

## Original article

## Preconditions for successful implementation of the Finnish standard for sustainable mining

Eeva Ruokonen

School of Chemical Engineering, Aalto University, PL 16300, 00076 Aalto, Finland



## ARTICLE INFO

## Keywords:

Mining industry  
Sustainability initiative  
Towards sustainable mining  
Mining standard  
Implementation

## ABSTRACT

Mining companies are facing various environmental and social challenges, ranging from ecological concerns to community relations issues. In Finland, mining companies have responded to these challenges by developing a sustainability initiative to increase their responsibility. This study is based on a questionnaire administered to senior mine managers to capture their views on the matter. This research argues that for successful implementation of the 'Towards Sustainable Mining Standard', organizations need certain leadership and management processes to support implementation. This research also argues that organizations need a set of sustainability initiatives to guide their operations towards improved environmental performance. This research shows that sustainability initiatives play an important role in mining companies' operations, and companies are committed to several initiatives in their businesses. Results show that top management commitment, adequate resource allocation, and a functioning management system with an emphasis on communication and stakeholder engagement are essential to support implementation.

## 1. Introduction

## 1.1. Background

Major developments in the global mining and metals industry in the 1990s led to the development of sustainability initiatives (e.g. Brereton, 2002; Dashwood, 2012, 2014; Franks, 2015; Tost et al., 2018; The World Economic Forum [WEF], 2016). Commodity prices were low, and investors were reluctant to invest in mining operations. In addition, several highly publicised major environmental incidents in the 1990s resulted in a growing global environmental movement against mining (e.g. Dashwood, 2012; Franks, 2015). Due to weakened public trust and sullied reputations, major mining and metals companies instituted the Global Mining Initiative in 1998, aiming to develop the industry's role in the transition to sustainable development (International Council on Mining and Metals [ICMM], 2018; International Institute for Environment and Development [IIED], 2002).

Since then the mining industry has developed its approaches towards environmental considerations, including its relations with society and local communities (Franks, 2015; Tost et al., 2017; WEF, 2016), and implemented numerous sustainability initiatives developed for the mining industry (Kickler and Franken, 2017; Potts et al., 2018; Ranängen and Lindman, 2017; Virgone et al., 2018; WEF, 2016).

Fraser (2019) studies mining companies and the United Nation Sustainable Development Goals (SDGs) and argues that managers should align their business strategies accordingly to advance implementation.

The Finnish Network for Sustainable Mining (hereafter the Network) was set up in 2014 to ensure that mining practices in Finland are responsible and to promote open dialogue with all stakeholders (Kaivosvastuu, 2015). The Network operates as its own entity, even though it is placed administratively under the auspices of the Finnish Mining Association (FinnMin). In 2016, the Network introduced the 'Finnish Towards Sustainable Mining Standard' (hereafter the Mining Standard) as a framework for mines to adopt voluntarily. The Mining Standard is based on the 'Canadian initiative Towards Sustainable Mining' (TSM) but is adjusted to Finnish legislation and context (Yrjö-Koskinen, 2015). It is noteworthy that the Mining Standard was developed by a wide range of stakeholders, such as environmental NGOs (non-governmental organizations), other industries (such as tourism and reindeer herding), the mining industry itself and local communities, and it is important to show results in terms of continued positive cooperation. Due to the short history of the Mining Standard, public information is limited to what was written by the Finnish Innovation Fund Sitra (Sitra, 2015) and the Finnish Network for Sustainable Mining (Kaivosvastuu, 2015) during the development phase of the Mining Standard.

Fraser (2019) argues that the decline in trust of mining companies is

E-mail address: [eeva.ruokonen@aalto.fi](mailto:eeva.ruokonen@aalto.fi).

<https://doi.org/10.1016/j.exis.2020.03.008>

Received 29 November 2019; Received in revised form 16 March 2020; Accepted 17 March 2020

Available online 06 April 2020

2214-790X/ © 2020 Elsevier Ltd. All rights reserved.

**Table 1**  
Types of initiatives the mining industry is engaged in.

	Groups	Examples of initiatives
General initiatives	Global principles and guidelines	The Universal Declaration of Human Rights United Nations Global Compact The OECD Guidelines for Multinational Enterprises
	Management standard systems	ISO 14001 Environmental Management Systems, ISO 26000 Social responsibility, ISO 45000 Health & Safety, ISO 50001 Energy management, ISO 9001 Quality Management Systems
	Reporting and financial market initiatives	Global Reporting Initiative (GRI) AccountAbility's AA1000 standards Global environmental disclosure system (GDP)
Mining Initiatives	Commodity focused	Aluminium Stewardship Initiative (ASI)
	Issue focused	Kimberley Process (KP) is a commitment to remove conflict diamonds from the global supply chain
	Large-scale mining scale mining	Canadian Towards Sustainable Mining (TSM) Initiative for Responsible Mining Assurance (IRMA) Fair-minded standard for gold from artisanal and small-scale mining

due to a lack of alignment between mining companies' strategies and values of society. In this case, accordingly, for successful implementation of the Mining Standard, organizations need the involvement of company management to support implementation. Efficient leadership and management processes are needed for company management to ensure successful implementation of sustainability considerations (Atkinson et al., 2000; Epstein and Buhovac, 2014; Halme et al., 2018), as there is often a gap between strategic intention and implementation (Engert and Baumgartner, 2016; Epstein and Roy, 2001; Ruokonen and Temmes, 2019). In particular, mining companies need to understand stakeholders' expectations (Hedin and Ranängen, 2017), as management's views can differ from those of stakeholders (Mzembe and Downs, 2014), and companies should practice respectful dialogue with stakeholders (Conde and Le Billon, 2017; Sairinen et al., 2017) as part of normal operations. The benefits are mutual, since proactive engagement with local communities can improve regional economies (Basu et al., 2015).

