses. However, increased demand may cause the prices of goods and services to rise locally. Moreover, the concentration of economic activity centered around the mine often increases the community's dependence on the mining operation, making it vulnerable to downsizing or other changes and exacerbating the power imbalance. On the other hand, since the company may also depend on the community for employees and services, a well-organized community can potentially make numerous demands on the company.

Environmental Perspective

The environmental problems related to mining and extractive metallurgy have been known since ancient times. In *De Re Metallica*, first published in 1556, German mineralogist Georgius Agricola, who traveled extensively in Saxony and its neighborhoods to visit mines and smelters, referred to mining and smelting of ores generating poisonous fumes at the workplace (Agricola 1950).

In this subsection, the main environmental problems of mining from the community's perspective are summarized. For a more detailed description of environmental impacts of mining projects, see the *Guidebook for Evaluating Mining Project EIAs* (ELAW 2010).

Problems related to water management and impacts on aquatic ecosystems. The effective management of mining water and effluents constitutes a primary environmental problem and community concern at most mines, especially in metal and coal mining and metallurgy. The main water management concerns include (1) segregating clean and contaminated water flows and recycling process water to minimize water usage and effluent generation and (2) addressing surface and groundwater contamination from seepage from mine rock and tailings containment structures. In this context, community concerns relate to water needs and the following environmental impacts:

- Most metallic ores and waste rocks contain sulfide minerals which, in the presence of water and oxygen, induce "acidic drainage," an oxidation process that generates metal-laden effluents of low pH. Acidic drainage results in the release of metals in effluents and, if not carefully managed, can significantly affect aquatic ecosystems and long-term liability for effluent treatment by mine owners/operators (Earthworks n.d.). Potentially, defective mine water and inadequate effluent management may also affect wildlife, such as plants, because the release of airborne particulate matter and seepage of groundwater or surface water may transport metals to areas adjacent to mine sites.
- Acidic drainage collected from waste dump mines is commonly treated with lime. A by-product of this treatment is sludge, a residue that may contain a wide range of metals. The volume of sludge produced may be large and is generally disposed of on-site or sent to smelters for recycling. There are uncertainties about the long-term chemical stability of many sludges and concerns that sludge could become an additional source of the release of metals.
- Flotation and other ore separation processes require high pH (alkaline), thus requiring the addition of lime and flotation reagents to ore pulps. As a result, alkaline effluents are produced and, if the water balance is positive, a well-controlled pH adjustment of effluents is necessary prior to discharge.
- Cyanide is used in the recovery of gold by heap leaching and other gold recovery processes. As a result, wastewater from processes using cyanide may contain cyanide and cyanide compounds. Cyanide is also used as a reagent

in flotation separation circuits. Thus, cyanide compounds may also occur from the recycling of process water from tailings ponds in some base metal flotation mills.
- Ammonia from ammonium nitrate and fuel oil (ANFO) and other blasting agents is soluble in water. Ammonium nitrate spilled in preparation for blasting or left over after a blast may reach aquatic ecosystems. In addition, ammonia may occur as a decomposition product from cyanide wastes.
- Wastewater may contain suspended solids ranging from colloidal (non-settleable) to settleable materials. Depending on its composition, settling of these solids may result in the contamination of sediments with metals and other contaminants, which may cause a range of problems in aquatic environments, including impeded oxygen intake by fish and reduced light availability for aquatic plants.
- Thiosalts are sulfur oxide compounds that result from partial oxidation during the milling, grinding, and flotation of some sulfide ores under high-pH conditions. Thiosalts are a concern because they can oxidize in water to form sulfuric acid, which lowers the pH of the receiving water and affects metal mobility, and significantly affects resident aquatic organisms.

Problems related to waste rock and tailings disposal. Tailings disposal has become a serious matter for the mineral industry. During the beneficiation of valuable metals and industrial minerals from their ores, large volumes of waste materials or tailings may be produced and these tailings may be harmful to the environment. It is now necessary to design and build tailings dams to store these waste materials for the modern mining industry. The possible social and environmental impacts related to mine tailings disposal are highlighted in the following list.

