



Principles and criteria of sustainable development for the mineral exploration industry



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ABSTRACT

Mineral exploration has experienced significant growth over the past decade. Characterized by the absence of production revenues, mineral exploration companies rely on investors, who are increasingly concerned about environmental compliance and social acceptability. Although several guidelines have been developed (e.g. e3 Plus, ISO 26000, BNQ 21000), none provides for third-party evaluation and issuing of a certificate of compliance with sustainable development principles. Given the specificities of the mineral exploration industry, a sectorial certification standard would be better suited to frame their activities. This study suggests a set of principles and criteria of sustainable development that could be the basis for developing a sectorial standard for the mineral exploration industry. Available sustainable development guidelines were analyzed in order to obtain a preliminary list of principles and criteria. A Delphi survey involving 44 experts then allowed to obtain a final, consensual list of 8 principles (*Environmental quality, Quality of life, Work environment, Local investment, Business ethics, Transparency and reporting, Innovation, Economic efficiency*) and 27 criteria.

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1. Introduction

Mineral exploration has experienced significant growth over the past decade (Khindanova, 2012; SNL MEG, 2013). Having no

Acronyms: BNQ 21000, BNQ 9700-021 Développement durable, Guide pour l'application des principes dans la gestion des entreprises et des autres organisations; CEPME, Code for Environmental Practice for Mineral Exploration in Western Australia; e3 Plus, e3 Plus: A Framework for Responsible Exploration; ENGO, Environmental non-governmental organization; EO100, Equitable Origin's standard for oil and gas exploration and production; FRM, Framework for Responsible Mining: A Guide to Evolving Standards; FSC, Forest Stewardship Council; GERME, Guidelines for Environmentally Responsible Mineral Exploration & Prospecting in Western Australia; GHG, Greenhouse gases; GLPSD, Guide to Leading Practice Sustainable Development in Mining; GREMT, Guide for Responsible Exploration in Municipal Territories; GRI, Global Reporting Initiative; ICMM, International Council on Mining & Metals; IFC, International Finance Corporation; IISD, International Institute for Sustainable Development; IRMA, Initiative for Responsible Mining Assurance; ISO, International Organization for Standardization; ISO 14000, ISO 14000 – Environmental management Systems; ISO 26000, ISO 26000: 2010, Guidance on social responsibility; MCA, Multi-Criteria Analysis; PDAC, Prospectors & Developers Association of Canada; QMEA, Québec Mineral Exploration Association; TSM, Towards Sustainable Mining.

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production revenues, mineral exploration companies are not financially self-sufficient and have little access to loans (Miranda et al., 2005). They therefore depend on investors, who are increasingly sensitive to the environmental and social impacts of exploration activities (Humphreys, 2001; IIED and WBCSD, 2002; Klassen and McLaughlin, 1996). Mining activities – including mineral exploration – have often been associated with negative environmental impacts and social disruption (Miranda et al., 2005; Prno and Slocombe, 2012). Local communities are now more suspicious given the past behavior of some companies, especially those that have abandoned unrestored mineral exploration sites (Campbell et al., 2012; Lapointe, 2010; Luning, 2012).

To address the concerns of local populations, sustainable development standards have been developed for resource extraction industries such as forestry (e.g. FSC) or oil and gas exploration (e.g. EO100). Sustainable development standards include a certification procedure in which a third party gives written assurance that a product, process or service conforms to specific requirements, based on an audit conducted in accordance with agreed procedures (Grenard, 1996; Merger et al., 2011; Silva-Castaneda, 2012). There is currently no sustainable development standard regulating mineral exploration activities. Because sustainability requirements must be specifically developed for each sector of activity (Azapagic, 2004),

the standards developed for other industries might not be relevant to the mineral exploration context. Although sustainable development guidelines have been developed specifically for the mineral exploration industry (e.g. CEPME, e3 Plus, GERME, GREMT) they do not lead to certification following independent third-party auditing.