### 1.2. Purpose and significance of this paper

This research contributes to the literature of the mining industry's sustainability initiatives through empirical analysis. The number of sustainability initiatives is vast, and previous research has focused mainly on explaining their content and criteria (Kickler and Franken, 2017; Potts et al., 2018; WEF, 2016) while less attention has been paid to explaining how organizations can successfully implement these initiatives. Therefore, the objective of this paper is to assess the preconditions for implementation to ensure that the full benefits of the Mining Standard are achieved.

The topic is relevant in two ways. First, the Finnish mining industry is currently implementing a new Mining Standard and for effective implementation, a mine needs a strategic approach to environmental management. Secondly, as new mines are expected to be opened (Tuusjärvi et al., 2014), the results of this research can facilitate the new mining organization's implementation of the Mining Standard.

### 1.3. Research questions

The overall question is whether we can expect that with the Mining Standard alone mining companies can improve their environmental performance. In order to answer the overall question, the research questions (RQ) addressed in this paper are:

*RQ1. What are the mine management's experiences with the Mining Standard, and what are the expectations of the benefits implementing the Mining Standard?*

*RQ2. What are the essential leadership and management processes to support the implementation of the Mining Standard?*

Following this introduction, the theoretical background is presented. Next, the research material and methodology are presented in Section 3, in which the reliability and validity are discussed (3.2.1). After the results, the discussion and conclusion are presented.

## 2. Theoretical background

This section describes the sustainability initiatives the mining industry is engaged in, along with the general content of the Mining Standard, and also opens up the theoretical background for leadership and management processes for sustainability strategy implementation.

### 2.1. Sustainability initiatives

The mining industry employs various tools, programs, standards, guidelines and frameworks to increase sustainability. In this research, they are called sustainability initiatives and referred to as initiatives. Though the initiatives contain, to varying degrees, social, economic and environmental aspects, they are all called sustainability initiatives.

Initiatives have been created to address specific environmental, social, and economic aspects, and therefore the content and requirements vary considerably among them (Potts et al., 2018). Sustainability initiatives exist for different mining scales and supply chain coverages, various geographical areas, certain commodities or all minerals, and various objectives (Kickler and Franken, 2017; Potts et al., 2018; WEF, 2016), and the classification of the sustainability initiatives differs between researchers. The combination of the classifications is presented in Table 1.

Ranängen and Lindman (2017) identify initiatives in which the Nordic mining companies, including Finland, are engaged; Global Reporting Initiative (GRI), International Organization for Standardization (ISO) 14001 and Occupational Health and Safety Assessment Series (OHSAS) 18001 are three of the most-used by the seven companies Ranängen and Lindman (2017) studied. Based on the research by Ranängen and Lindman (2017), the Nordic mining companies apply eight initiatives on average in their operations. It is notable that the GRI mining supplement is the sole standard especially designed for the mining industry.

The adoption of sustainability initiatives originates from investors, customers, society, and regulation (Potts et al., 2018; WEF, 2016). According to Potts et al. (2018) the adoption of initiatives may bring several strategic benefits, such as better positioning compared to competitors, improved reputation and product branding, reduced operating costs with improved operational efficiency, reduced risk levels, meeting customer and investor requirements, and also showing compliance.

Some researchers criticise sustainability initiatives. There is a continued lack of comprehensiveness or holistic consideration (WEF, 2016), and some issues are poorly addressed in existing

initiatives (Potts et al., 2018; Virgone et al., 2018; WEF, 2016). Mining companies are largely using the Global Reporting Initiative as a reporting standard (Fonseca et al., 2014; Virgone et al., 2018) and indeed have improved their sustainability and environmental reporting (Jenkins and Yakovleva, 2006; Lee, 2017; Lodhia and Hess, 2014; Lokuwaduge and Heenetigala, 2017). However, the mining companies' GRI reports are criticised for not being comparable (Boiral and Henri, 2017) and there is room for improvement (Fonseca et al., 2014; Northey et al., 2019). The number of sustainability initiatives is rising (Potts et al., 2018; WEF, 2016), and it is understandable that researchers suggest harmonization and creation of linkages between initiatives (Kickler and Franken, 2017; WEF, 2016). The World Economic Forum (WEF, 2016) reiterates that the mining industry is looking for practical initiatives that can be implemented through their management system, which supports the harmonization suggestion. Kickler and Franken (2017), who identify 158 initiatives specifically for mineral resources, raise the question about management practices as requirements within the sustainability initiatives, concluding that they include, to varying degrees, demands on management for better performance. Kickler and Franken (2017) suggest aligning the initiatives according to existing environmental or safety management systems (e.g. ISO 14001, OHSAS 18001) for easier implementation.

## 2.2. Features of the Finnish 'Towards Sustainable Mining Standard' (Mining Standard)

This research focuses on the Mining Standard, which was developed to serve mining companies operating in Finland. The Mining Standard is governed by the Finnish Network for Sustainable Mining. The Network board has equal representation from the mining industry, environmental NGOs, other industries, and local communities. The Mining Standard consists of the guiding principles and assessment protocols for managing risk, such as dialogue with communities and environmental, safety and health practices. Compared to the Canadian TSM, the Finnish Mining Standard is complemented by two additional assessment protocols, water management and mine closure, covering then the entire life cycle of mining operations. Each of the assessment protocols consists of performance indicators with criteria for five performance levels. The complexity of assessment criteria for each level increases from the lowest to the highest performance level. When the system is in place, mines will be audited regularly and the audit results will be reported publicly. The Mining Standard, with its requirements, is published in Finnish and English at [www.kaivosvastuu.fi](http://www.kaivosvastuu.fi).

The Mining Standard protocols consist of various technical,

environmental, social, and operational requirements (Table 2), even though the main focus is on environmental issues. After reviewing the assessment protocols and indicators for this paper, the conclusion is that some leadership and management process requirements are present through all or most of the protocols, as presented in Section 4.3 in Table 4.

As a summary, the Mining Standard is a site-based initiative, adjusted to Finnish legislation, targeted to large scale-mining and all mineral commodities. The Mining Standard consists of various technical, environmental and social requirements, but also some leadership and management requirements. Transparency is built in with requirements for external assurance and public reporting of the audit results. The aim is for mines to improve their performance on a voluntary basis stepwise and at their individual pace.