- Groundwater seepage is of concern for both waste rock piles and tailings management facilities. Seepage of rainwater through these structures could result in the release of contaminants through a permeable foundation layer or generate instability (IFC/World Bank 2007).
- Air quality impacts associated with the generation of dust are of concern. Dust may result from mining operations (e.g., drilling and blasting, crushing, loading, hauling, and transferring by conveyor). Also, wind-blown particulate matter may be released at open pits, waste rock piles, tailings management facilities, and stockpiles.
- Failure of dams or other containment structures for tailings can lead to severe environmental impacts and significant risks to human health. The risk of failure of these containment facilities (Kemp et al. 2016) is difficult to assess, mainly because they are built in several phases over many years and use waste materials from the mining operations, with limited or nonexistent quality assurance procedures for construction and maintenance. In addition, earthquakes can destabilize these structures, and catastrophic storms have the potential to flood tailings ponds. Regarding the risks related to heavy rains potentially eroding or destroying these structures, Environment Australia states that "It is self-evident that a Sediment and Erosion Control Plan is a fundamental component of a Mine Site Water Management Plan" (Environment Australia 2002).

Table 6 Main environmental concerns in extractive metallurgy

Industry	Concerns
Iron and steelmaking	Gases in coke production, slags, blast furnace, cyanides, electric furnace dust, pickle solution
Aluminum industry	Mercury, red mud, fluorine compounds, toxic organic compounds, cyanides
Sulfide ores: copper, lead, zinc, and nickel	SO_2, mercury, selenium, arsenic
Hydrometallurgical processes: gold, silver, copper, and zinc	Arsine, phosphine, cyanides
Radioactive ores: uranium and thorium	Radon gas (radioactive)
Industrial minerals: coal, phosphate rock, ilmenite, asbestos	Sulfur, ash, trace metals, nitrogen oxides, phosphogypsum, waste acid, toxicity of fibers, tailings

Adapted from Habashi 2012

Problems related to land management. Mining projects are characterized by extensive land requirements for the mine, plants, and the storage of waste rock and tailings, and the additional land development required to host employees and contractors. This large land requirement is of concern for hosting communities because it may affect migration routes, breeding grounds, or nesting areas and affect species that have special cultural significance to local communities. In addition, cattle and wild mammals may be dislocated from mine sites, which could have economic and cultural impacts.

Problems related to extractive metallurgy operations. Extractive metallurgy operations may take place at mine sites as part of mining operations in occupational communities or at custom metallurgical facilities treating concentrate for several mines and located near residential communities. In both cases, the communities near extractive metallurgy operations are concerned about environmental problems related to air emissions and the disposal of solid and fluid waste products (Habashi 2012), as summarized in Table 6.

Regarding air emissions, the smelting of sulfide ores results in the emission of sulfur dioxide gas (SO_2), which, once in the atmosphere, mixes with liquid and solid particles into raindrops and snowflakes that are carried back to the ground. Acidic rain increases the acidity of soils, streams, and lakes, harming the health of vegetation, fish, and wildlife populations. Inhaling SO_2 emissions causes eye and respiratory irritation in people at the plant and in the nearby community. Emissions from smelters also may contain arsenic, cadmium, and mercury in oxide form, which at concentrations above certain limits may be toxic.

A well-documented case history of pollution from extractive metallurgy in Sudbury (Ontario, Canada) is described by Winterhalder (1996). During the 1960s, after decades of smelting in the area, air pollution had generated more than 100,000 ha of barren or semibarren lands and acidified lakes. The situation changed in the late 1960s and 1970s when, under stricter environmental regulations (Buhr 1998), an extensive remediation plan was executed. The plan included the construction of a 380-m super stack and a regrinding program for regenerating 3,435 ha of barren land and planting more than nine million trees.

A lesser environmental risk is that related to the slags. In general, extractive metallurgy slags contain impurities of

toxic elements, such as Cu, Pb, Zn, Co, Cr, Ni, As, Cd, and so forth. These slags are recycled through the cement industry or disposed of as landfill. Before disposal, they are chemically stabilized, but environmental liability cannot always be excluded (Barcza et al. 1993).