Given the particularities of the mineral exploration industry (few employees, lack of production revenues; Miranda et al., 2005; Jébrak and Marcoux, 2008), and given the different expectations of stakeholders regarding mineral exploration and mining (Laurence, 2011), a sectorial standard is needed to address corporate social responsibility and sustainable development challenges specific to mineral exploration. Such a certification standard would encourage better environmental and social practices, reassure investors and promote competitiveness (Bouslah et al., 2006; IIED and WBCSD, 2002). At the basis of the standard development process, principles are fundamental truths, further defined by criteria whose state is measured with indicators (Morin et al., 1996). This study suggests a set of principles and criteria of sustainable development that could be the basis for developing a sectorial standard for the mineral exploration industry.

2. Methodology

A content analysis was realized on 15 sustainable development guidelines selected for their relevance to mineral exploration, using the 9th version of the NVivo software (QSR International inc., Melbourne, Australia). This led to the identification of the most commonly used themes and the elaboration of a preliminary list of principles and criteria. In order to validate and enhance this preliminary list of principles and criteria, experts were consulted through a Delphi survey (Linstone and Turoff, 1975). In this method, the experts were first asked to individually evaluate the relevance of each criterion. The compiled results of this first round were then presented to each expert in a second round, allowing them to change their rating if they judged it necessary. Additional rounds could be necessary until the ratings settle. The whole process was completed without the experts actually meeting or knowing each other's identity, thus avoiding direct confrontation (Linstone and Turoff, 1975; Steurer, 2011). The aim was not to reach unanimity, but rather to assess the degree of consensus on the rating of each criterion (Ekionea et al., 2011). The Delphi method was preferred to Multi-Criteria Analysis (MCA), an oft-used criteria selection method (Antunes et al., 2006; Platts, 1996). MCA is used when criteria ranking is necessary (Komuro et al., 2006), which was not the case in this study.

A list of experts was elaborated for each stakeholder group (managers and employees of mineral exploration companies, sub-contractors, investors, local and aboriginal communities, environmental non-governmental organizations and governments), based on experience, expertise, reputation, occupation and knowledge of the mineral exploration industry. All experts were familiar with the Quebec and Canadian contexts. Nevertheless, the final list of principles and criteria of sustainable development for the mineral exploration industry will likely be relevant to other countries that share similar contexts.

In the first round of the Delphi survey, a questionnaire was sent to the participants using the SurveyMonkey software, asking them to evaluate the relevance of the preliminary list of criteria using a Likert scale with no central point, to establish a clear distinction between favorable and unfavorable positions (Trochim, 2006). Participants were allowed to add or reformulate certain items if necessary, and were asked to justify their answers or to provide any additional comments to clarify their views on each criterion. When processing the data, the consensus level was evaluated for each

criterion based on the proportion of participants having rated it as “relevant” or “highly relevant”, according to the following decision rule: high (80–100%), moderate (60–79%), low (50–59%) consensus (Ekionea et al., 2011).

In the second round, the experts were asked to reassess their judgment for the criteria that did not reach a high consensus level at the first round (Okoli and Pawlowski, 2004; Steurer, 2011). They were shown their original relevance rating, compared to the compilation of all ratings, and asked to justify whether they chose to maintain their initial rating, or modify it (Slocum, 2006). The experts were also asked to rate new criteria or criteria that were considerably modified after the first round following their recommendations. The Delphi survey ended when stabilization of the consensus levels of all criteria was reached.

3. Results

A preliminary list of eight principles, each comprising 1–6 criteria, was obtained from the analysis of the 15 sustainable development guidelines (Table 1). From the 66 experts that were invited to participate in the Delphi survey, 46 accepted and 44 completed the process: 18 experts involved in the mineral exploration industry (companies, contractors, investors), 19 experts from stakeholder groups affected by the industry (local communities, indigenous communities, ENGOs), and 7 experts from different governmental organizations (Table 2).