## 2.3. Leadership and management processes for sustainability strategy implementation

Strategy is defined as a game plan for achieving goals and competitive advantage (e.g. Hitt et al., 2005; Kotler, 2000). Porter (1996) reminds us furthermore that “the essence of strategy is choosing to perform activities differently than rivals do.” Kotler (2000) lists processes for strategy implementation - namely strategy, structure, and systems - reminding us that a company also needs elements such as shared values, right skills, common ways of thinking and behaving, and competent people.

In this context, sustainability strategy is defined as a company's commitments to sustainability aspects as part of its business strategy. Baumgartner and Rauter (2017) argue that “the lack of strategic orientation in corporate sustainability management is one major reason for lack of progress in this field,” while Epstein and Buhovac (2014) remind us of the importance of incorporating sustainability into management decisions. Various researchers have contributed to explaining sustainability strategy implementation processes: in their study, Engert and Baumgartner (2016) summarise several theoretical models and empirical studies on the implementation of corporate sustainability strategies. In order to operationalise company sustainability commitments, certain managerial and leadership processes are essential (Engert and Baumgartner, 2016; Epstein and Buhovac, 2014), highlighting the importance of strong leadership and embedding sustainability strategy into overall management processes as summarised in Table 3. Both models include processes for an efficient management system with an emphasis on external communication.

In order to manage environmental considerations, companies have

**Table 2**  
Selected requirements within the Mining Standard classified by their content.

Classification	Examples of requirements	Assessment protocol
Social	The <b>social and societal impacts</b> of the project have been assessed... The facility's <b>lost-time injury frequency rate is less than 5</b> taking account of the <b>impacts of mine closure on the surrounding community</b> and identifying measures to <b>minimise any adverse socioeconomic impacts</b> of mine closure	Community Outreach Health and Safety Mine Closure
Environmental	The company is committed to <b>balancing the negative biodiversity impacts of its operations with biodiversity offsetting</b> The company is committed to <b>ensuring that the net impact of its operations on biodiversity is positive</b> describes how it has <b>prepared for exceptional circumstances and climate change</b> in its water management has specified the <b>impacts on water bodies</b> The company participates significantly in the <b>protection of fresh water resource</b> the controlling of GHG emissions and the planning of measures for increasing the <b>use of renewable energy sources</b>	Biodiversity Conservation Biodiversity Conservation Water Management Water Management Water Management Energy and GHS
Technical	The company is committed to studying <b>emerging technologies and techniques</b> , and applying these to its operations	Mine Closure
Leadership and Management processes	<b>Management visibly demonstrates a commitment...</b> <b>Systems/processes have been integrated into management decisions and business functions</b> <b>Roles, responsibilities and accountabilities</b> are clear... General energy use and GHG emissions <b>awareness training is provided...</b> <b>Public reporting</b> meets the requirements of the best available practices A formal <b>external, independent audit</b> to ensure...	Health and Safety Community Outreach Biodiversity Energy and GHS Water Tailings Management

**Table 3**

Leadership and management processes for sustainability strategy implementation according to Engert and Baumgartner (2016) and Epstein and Buhovac (2014).

Processes by Engert and Baumgartner (2016)	Summarised content of each process
Leadership	Managerial attitudes and values regarding issues of sustainability.
Organizational culture	Incorporating sustainability strategies and activities into an organizational culture.
Organizational structure	Organizational structure which is appropriate to strategy and processes.
Management control	Management systems and standards, performance indications and assessing processes.
Employee motivation and qualification	Central factor in implementation process. Sufficiently qualified and trained personnel, employee motivation with leadership
Communication	Includes internal and external communication. Internal communication is important for implementation of sustainability considerations, while external communication through stakeholder dialogue is used as input for strategy process
Processes by Epstein and Buhovac (2014)	Summarised content of each process
Leadership	Top management displays visible commitment and effective communication of mission, vision and strategy. Creation of culture that encourages sustainability throughout the organization.
Strategy	Aligned with company strategy, which takes into account necessary inputs.
Organizational structure	Shared responsibilities for sustainability throughout the organization. Adequate resources for the implementation and control of sustainable strategies. Top management access for sustainability officer.
Sustainability systems, programs and actions	Management systems include processes to implement strategies, such as identification of sustainability-related risks and opportunities, budgeting processes, performance evaluation and reward system to improve sustainability performance, and performance measurement system for managerial decision-making and for communicating management priorities. Feedback system to identify areas of improvement. External reporting is for sharing sustainability performance to stakeholders, and verification of reports increases stakeholder confidence.

adopted environmental management standards, such as ISO 14001 (Salim et al., 2018; Virgone et al., 2018), which specifies requirements that enable an organization to achieve the intended outcomes. The approach of the standard is based on the concept of Plan-Do-Check-Act, which is an iterative process to achieve continual improvement (ISO 14001:2015, 2015). The ISO 14001 consists of the same elements as models by Epstein and Buhovac (2014) and Engert and Baumgartner (2016), but the emphasis on continual improvement is more evident.

Kirkland and Thompson (1999) affirm that implementation of environmental management systems is challenging, and certain processes are needed, such as training, resources and commitment. Halme et al. (2018) argue that external pressure together with a well-managed environmental management system are likely to lead to improved environmental performance.

As a summary, for efficient implementation of sustainability strategies, a set of interrelated leadership and management processes are needed. To study the importance of these processes, this research uses models by Epstein and Buhovac (2014), Engert and Baumgartner (2016) and the ISO 14001 environmental management system (ISO 14001:2015, 2015), as explained in section 3.1.

### 3. Research material and methodology

#### 3.1. Research design

This research is descriptive and quantitative using frequency analysis. In order to study the preconditions for successful implementation of the Mining Standard, this research is divided into three parts. First, the *implementation experiences* were studied with general questions on the Mining Standard and its governance (survey questions 8, 12, 14 and 21 in Appendix A). Secondly, since mining companies may perceive various strategic advantages with the uptake of sustainability initiatives (Potts et al., 2018), the *strategic expectations* that the mine management perceived, were studied with a question inspired by a sustainability business value-creation model from Laszlo and Zhexembayeva (2011) as presented in survey question 9 in Appendix A. Further details on the model are reported in Ruokonen and Temmes (2019).