Treatment of ores by hydrometallurgical methods produces residues and waste solutions. Solid residues filtered off aqueous solutions contain soluble compounds with the potential to contaminate surface waters or groundwater. Consequently, direct disposal into tailing ponds may be hazardous unless they are properly constructed (Reuter et al. 2004). Waste solutions containing toxic reagents must be treated before being discharged in streams (Habashi 2001).

Electrometallurgical processes are used in the aluminum industry and the electrorefining of copper and zinc. The processing of aluminum generates large amounts of gases and dust. Copper electrorefining and zinc electrowinning also cause pollution, but in lesser amounts since these processes have undergone intensive improvement.

Social Perspective

It is difficult to separate the economic impacts of mining operations from the social impacts. Mining helps a community become prosperous, and may tackle social ills such as malnutrition, illiteracy, and poor health. On the other hand, mining activities may cause economic hardship by polluting rivers and damaging fish stocks, for instance, or by appropriating grazing land and forestry resources.

Although mining generates a positive economic impact on the community, it may exacerbate existing social problems or create new ones, such as social inequality resulting from changes in the traditional income distribution and social status. For example, mining districts in Peru have larger income per capita and lower poverty rates than other districts, but consumption inequality within mining districts is higher than in comparable nonproducing districts (Loayza and Rigolini 2016). Also, a social audit of the Grasberg mine showed that the worsening inequalities in income distribution favor young adults, modifying their position and prestige vis-à-vis their elders and affecting traditional social structures (McMahon and Remy 2001). If people in a community perceive social inequality, this can result in social tension and even violent conflict within the community or between the community and the mining company or government.

Physical displacement, relocation, and resettlement associated with large-scale mineral development are widely acknowledged as posing enormous social risk (Owen and Kemp 2015). Communities may lose their land, and thus their livelihoods, disrupting community institutions and power relations. Entire communities may be forced to shift to purpose-built settlements, or into areas without adequate resources. They may be left near the mine, where they may bear the brunt of pollution and contamination. Involuntary resettlement can be particularly disastrous for indigenous communities with strong cultural and spiritual ties to the lands, who may find it difficult to survive when these are broken (IIED 2002). A paradigmatic example of the massive relocations near the Chuquicamata (Chile) and Butte (Montana, United States) mines is described by John Hillman (1999).

One of the most significant impacts of mining activity is the migration of people into a mine area, particularly where the mine represents the most important economic activity. For example, at the Grasberg mine, the local population increased from fewer than 1,000 in 1973 to between 100,000 and 110,000 in 1999 (Freeport-McMoRan 2017). Sudden increases in population can also lead to pressures on land, water, and other resources as well as introduce problems of sanitation and waste disposal. In San Ramon in Bolivia, for instance, migration led to an increase in land and housing prices and the saturation of public services, including schools.

The construction of a large mine can produce significant infrastructure improvements. Most mining operations of any size are served by airstrips, roads, water supplies, sanitation systems, and electricity. With some planning and a willingness to consult with the community, these can bring lasting benefits at little or no added cost. And the development of infrastructure may facilitate other forms of economic activity, such as tourism.

Health services typically increase markedly with the advent of mine development as companies develop facilities for employees and their families, but these may not necessarily translate into overall improvements in community health if the facilities are not made available to the broader community or if the introduction of new diseases and health risks associated with the mine are taken into account. Relatively isolated communities, including indigenous peoples, may be particularly vulnerable to diseases brought by miners, such as influenza, malaria, and HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome).

A key issue is sustaining health services and benefits in the community after mine closure, which might depend on the approach taken during the life of the mine. Training local health paraprofessionals, for example, might provide higher benefits in the long term than importing contract doctors. Also, some of the detrimental health effects of mining on communities (silicosis, asbestosis, etc.) may surface years after mining has ceased.

Mining companies are often involved in the provision of educational infrastructure or educational opportunities through scholarships. These can come in the form of corporate support or through trust funds or foundations, such as the Rio Tinto Aboriginal Foundation in Australia. However, because of a highly competitive market and the need to improve efficiency, there is a tendency to move away from providing services such as housing, schools, and health care for mine workers and their families, except in remote regions.

The social benefits of minerals development must be seen in the context of the many problems associated with mining-induced social change. Large mine development may be accompanied by the widespread availability and consumption of alcohol, an increase in gambling, the introduction of or increase in prostitution, and a widely perceived breakdown of law and order. Male-dominated mining camps and communities, such as those found in South Africa, often attract prostitutes and may lead to high levels of sexually transmitted diseases.