Following the first round of the Delphi survey, 20 criteria reached a high level of consensus, six reached a moderate level of consensus, and one required major rewording to clarify its meaning (Table 3). Furthermore, four criteria were added based on experts' suggestions. In the second round, the four new criteria and the reworded criterion reached a high level of consensus. From the six criteria that reached moderate consensus after the first round, four maintained the same consensus level and two reached high consensus after the second round (Table 3). Given that the consensus level was high or stable for all criteria after the second round, a third round was not necessary. The following sections summarize the experts' comments and recommendations for all the assessed criteria. A thorough description of their comments and suggestions is provided in Caron (2014).

3.1. Environmental quality

The *Environmental quality* principle included six criteria. They all reached a high consensus level after the first round and no new criterion was suggested. Regarding the *Efficient use of natural resources* criterion, the experts emphasized that water and waste management are the most important aspects. Some mentioned this criterion was not relevant as few resources are used in mineral exploration. The *Respect of sensitive areas* criterion was judged very relevant by a strong majority of experts, and several emphasized that, beyond the areas protected by law, it is essential to respect sensitive areas indicated by local communities. The *Air quality* criterion achieved a high consensus level, but several experts mentioned that it gains importance as exploration projects progress to advanced stages, when dust management becomes problematic. Experts mentioned the importance of managing dust and air contaminants when people lived nearby exploration operations, but only a few mentioned that impacts on wildlife should also be minimized. The *Water and soil quality* criterion reached perfect consensus. Specific issues were discussed, such as water management at camp sites, impacts of machinery operations on water and soils, wastewater from drilling, impacts of blasting, risks of underground water contamination, management of radioactive waste, as well as site restoration and rehabilitation. The *Wildlife*

Table 1
Preliminary list of principles and criteria of sustainable development for the mineral exploration industry.

Principles	Criteria
Environmental quality	Efficient use of natural resources Respect of sensitive areas Air quality Water quality Soil quality Wildlife habitat quality
Quality of life	Audible environment Visual environment Health and safety Recognition of local communities' concerns Recognition of indigenous communities' concerns Respect of cultural heritage
Work environment	Labor relations Working conditions Equity Occupational health and safety Training
Local investment	Social development Job creation Selection of local suppliers
Business ethics	Corruption prevention Promotion of sustainable development along the value chain Agreements Cost internalization
Innovation	Responsible use of technologies
Transparency and reporting	Information sharing
Economic efficiency	Optimal use of financial resources

Table 2
Distribution of participants based on stakeholder categories.

Stakeholders	Invited	Participants Round 1	Participants Round 2
Managers and employees	7	7	7
Subcontractors	18	5	5
Investors	7	6	6
Local communities	8	7	7
Indigenous communities	9	7	6
ENGOs	9	7	6
Government	8	7	7
Total	66	46	44

habitat quality criterion was particularly relevant for indigenous experts, as several cultural practices depend on wild plants and animal species. Moreover, the majority of experts stressed that the mere presence of humans, machinery, or helicopter flights might be disturbing to some wildlife species. Several participants emphasized the importance of avoiding the habitats of threatened or endangered species.

3.2. Quality of life

The *Quality of life* principle included six criteria which all reached a high consensus level following the second round. One criterion was added following suggestions by four participants: *Free, prior and informed consent*. The *Audible environment* criterion, which involved both noise and vibration, was reworded as *Audible and sensory environment*. This criterion was considered relevant for mineral exploration activities taking place near inhabited areas, or when projects progress to the mining stage. In addition to the impacts on host communities, some participants discussed the relevance of this criterion for wildlife, even in remote areas. The *Visual environment* criterion reached a high consensus level at the second round, as several experts mentioned the importance of restoring and rehabilitating the premises. In terms of *Health and*