Thirdly, the importance of certain *management and leadership processes* was studied with questions inspired by models from Epstein and Buhovac (2014), Engert and Baumgartner (2016) and the ISO 14001 environmental management system (ISO 14001:2015, 2015) as presented in survey questions 10, 11 and 19 in Appendix A. That particular survey question was formulated by asking respondents' views on

implementing environmental strategies, even though the Mining Standard covers a broader scope, including protocols on safety, crisis management, and stakeholder dialogue. The environmental scope was chosen to simplify and minimise the questions, and also to avoid double-barrelled questions. However, when a question precisely concerned the Mining Standard, the question was formulated asking about the standard as a whole, not only the environmental considerations.

#### 3.2. Questionnaire survey research

##### 3.2.1. Survey

The survey questionnaire was pretested by five persons: two from academia and three from the target population. The survey consisted of 26 questions altogether, from which 15 are used in this article (Appendix A): 7 questions on *Background Information* on the mines that the responders represent, 6 questions on *Implementation of the Mining Standard*, and 2 questions on *Management and Leadership Practices for Environmental Considerations*. The questions chosen for this study were designed to respond to this particular research problem and research questions. The survey consisted of four sections, of which, three are used in this study. This study is part of research, which claims that mine management needs strategic approach to manage environmental and social considerations. The questions, which are not used in this study, will be used to study the driving forces that will advance environmental considerations and the overall environmental direction the mining industry is currently taking.

The survey collected multiple types of answers, such as closed and open questions, multiple choice lists, and scales. The questions were formulated mainly so that the respondent's opinion was asked at the start of the question, such as "according to your opinion" or "based on your understanding." The survey was sent to respondents through an online survey platform. The survey was prepared so that neither the respondent's nor the company's name was asked in the questionnaire.

##### 3.2.2. Response rate and statistical analysis

Since the target population is small, an extra effort was made to maximise response rate, and guides from literature (e.g. Bryman and Bell, 2015; Van Mol, 2017) were used. A minimum of one person from each mining company was first contacted by phone or email to ask if they were willing to participate in the survey and to whom to send the survey. After the invitations were sent, the initial contacts were reminded once or twice to challenge their colleagues to participate in the survey. Everyone received a reminder email about participating. The cover letter provided guarantees of confidentiality and explained the



purpose of the survey, and the invitation email reminded them of the importance of a high response rate. Extra care was taken with attractiveness of the questionnaire layout. The invitation email was signed by the Finnish Mining Association to get the recipients' attention in order to improve the response rate.

The online survey was open from March 8 to April 3, 2018. In total, 36 responses were received, resulting in a response rate of 71%. Based on Mangione (1995) in Bryman and Bell (2015), the response rate is classified as "very good." The raw data was transferred into Excel, and responses were coded and analyzed for frequencies.

### 3.2.3. Scope of the study and sample characteristics

The questionnaire was sent by email to 51 persons in managerial positions representing 15 mining companies. The survey covered the whole mining sector in Finland, as the target companies represent 99.7% of the annual ore production in 2017 in Finland. One small industrial mineral mining company with ore production of 0.1 Mt was left out due to lack of contact information. Since the population is small, the survey was done as a census. In a census study the data is collected in relation to all units in a population (Bryman and Bell, 2015) and is subjected to non-sampling errors (Cantwell, 2011), such as non-response. Therefore, it was appropriate to stress the importance of maximizing the response rate as explained in Section 3.2.2.

The respondents were from various types of mines in terms of such characteristics as number of employees and annual ore production (Appendix B). Respondents were mainly members of management groups (81%) and occupy senior roles. Several researchers emphasise the importance of top management commitment for different aspects of sustainability implementation (e.g. Atkinson et al., 2000; Dobelet al., 2014; Epstein and Buhovac, 2014), and this study is based on a questionnaire administered to senior mine management to ascertain their views of the matter. This research does not study the content of the Mining Standard nor its relevance in addressing effectively the environmental and social concerns it deals with.

## 4. Results

The results are described in three separate sections, as presented in Section 3.1, starting with experiences of implementing the Mining Standard, moving toward expectations regarding it, and ends with results regarding perceptions of the importance of leadership and management processes.

### 4.1. Implementation experiences

This study reveals that altogether 81% of the respondents cited they are going to implement the Mining Standard. In total, 8% of the respondents have implemented, 56% have started to implement and 17% have not yet started to implement the Mining Standard.

Transparency is built into the Mining Standard through a requirement of external verification and public reporting of the verification results. The survey respondents were asked how those external audits should be conducted and also how the standard should be embedded into overall business management systems. The respondents recognised that the Mining Standard should be integrated into existing business management systems (81%). The opinion of audits was not as unanimous. 42% of the participants cited that the Mining Standard should be audited together with existing management systems and 22% wanted a separate external audit. Since some of the mines are also implementing other mining initiatives, such as Canadian TSM, respondents felt the audits should be interchangeable (17%).

The following question focuses on understanding how respondents have improved their environmental performance with voluntary initiatives. The positive impacts of a corporation's own management system and the use of the ISO 14001 management system were substantial (Fig. 1). However, at the early stage of implementing the

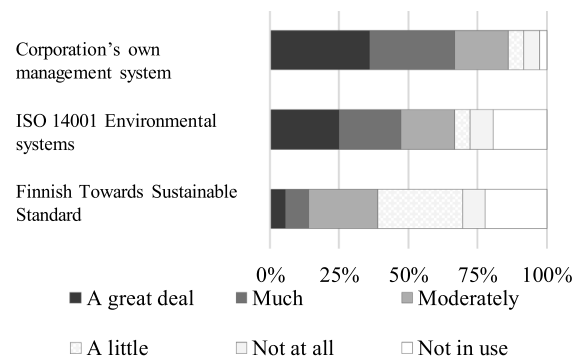


Fig. 1. The respondents' views on how much self-regulation tools have improved their environmental performance. The percentage represents how many of the respondents chose a scale category. N = 36.