Mining operations are often perceived as widening gender disparities within communities. Women benefit from mining from better living standards and services such as water and electricity in occupational communities. There are also benefits from improved nutrition and access to medical services. However, women tend to bear a disproportionate share of the social costs and receive an inadequate share of the benefits. In occupational communities, women are more often spouses of mine employees, and are therefore passive recipients of benefits. There are few job opportunities for women in mining

communities, and this lack of job opportunities is aggravated by other limiting factors, including the relative isolation of many mine sites, the absence of local markets to support other economic activities, a lack of higher education institutions, and so forth. Increasing female employment at mine sites would not only bring direct benefits from increasing their incomes but would also help to mitigate many of the social ills, such as alcoholism and prostitution, found in some occupational communities. Clearly, strategies need to be developed for integrating women into the sector.

Conflict in and around mining operations usually stems from poor governance. It is also more likely to take place where the distribution of mineral revenues and benefits are nonexistent or perceived to be unjust, or where the community opposes and actively resists any mining activity on their land. Companies or even central governments may have little understanding of the customs and traditions of those living in and around the mines, and they may therefore be insensitive in their dealings with local communities, potentially fueling further conflict. It has been suggested that in many cases of conflict involving local communities and mining interests, radical environmental NGOs (often headquartered in a foreign country) have been involved whose primary aim is to contribute to tension in the community through misinformation and fearmongering.

In some cases, human rights abuses by police or security forces acting in the interests of the company may occur. Several complaints recently brought to the Community Aid Abroad Mining Ombudsman concerned Australian companies operating in various developing countries that had been removing people, sometimes violently, from their land or homes (Oxfam Community Aid Abroad 2004). In some instances, their houses, mining equipment, or other assets have been destroyed.

Mining activities can cause considerable disruption to local cultures, especially when the operations occur, as is increasingly the case in areas occupied by indigenous people who have had little contact with the outside world. Although some of the "Western" values imported by the mining company and its workers may be admirable or suitable, this is by no means always the case. Cultural clashes may occur, with deep-reaching, destabilizing effects on traditional ways of life.

Some local cultural traditions and practices decline, or their significance alters, which may be particularly lamented by older members of communities. At some locations, companies may deliberately intervene and try to support cultural institutions or events. A related cultural issue is that of geographic boundaries between groups. Borders that may have been fluid may become more precise and fixed as they become critical to obtaining benefits from a development. For example, a group's traditional rights to hunt in an area may not be recognized in the distribution of benefits from a mine if there are groups with a more complete set of rights (such as residence) to the area.

SUMMARY

Community and social issues are of paramount importance for sustainable mining, as acknowledged by the United Nations in *Berlin II: Guidelines for Mining and Sustainable Development* (UN 2002). In this report, sustainable mining is defined as "developing mining projects in a socially acceptable manner and ensuring that its benefits are employed in a way that will survive long after the mine is closed."

Three mining-specific factors explain why community and social issues are key for a mining company:

1. When an ore body is discovered, the geographical, social, and political environment become locked for the mine life.
2. Mining interaction with its social environment is strong, and sometimes communities rely extensively on mining for all or most of their income.
3. Mining activity generates employment and other social benefits for the community, but mining of an ore body is not sustainable in time and therefore neither are its socioeconomic benefits unless invested in sustainable social fabric.

Companies interact with communities through CSR actions; these are voluntary contributions beyond compliance with laws and regulations. Although CSR practices are voluntary, market pressures and stakeholders' demands are gradually leading to a situation where noncompliance with international CSR frameworks may bear an increasing social and economic risk. In fact, there is a growing evidence of the link between environmental and social performance and company financial performance, which eventually may lead to the "business case of sustainability," where the potential benefits in terms of higher operational efficiency, lower risk profile, and better reputation would balance the costs of CSR. In this context, many international institutions and multiparticipant initiatives (ICMM, GC, and others) have developed sustainable development frameworks, standards, and toolkits for voluntary adherence and assistance, as well as provided independent third-party auditing and assurance.

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