safety of host communities, it was emphasized that mineral exploration projects can take several years, which may result in stress and anxiety in host communities. Despite the high consensus level, some experts considered this criterion as irrelevant, arguing that mineral exploration creates little impact on communities or that most activities take place in remote areas. In response to suggestions from some experts, the *Recognition of affected communities' concerns* and *Recognition of indigenous communities' concerns* criteria were reworded as *Consultation and accommodation of local communities* and *Consultation and accommodation of indigenous communities*. The participants emphasized the importance of negotiation transparency, disclosure, interest recognition and impact mitigation. Some participants stressed that the level of demands from local communities needed to be “reasonable”, and others mentioned the importance of considering the well-being of the entire population, not just that of host communities. The majority of experts rated the *Respect of cultural heritage* criterion as “very relevant”, stressing the importance of identifying sensitive areas beyond those recognized by law. Regarding the *Free, prior and informed consent* criterion, some experts emphasized that common good must prevail over individual good. On the other hand, some experts thought it was unfair for a community to be disadvantaged “for the greater good”, and that host communities should have the right to say “no”.

3.3. Work environment

The *Work environment* principle included five criteria, of which only two reached a high consensus level: *Occupational health and safety* and *Training*. Although many experts recognized that laws already govern occupational health and safety, this criterion was prioritized given the risks inherent to mineral exploration and given the lack of verification from the legislative authorities. The *Training* criterion reached a high consensus level as many discussed the importance of employee training with regards to environmental quality, health and safety, as well as quality of life in host communities. Some experts also argued that trained workers will

Table 3
Distribution of experts' judgments on the relevance of sustainable development criteria for the mineral exploration industry.

Criteria	Round 1					Round 2				
	Irrelevant	Not very relevant	Relevant	Very relevant	Consensus level	Irrelevant	Not very relevant	Relevant	Very relevant	Consensus level
Environmental quality										
Efficient use of natural resources		8.7%	41.3%	50.0%	High					
Respect of sensitive areas		2.2%	13.0%	84.8%	High					
Air quality	2.2%	15.2%	41.3%	41.3%	High					
Water quality			19.6%	80.4%	High					
Soil quality			26.1%	73.9%	High					
Wildlife habitat quality		6.5%	37.0%	56.5%	High					
Quality of life										
Audible environment ^a	2.2%	8.7%	56.5%	32.6%	High					
Visual environment		23.9%	60.9%	15.2%	Moderate		15.9%	72.7%	11.4%	High
Health and safety	2.2%	6.5%	26.1%	65.2%	High					
Consultation and accommodation of local communities ^a			26.1%	73.9%	High					
Consultation and accommodation of indigenous communities ^a		2.2%	30.4%	67.4%	High					
Respect of cultural heritage		2.2%	39.1%	58.7%	High					
Free, prior and informed consent ^b						4.5%	15.9%	34.1%	45.5%	High
Work environment										
Labor relations	2.2%	23.9%	54.4%	19.6%	Moderate	4.5%	27.3%	52.3%	15.9%	Moderate
Working conditions	2.2%	26.1%	47.8%	23.9%	Moderate	4.7%	30.2%	48.8%	16.3%	Moderate
Equity	4.4%	23.9%	37.0%	34.8%	Moderate	2.3%	18.6%	46.5%	32.6%	Moderate
Occupational health and safety	–	6.5%	28.2%	65.2%	High					
Training	–	10.9%	52.2%	37.0%	High					
Local investment										
Social development	6.5%	23.9%	41.3%	29.3%	Moderate	6.8%	31.8%	40.9%	20.5%	Moderate
Job creation		19.6%	54.4%	26.1%	High					
Selection of local suppliers		6.5%	47.8%	45.7%	High					
Selection of local workforce ^b						4.5%		45.5%	50.0%	High
Business ethics										
Corruption prevention	6.5%	15.2%	41.3%	37.0%	Moderate	2.3%	11.4%	38.6%	47.7%	High
Agreements		6.5%	32.6%	60.9%	High					
Cost internalization		8.7%	32.6%	58.7%	High					
Respect for sustainable development principles along the value chain ^c	2.2%	19.6%	43.5%	34.8%	Moderate		11.4%	36.4%	52.3%	High
Accountability of the Board of directors and management team ^b							4.7%	44.2%	51.2%	High
Transparency and reporting										
Information sharing	–	8.7%	26.1%	65.2%	High					
Independent verification of the information ^b							11.4%	36.4%	52.3%	High
Innovation										
Responsible use of technologies	–	4.4%	47.8%	47.8%	High					
Economic efficiency										
Optimal use of financial resources	2.2%	17.4%	41.3%	39.1%	High					