Mining Standard (within two years of its introduction), 14% cited substantial benefits with its use.

Based on this survey, the respondents agreed broadly that the Mining Standard covers all relevant sustainability aspects (78%), and, with it, that the organizations are aiming for operational excellence (75%). Also, 56% of the respondents perceived that its requirements are logical.

### 4.2. Strategic expectations

Respondents were asked their opinions about the expected benefits that using the Mining Standard might eventually bring to their organizations at the mines. Based on this survey, the most important benefits are related to reputational issues and improving operational performance (Fig. 2). The reputational issues are related to demonstrating transparency, improving acceptability, and enhancing their company brand. The key benefits to improving operational performance are related to risk mitigation and continual improvement. The respondents see the Mining Standard as a means to improve environmental efficiency, such as minimizing waste, energy, and materials (question 9 in Appendix A). The least important benefits are related to products and new business.

### 4.3. Leadership and management processes

Respondents were asked who and what are needed for the successful implementation of the Mining Standard. The role of their own personnel is essential while the need for external consultants is low (Fig. 3). The roles of mine management, line managers, and environmental experts are crucial when an organization is implementing the Mining Standard.

The survey highlighted that, for successful implementation, organizations need enough human resources, and also training and

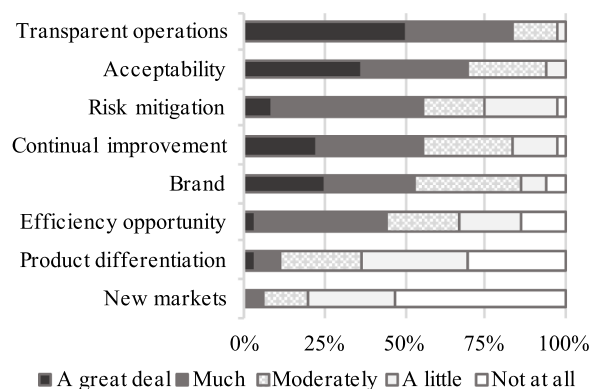


Fig. 2. The expected benefits for using the Mining Standard. The percentage represents how many of the respondents chose a certain 5-point scale. N = 36.

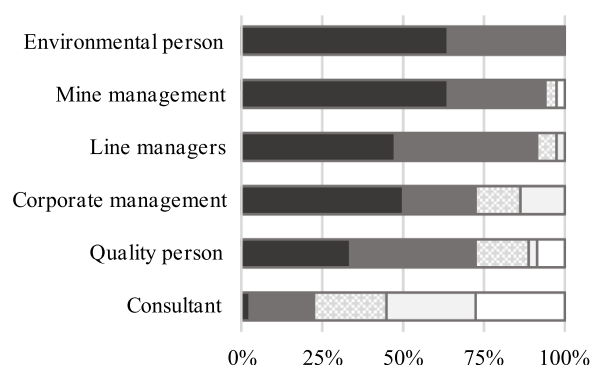


Fig. 3. Perceived opinion of who is needed for successful implementation of the Mining Standard. N = 36.

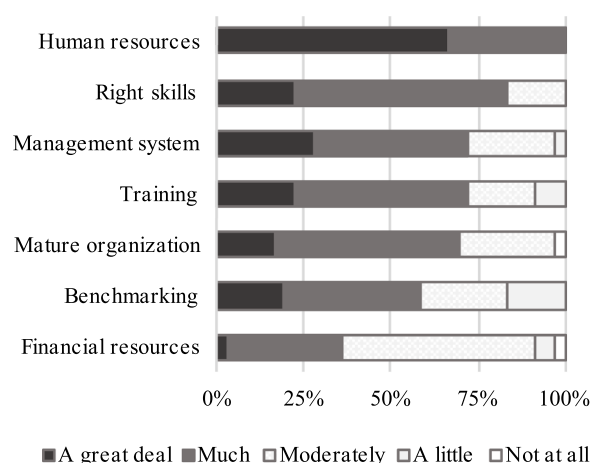


Fig. 4. Perceived opinion of what is needed for successful implementation of the Mining Standard. N = 36.

appropriate skills (Fig. 4). The importance of a mature organization with a functional management system is also apparent. The perceived opinion is that financial resources are not necessarily the determining factor for successful implementation.

Respondents were asked *how important are the given management and leadership processes to implement environmental strategies*. The list of business processes in the questionnaire consists of 21 items (Appendix A) and the results are presented in Table 4.

Respondents prioritised leadership and people processes (priority level A) and certain operational processes (priority levels A and B). At priority level C, respondents placed strategy processes, external communication, and systems for continual improvement for implementing environmental considerations.

## 5. Discussion

In this section two main topics for discussion are presented. First, sustainability initiatives with a focus on the Mining Standard are discussed. Secondly, research questions are discussed, following the suggestions for key factors as preconditions to implementing the Mining Standard successfully.

First, sustainability initiatives play an important role in mining companies' operations. Mining companies operating in Finland are typically engaged in initiatives which consist of principles, management standards, specific mining standards and reporting frameworks. Besides technical, environmental and social requirements, the Mining Standard includes some built-in leadership and management processes, which are required in most of the assessment protocols, but which are not adequate alone to substitute for a management system. The challenge is

Table 4

Survey results of the importance of leadership and management processes in implementing environmental strategies. N=36. Processes prioritised throughout the Mining Standard are presented in *italics*.