The consensus level was marked as high, moderate, or low when the sum of the “relevant” and “highly relevant” percentages was 80–100%, 60–79%, and 50–59%, respectively.

^a These criteria were slightly reworded, without changing their meaning. They were not reassessed at round 2.

^b These criteria were added following recommendations made by the experts at round 1.

^c This criterion was considerably reworded, resulting in a change of meaning. It was reassessed at round 2.

be able to find work elsewhere once an exploration project is over, thus contributing to employment sustainability. The *Equity*, *Labor relations* and *Working conditions* criteria did not reach a high consensus level, as many experts judged that mineral exploration companies only have a few employees, and that they often deal with subcontractors. Furthermore, experts frequently justified that there are laws and labor standards to which companies must comply, and that the mineral exploration workforce already benefits from good working conditions.

3.4. Local investment

The *Local investment* principle included three criteria, of which only *Social development* did not reach a high consensus level, as many believed that it is the government's responsibility, and that it really becomes relevant only at the mining phase. The *Job*

creation and *Selection of local suppliers* criteria were rated as relevant by the majority of experts because of local economic benefits and development expertise. Furthermore, a criterion was added, *Selection of local workforce*, which reached a strong consensus level. Several experts however mentioned that it may be difficult for companies to find qualified local workforce or adequate local suppliers, and that quotas should therefore not be applied.

3.5. Business ethics

The *Business ethics* principle included four criteria which all reached a high consensus level following the second round. As suggested by some experts, the *Sustainable development promotion along the value chain* criterion was reworded as *Respect for sustainable development principles along the value chain*, and a

criterion was added: *Accountability of the Board of directors and management team*. The majority of participants who assessed the *Corruption prevention* criterion as relevant argued that mineral exploration companies should develop and implement a code of ethics. Although the majority of experts assessed the *Agreements* criterion as relevant as it favors community trust towards companies, many mentioned that it becomes more important as a project approaches the mining stage. Some experts mentioned that mutual agreements often isolate citizens and reduce their ability to critically analyse the proposed conditions. The *Cost internalization* criterion was deemed relevant, but more to mining than to mineral exploration. Experts who assessed the *Respect for sustainable development principles along the value chain* criterion as relevant discussed the importance of selecting subcontractors and suppliers who apply principles of sustainable development. A strong majority of experts believed that the *Accountability of the Board of directors* criterion is essential to the social acceptability of a project.

3.6. Transparency and reporting

The *Transparency and reporting* principle only included one criterion: *Information sharing*. Four experts considered it irrelevant, either because of existing legal requirements, or because the information collected during the exploration stage is confidential. The vast majority of experts in favor of this criterion mentioned that transparency is essential for social acceptability and the establishment of trust between company and community. Beyond information sharing, most participants believed that host communities should have the opportunity to validate the information disclosed by mineral exploration companies through independent experts. Consequently, the criterion *Independent verification of the information* was added.

3.7. Innovation

The *Innovation* principle included only one criterion: *Responsible use of technologies*. It reached a high consensus level, but some experts stated that it may be difficult to quantify and measure.

3.8. Economic efficiency

The *Economic efficiency* principle included only one criterion: *Optimal use of financial resources*. It reached a high consensus level, but experts' opinions were mixed. On the one hand, some argued that the use of financial resources depends on the company's management and should not be part of a sustainable development standard. On the other hand, some experts emphasized the importance of maintaining fixed costs at a reasonable level, using all possible sources of funding, properly planning of projects in accordance to available financial resources, and establishing a remuneration policy.

4. Discussion

Although mineral exploration rarely leads to the actual development of a mine, it impacts the environment and affects communities (Laurence, 2011; Luning, 2012). The need to maintain social welfare and environmental quality motivates the creation of certification standards (Capron and Quairel-Lanoizelée, 2007; Lauriol, 2004). Several sustainable development guidelines, including certification standards, apply to the mining industry globally. In addition to the 15 sustainable development guidelines examined in this research, the Global Compendium of Sustainability Indicator Initiatives takes account of twenty sustainability

frameworks measuring the performance of the mining industry (IISD, 2013). Several studies have focused on the mining industry from a sustainable development perspective (e.g. Cowell et al., 1999; Humphreys, 2001; Jenkins, 2004; McLellan et al., 2009; Whitmore, 2006), or on performance indicators for the mining industry as a whole (Azapagic, 2004; Fonseca et al., 2013; Worrall et al., 2009). Few studies, however, have addressed principles and criteria of sustainable development that would apply specifically to mineral exploration.

4.1. A consensual list of principles and criteria of sustainable development for mineral exploration

For a sustainable development approach to be effective, clear evaluation methods are necessary (Lauriol, 2004). One of the first steps in the development of a certification standard, the definition of principles and criteria (BNQ, 2012; ISO, 2012; PDAC, 2012), was the subject of this research. The study of 15 sustainable development guidelines resulted in the production of a preliminary list of 8 principles and 27 criteria. This list was then submitted to a Delphi panel of 44 experts representing the main stakeholders associated with mineral exploration, resulting in a final, consensual list also consisting of 8 principles and 27 criteria, but with some modifications compared to the preliminary list.

In accordance with Ekionea et al.'s (2011) decision rule, only the criteria that obtained a high level of consensus were kept in the final list. Among the non-selected criteria, three fell under the *Work environment* principle: *Labor Relations*, *Working Conditions* and *Equity*. The experts who assessed these criteria as irrelevant referred to the small number of employees, and to the fact that the current regulatory system in Quebec and Canada already addresses these issues adequately. Given the importance of labor laws in the sustainable development guidelines developed at the international level (e.g. IRMA, FRM, ICMM, ISO 26000, IFC), the exclusion of these criteria from the consensual list would restrict the applicability of the certification standard in other areas, particularly in developing countries.

The other criterion that was not retained in the consensual list was *Social development*, under the *Local investment* principle. During the Delphi survey, several experts highlighted a fundamental characteristic of mineral exploration companies: the lack of production revenues. Thus, they pointed out that although the mining industry should participate in social development, this responsibility does not apply at the stage of mineral exploration, but rather when a mine is developed. Other experts emphasized that government agencies should take care of social development and that royalties are paid by mining companies for this purpose (Guj, 2012; Otto, 2006). However, the establishment of an adequate royalty system remains a challenge for many countries (Azapagic, 2004), including Canada (Chen and Mintz, 2013). Other criteria included in the consensual list, such as *Consultation and accommodation of (local and indigenous) communities*, as well as *Selection of local labor* and *Selection of local suppliers*, integrate dimensions of social development. Finally, the four criteria that were not retained – *Labor relations*, *Working conditions*, *Equity* and *Social development* – respectively reached consensus levels of 68.2%, 65.1%, 79.1% and 61.4% (all moderate). Although the exclusion of these criteria was justified because of the lack of coherence with the Quebec mineral exploration context, it should be stressed that the measure of consensus may vary between studies using Delphi surveys (Rayens and Hahn, 2000). Here, only one additional relevant assessment would have allowed the inclusion of the *Equity* criterion to the consensual list. Although cases of abuse in terms of labor rights in the mining industry are more frequent in less regulated countries, equity between men and women, or between indigenous and non-

indigenous people, remains an issue in Quebec and Canada (Chambre des communes Canada, 2010; Garon and Bosset, 2003; Marchand et al., 2007).