	Priority level <sup>†</sup>
<b>Leadership, culture and organizational structure</b>	
<i>Top management commitment</i>	A
<i>Personnel awareness</i>	A
<i>Competent resources and assigned responsibilities</i>	A
<b>Strategy</b>	
Systems to identify environmental inputs to company strategy	C
Systems to identify stakeholder needs and expectations	C
<b>Systems</b>	
Objectives for environmental considerations	A
Internal communication	A
Emergency preparedness and response	A
Systems to detect deviations	A
Systems to find root causes	A
KPIs to monitor performance	B
Regular meetings throughout organization	B
<i>Working instructions for operations/management system</i>	B
Internal audits	B
External audits	B
Stakeholder dialogue	B
<i>External communication</i>	C
<b>Actions for continual improvement and innovations</b>	
Management reviews	B
<i>Systems for continual improvements</i>	C
Innovations for radical change	C

<sup>†</sup> The share of respondents who chose "very important": A ≥ 60%, B 40–59%, C 10–39%

with new mining organizations, which lack a supporting organizational culture and functional management system. The observation by Kickler and Franken (2017) to harmonise the sustainability initiative requirements with an environmental management system such as ISO 14001 also applies in the case of facilitating the implementation.

The Mining Standard is developed from the Canadian TSM standard, which has been criticised for its narrow coverage of sustainability issues (Potts et al., 2018; Virgone et al., 2018). Even though the Mining Standard is complemented by two additional assessment protocols on environmental issues, the narrow coverage remains in social and business practices. However, it is important to recognise that mining companies are already engaged in several initiatives, and the full scope of sustainability can be covered. Potts et al. (2018) remind us of the "challenge of finding a one-size-fits-all initiative." The added value of the Mining Standard is that it has been developed by a large number of stakeholders and its scope covers all relevant areas of the life cycle of a mining operation.

The second topic for discussion relates to research questions. Based on the findings for research question 1 (RQ1), the adoption of the Mining Standard by the mines will be extensive. Respondents indicate they are going to integrate the Mining Standard into their existing management system, which is also how the global mining industry aims to implement sustainability initiatives (WEF, 2016). Epstein and Roy (2007) argue that corporations often adopt global environmental standards to govern environmental activities at their units. Since 81% of respondents represent a subsidiary of a corporation, the centralised governance can lead to a situation in which global corporations choose global standards over the Mining Standard.

The survey respondents' most important expected benefits from the Mining Standard are related to reputational issues, such as improving transparency of operations and the mine's acceptability (RQ1). Overall, the findings support the use of Laszlo and Zhexembayeva's sustainability value creation model (2011), since all variables were chosen as expected benefits to some extent.

Even though reputational issues are the most important expected benefits, surprisingly, results of this survey also indicated that external

**Table 5**

Key factors for mine management to adhere to and succeed in for the implementation of the Mining Standard.

Process	Subprocess
Leadership and strategy	Top management commitment Environmental and social considerations part of management decisions
Structure Systems	Resources and right capabilities Efficient management system Sustainability initiatives based on company needs
Communication	Internal and external communication Stakeholder engagement

communication and stakeholder needs and expectations are not prioritised at the mines. There is no obvious reason for this, but since most mines are subsidiaries of a corporation, it can be assumed that communication and stakeholder relations are excluded from the unit operations. Based on a World Economic Forum (WEF, 2016) survey on mining industry initiatives, the industry's stakeholders are seeking transparent reporting on sustainability performance, which also corresponds to the survey respondents' expectations.

To answer research question 2 (RQ2), this research shows that implementing the Mining Standard requires top management commitment, human resources, diverse skills and a functioning management system. Compared to models from Epstein and Buhovac (2014), Engert and Baumgartner (2016) and the ISO 14001 environmental management system (ISO 14001:2015, 2015), the importance of processes for innovations and improvements, identifying strategy inputs and external communication didn't stand out from the survey: only a minority of respondents chose those processes as "very important."

As an outcome, this study highlights the key factors as preconditions to implementing the Mining Standard successfully (Table 5) in order to create value for businesses, society and the environment.

The conclusion is that the key factors, which are essential to support implementation, are related to top management commitment, adequate resource allocation and a functioning management system with emphasis on communication and stakeholder engagement. In addition, the selection of sustainability initiatives is crucial for comprehensive coverage of all relevant areas of sustainability. The question is whether the implementation of the Mining Standard will be successful and improve the mining industry's environmental and social performance can be expected. Since the mines have functioning management systems and they are widely adopting the Mining Standard, it can be concluded that favourable conditions exist to improve environmental and social performance.

## 6. Conclusions

This study provides new empirically validated evidence of the preconditions for a successful implementation of sustainability initiatives with a focus on the Finnish 'Towards Sustainable Mining Standard'. Even though the focus is a Finnish context, this research gives insights into sustainability initiatives for the mining sector in general. It can be concluded that sustainable initiatives provide leading practices towards improved environmental performance when the mining companies invest in implementation and incorporating sustainability into their business strategies and practices.

As a managerial implication, these results provide insights about factors that mine management needs to adhere to and succeed in for improved environmental and social performance. Also, this study contributes to academia by combining two separate areas of academic research: namely, mining industry sustainability initiatives and leadership and management processes for implementation of those commitments.

Questionnaire surveys are subject to errors, which can affect reliability, validity and generalizability. In order to enhance the reliability and validity of this survey, the questionnaire was pretested, it was anonymous and the questionnaire was formulated with an emphasis on clarity. Since the target population is small, an extra effort was made to maximise the response rate, resulting in a very good response rate of 71%. This research concerns companies with mining operations in Finland, and the results are limited to companies operating in similar societies and jurisdictions.

These results provide aspects for future research to harmonise and create linkages between initiatives in which the mines are engaged. A specific focus is suggested to clarify the Mining Standard requirements and create linkages to management standards for efficient implementation of the initiatives.