4.2. Stakeholder participation and positioning

The results of this study show little differences of opinion among stakeholders representing the three different positions relating to mineral exploration. The only criterion for which a discrepancy was observed is *Labor relations*, under the *Work environment* principle. The majority of government stakeholders assessed the criterion as irrelevant, stating that it was already regulated by laws, that mineral exploration companies only have a few employees, and that companies often deal with subcontractors. This criterion did not reach a high level of consensus in both the first and second rounds, as many experts from other stakeholder groups also assessed it as irrelevant, emphasizing the same reasons stated by government stakeholders.

The imprecise nature of principles and criteria could explain the convergence of views of the different stakeholder groups. It is to be expected that divergent concerns from the different stakeholders will be more exposed when developing indicators to infer the state and trend of the criteria (Center for International Forestry Research, 1999; Morin et al., 1996).

Although it reached a high level of consensus, the *Free, prior and informed consent* criterion generated the most divergent comments during the Delphi survey, in line with previous studies (Cariño and Colchester, 2010; Mahanty and McDermott, 2013; Szablowski, 2010). The first significant incarnations of free, prior and informed consent in the mining industry date back to the early 1990s and are part of Convention No. 169 of the International Labor Organization (International Labor Organization, 1991). Since then, its importance has increased, particularly because of the negative image of the mining industry in terms of social acceptability and compliance with environmental standards (Macintyre, 2007). Free, prior and informed consent is now included as a right in some states and as a dimension of many guidelines and voluntary codes (Lebuis, 2009). Financial institutions were among the first players to have included this dimension as a condition for investing in projects (Colchester and Caruso, 2005; MacKay, 2004; World Bank, 2004). The debate is now oriented towards the extent to which local communities should have decisive power over projects (Barstow-Magraw and Baker, 2006; Colchester and Ferrari, 2007; Lebuis, 2009; Satterthwaite and Hurwitz, 2005). According to some authors, mining companies must identify and deal fairly with all communities affected by projects, and accept “no” as an answer if that is the wish of the community (Goodland, 2012; Whitmore, 2006). For Rumbiak (2003), the failure to respect the will of communities to reject mining projects is a violation of human rights and is the source of many conflicts.

In addition to stakeholders' positions, it is also important to address their participation in a fair representation perspective. During the Delphi survey, the objective of a minimum of five experts per stakeholder group was reached (Table 2). However, unlike the participation rate of the other experts categories, it was difficult to reach subcontractors (18 invitations for 6 acceptances). The impression of being less concerned about the development of a certification standard for mineral exploration companies could explain this lack of interest. However, subcontractors have an important role in mineral exploration, and they could eventually feel pressure to obtain certification as well. The inclusion of the *Respect of sustainability principles in the value chain* criterion in the consensual list of principles and criteria confirms the potential effects of such a standard on subcontractors' activities.

4.3. Comparison of the consensual list with other sustainable development guidelines

The 27 criteria from the consensual list were compared to those included in the 15 sustainable development guidelines used to develop the preliminary list (Table 4). Six guidelines included at least 19 of the 27 criteria of the consensual list and therefore require special attention: FRM, EO100, ISO 26000, ICMM, BNQ 21000 and e3 Plus.

Among the 15 sustainable development guidelines analyzed, FRM addresses the highest number of criteria from the consensual list. One criterion is not directly addressed: *Selection of local suppliers*. However, of 91 “leading edge issues” addressed by FRM, which generally translate into criteria, only four apply specifically to mineral exploration. This is also the case for ICMM principles, which also apply to the mining industry globally. As for EO100, its indicators address sustainability issues that are specific to exploration in the oil and gas industry. Furthermore, as it is an international standard, it covers criteria that were not retained in the consensual list, such as working conditions and labor relations. ISO 26000 provides socially responsible guidelines for companies and organizations, but unlike other ISO standards, it does not lead to a certification involving auditing from a third party. This is also the case for BNQ 21000, which only provides guidelines enabling organizations to improve their practices by applying sustainable development principles (Cadieux and Dion, 2012). Both ISO 26000 and BNQ 21000 apply to all industries and raise sustainable development dimensions that are sometimes incoherent with the mineral exploration context, such as consumer protection, after-sales service, and responsible marketing. These sustainable development guidelines also address other criteria that were not retained in the consensual list, such as working conditions, labor relations and social development. As for e3 Plus, it is a voluntary tool developed by the PDAC for mineral exploration companies looking to improve their practices with regards to social responsibility, environmental stewardship and health and safety. Although it was specifically designed for the mineral exploration industry, it does not lead to certification.

5. Conclusion

This paper aimed to identify sustainable development principles and criteria that could be the basis of a specific certification standard for the mineral exploration industry. To do this, available sustainable development guidelines were analyzed in order to achieve a preliminary list of principles and criteria relevant to mineral exploration. A Delphi survey involving 44 experts then allowed to obtain a final, consensual list of 8 principles (*Environmental quality, Quality of life, Work environment, Local investment, Business ethics, Transparency and reporting, Innovation, Economic efficiency*) and 27 criteria specific to mineral exploration. The consulted experts included a fair representation of different stakeholders, according to best practices in standard development (Azapagic, 2004; Grolleau and Mzoughi, 2005; Thornber et al., 2000). None of the consulted guidelines included all of the criteria retained in the consensual list. Moreover, as most of these guidelines are adopted by companies on a voluntary basis and do not involve third-party evaluation, the consensual list of principles and criteria presented in this study could serve as a basis to develop a certification standard, and thus make a substantial and timely addition to the sustainable development assessment toolbox available to companies and communities. Additional work would be needed to broaden the scope to the international level (Grenard, 1996; Bridgeman and Hunter, 2007), as this study focused on the

Table 4
Final, consensual list of principles and criteria, and comparison with other sustainable development guidelines.

	FRM	EO100	ICMM	ISO 26000	BNQ 21000	e3 Plus	TSM	GLPSDM	IFC	CEPME	IRMA	Goodland	GERME	GREMT	GRI
Environmental quality															
Efficient use of natural resources	X	X		X	X	X	X	X	X	X	X				
Respect of sensitive areas	X			X		X					X	X			
Air quality	X	X		X	X	X	X	X	X	X					X
Water quality	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Soil quality	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Wildlife habitat quality	X	X	X	X	X	X	X	X	X	X					X
Quality of life															
Audible environment	X	X			X			X		X					
Visual environment	X	X	X	X	X	X		X	X	X			X		
Health and safety	X	X	X	X	X	X	X	X	X						
Consultation and accommodation of local communities	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Consultation and accommodation of indigenous communities	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Respect of cultural heritage	X	X	X		X	X	X	X	X	X	X			X	
Free, prior and informed consent	X	X							X		X	X			
Work environment															
Occupational health and safety	X	X	X	X	X	X	X	X	X		X				
Training	X		X	X	X	X		X							
Local investment															
Job creation	X	X	X	X		X	X	X							
Selection of local suppliers		X	X	X	X	X	X								
Selection of local workforce	X	X	X	X		X	X								
Business ethics															
Corruption prevention	X	X	X	X	X										
Agreements	X	X							X	X	X	X		X	
Cost internalization	X	X	X	X	X	X			X	X		X	X		
Respect for sustainable development principles along the value chain	X		X	X	X			X	X						
Accountability of the Board of directors and management team	X	X	X			X	X			X					
Transparency and reporting															
Information sharing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Independent verification of the information	X											X			
Innovation															
Responsible use of technologies	X		X	X			X								
Economic efficiency															
Optimal use of financial resources	X		X		X										
Total criteria met/27	26	21	20	20	19	19	16	16	15	14	11	10	7	5	3

mineral exploration context in Quebec and Canada. Nevertheless, the principles and criteria presented here would likely be relevant in other countries sharing similar contexts.

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