## References on initiatives

- AA1000. Retrieved from <https://www.accountability.org>
- Aluminium Stewardship Initiative (ASI). Retrieved from <https://aluminium-stewardship.org>
- CDP. Retrieved from <https://www.cdp.net/en>
- Fairmined Standard for gold from artisanal and small-scale mining. Retrieved from <https://www.fairmined.org>
- Finnish Towards Sustainable Mining Standard. Guiding Principles of Finnish Mining Standard Available in English. Retrieved from [https://www.kaivosvastuu.fi/app/uploads/2017/03/Kaivosvastuujarjestelma\\_EN\\_13-03-17.pdf](https://www.kaivosvastuu.fi/app/uploads/2017/03/Kaivosvastuujarjestelma_EN_13-03-17.pdf)
- Global Reporting Initiative (GRI) and its Mining and Metals Sector Supplement. Retrieved from <https://www.globalreporting.org>
- Initiative for Responsible Mining Assurance (IRMA). Retrieved from <https://responsiblemining.net>
- International Organization for Standardization ISO 14001 Environmental Management Systems, ISO 26000 Social Responsibility, ISO 45000 Health & Safety, ISO 50001 Energy management and ISO 9001 Quality Management Systems. Retrieved from <https://www.iso.org/home.html>
- Kimberley Process (KP). Retrieved from <https://www.kimberleyprocess.com/en>
- OECD Guidelines for Multinational Enterprises. Retrieved from <https://doi.org/10.1787/9789264115415-en>
- OHSAS 18001 Occupational health and safety management systems. OHSAS 18001 has been replaced with ISO 45001:2018
- Towards Sustainable Mining (TSM) - Mining Association of Canada. Retrieved from <http://mining.ca/towards-sustainable-mining>
- United Nations Global Compact (UNGC). Retrieved from <https://www.unglobalcompact.org>
- United Nations Sustainable Development Goals (SDGs). Retrieved from <https://sustainabledevelopment.un.org>
- Universal Declaration of Human Rights. Retrieved from <https://www.un.org/en/universal-declaration-human-rights/>

## Declaration of Competing Interest

The author has no conflicts of interest to declare.

## Acknowledgments

I am grateful to professor Olli Dahl and professor emeritus Kari Heiskanen for their supportive guidance and to the Finnish Mining Association for helping with the dissemination of the survey. The author was involved in the Finnish Network for Sustainable Mining during its development phase in 2014–2016. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Appendix A. Questionnaire

### Section 1 Background questions

Seven questions on respondent's mining sector (metal ores, industrial minerals), number of employees, period of ore production, annual ore production, ownership, respondent's responsibility and membership in a management group.

### Section 2 Implementation of the sustainability standard for mining

The "Standard" in the questionnaire refers the Finnish Towards Sustainability Standard for Mining.

- Survey question 8: In what phase is your organization in implementing Finnish Mining Sustainability Standard? Please indicate which of the following statement most closely reflect your company's situation now.
  - ☐ We have implemented the standard already
  - ☐ The implementation is an ongoing process
    - We have decided to implement the standard, but we have not yet started the work.
  - ☐ Currently we are not implementing the system
  - ☐ I don't know
- Survey question 9: Which are the benefits you eventually expect the implementation of the Standard will bring to your organization? (Scale: not at all, a little, moderately, much, a great deal, and not applicable).
  - ☐ It mitigates the risks
  - ☐ It is an efficiency opportunity (waste, energy, material etc.)
  - ☐ It shows transparency of our operations
  - ☐ It improves the acceptability of our operations
  - ☐ It is a way to differentiate our products and services
  - ☐ It opens new markets for our products
  - ☐ It enhances our brand
  - ☐ It enhances continual improvement
- Survey question 10: According to your opinion, whose commitment is necessary for a successful implementation of the requirements of the Standard? (Scale: not at all, a little, moderately, much, a great deal, not applicable).
  - ☐ Environmental specialist/manager
  - ☐ Quality specialist/manager
  - ☐ Consultant
  - ☐ Line managers
  - ☐ Mine management
  - ☐ Corporate management
  - ☐ Other who
- Survey question 11: According to your opinion, what is needed for successful implementation of the Standard? (Scale: not at all, a little, moderately, much, a great deal, not applicable).
  - ☐ Financial recourses to do the job
  - ☐ Human recourses to do the job
  - ☐ Mature organization culture
  - ☐ Integration of the Standard requirements to mine's existing operational management system
  - ☐ Right skills and competences
  - ☐ Training the standard requirements to whole organization
  - ☐ Benchmarking the experience with other mining companies
  - ☐ Other what
- Survey question 12: The Standard consists of technical and operational requirements. How should the requirements be/are implemented?
  - ☐ They should be/are integrated to our existing operational management system
  - ☐ It is an independent management system with own responsible persons
  - ☐ I don't know
  - ☐ Other, what
- Survey question 14: The Standard consists of a requirement for regular external audit. Please indicate which of the following statements most closely reflect your company's situation.
  - ☐ The requirements should be audited as part of the external environmental, safety, energy or quality audits, such as ISO 14001, ISO 50001 etc.
  - ☐ The requirements should be audited with own external audits and auditors
  - ☐ The audits should be substitutable with other Mining Standard audits (such as Canadian TSM) to which the corporation is committed
  - ☐ I don't know
  - ☐ Other what



### Section 3 Management and leadership practices

- Survey question 19. According to your experience, how important are the following management and leadership processes in order to implement environmental strategies? (Scale: not at all important, not very important, neither important nor unimportant, somewhat important, very important, not applicable).
  - ☐ Top management commitment
  - ☐ Company strategy includes objectives for environmental considerations
  - ☐ Systems to identify environmental inputs to company strategy
  - ☐ Systems to identify stakeholder needs/expectations
  - ☐ Competent resources and assigned responsibilities
  - ☐ Awareness of personnel
  - ☐ Internal communication
  - ☐ External communication
  - ☐ Stakeholder dialogue
  - ☐ Working instructions for the operations
  - ☐ Emergency preparedness and response
  - ☐ Managers' and supervisors' regular meetings throughout the organization
  - ☐ KPIs to monitor the performance
  - ☐ Compensation partly based on environmental performance
  - ☐ Internal audits
  - ☐ External audits
  - ☐ Management reviews
  - ☐ Systems to detect deviations
  - ☐ Systems to find root causes
  - ☐ Systems to promote incremental change for continual improvements
  - ☐ Systems to promote Innovations for radical change
- Survey question 21: According to your understanding, with the use of which self-regulation tools your company has improved environmental performance? (Scale: not at all, a little, moderately, much, a great deal and not in use)
  - ☐ ISO 14001 environmental management systems
  - ☐ Finnish Sustainability Standard for mining
  - ☐ Corporation's own management system

### Appendix B. Respondents' profile

	N	%
<i>Mining sector</i>		
Metal ores	25	69.4
Industrial minerals	11	30.6
	36	100%
<i>Number of employees</i>		
< 49	4	11.1
50–499	19	52.8
> 500	13	36.1
	36	100%
<i>Years of ore production</i>		
< 20 years	15	41.7
> 21 years	21	58.3
	36	100%
<i>Annual ore production</i>		
< 0.5 Mt	7	19.5
0.5 – 1 Mt	4	11.1
1 – 5 Mt	13	36.1
> 5 Mt	12	33.3
	36	100%
<i>Subsidiary of a corporation</i>		
Yes	29	80.6
No	7	19.4
	36	100%
<i>Area of responsibility</i>		
Corporate manager	5	13.9
Mine manager, mine CEO	9	25.0
Line manager at the mine	5	13.9
Sustainability or EHSQ	15	41.7
Other	2	5.6
	36	100%
<i>Member of a management group</i>		
Yes	29	80.6
No	7	19.4
	36	100%

## References

- Atkinson, S., Schaefer, A., Viney, H., 2000. Organizational structure and effective environmental management. *Bus. Strategy Environ.* 9 (2), 108–120. [https://doi.org/10.1002/\(sici\)1099-0836\(200003/04\)9:2<108::aid-bse236>3.3.co;2-c](https://doi.org/10.1002/(sici)1099-0836(200003/04)9:2<108::aid-bse236>3.3.co;2-c).
- Basu, P., Hicks, J., Krivokapic-Skoko, B., Sherley, C., 2015. Mining operations and corporate social responsibility: a case study of a large gold mine in regional Australia. *Extract. Ind. Soc.* 531–539. <https://doi.org/10.1016/j.exis.2015.03.002>.
- Baumgartner, R., Rauter, R., 2017. Strategic perspectives of corporate sustainability management to develop a sustainable organization. *J. Cleaner Prod.* 140, 81–92. <https://doi.org/10.1016/j.jclepro.2016.04.146>.
- Boiral, O., Henri, J.-F., 2017. Is sustainability performance comparable? A study of gri reports of mining organizations. *Bus. Soc.* 56 (2), 283–317. <https://doi.org/10.1177/0007650315576134>.
- Brereton, D., 2002. The role of self-regulation in improving corporate social performance: the case of the mining industry. In: Paper presented at the Australian Institute of Criminology Conference on Current Issues in Regulation: Enforcement and Compliance, Melbourne.
- Bryman, A., Bell, E., 2015. *Business Research Methods*, Fourth ed. Oxford University Press, Oxford, UK.
- Cantwell, P., 2011. Census. In: Lavrakas, P. (Ed.), *Encyclopedia of Survey Research Methods*. Sage Research Methods. Sage Publications, pp. 91–93. <https://doi.org/10.4135/9781412963947>.
- Conde, M., Le Billon, P., 2017. Why do some communities resist mining projects while others do not? *Extract. Ind. Soc.* 4, 681–697. <https://doi.org/10.1016/j.exis.2017.04.009>.
- Dashwood, H., 2012. *The Rise of Global Corporate Social Responsibility: Mining and The Spread of Global Norms*. Cambridge University Press, Cambridge, UK.
- Dashwood, H., 2014. Sustainable development and industry self-regulation: developments in the global mining sector. *Bus. Soc.* 53 (4), 551–582. <https://doi.org/10.1177/0007650313475997>.
- Dobele, A., Westberg, K., Steel, M., Flowers, K., 2014. An examination of corporate social responsibility implementation and stakeholder engagement: a case study in the Australian mining industry. *Bus. Strategy Environ.* 23 (3), 145–159. <https://doi.org/10.1002/bse.1775>.
- Engert, S., Baumgartner, R., 2016. Corporate sustainability strategy – bridging the gap between formulation and implementation. *J. Cleaner Prod.* 113, 822–834. <https://doi.org/10.1016/j.jclepro.2015.11.094>.
- Epstein, M., Buhovac, A., 2014. *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental and Economic Impacts*, second ed. Greenleaf Publishing Limited, Sheffield, UK, pp. 305.
- Epstein, M., Roy, M., 2001. Sustainability in action: Identifying and measuring the key performance drivers. *Long Range Plann.* 34 (5), 585–604. [https://doi.org/10.1016/S0024-6301\(01\)00084-X](https://doi.org/10.1016/S0024-6301(01)00084-X).
- Epstein, M., Roy, M., 2007. Implementing a corporate environmental strategy: establishing coordination and control within multinational companies. *Bus. Strategy Environ.* 16 (6), 389–407. <https://doi.org/10.1002/bse.545>.
- Fonseca, A., McAllister, M., Fitzpatrick, P., 2014. Sustainability reporting among mining corporations: a constructive critique of the GRI approach. *J. Cleaner Prod.* 84, 70–83. <https://doi.org/10.1016/j.jclepro.2012.11.050>.
- Franks, D., 2015. *Mountain Movers - Mining, Sustainability and the Agents of Change*. Routledge, New York, USA.
- Fraser, J., 2019. Creating shared value as a business strategy for mining to advance the United Nations Sustainable Development Goals. *Extract. Ind. Soc.* 6, 788–791. <https://doi.org/10.1016/j.exis.2019.05.011>.
- Halme, M., Rintamäki, J., Knudsen, J., Lankoski, L., Kuisma, M., 2018. When is there a sustainability case for CSR? Pathways to environmental and social performance improvements. *Bus. Soc.* <https://doi.org/10.1177/0007650318755648>.
- Hedin, L., Ranängen, H., 2017. Community involvement and development in Swedish mining. *Extract. Ind. Soc.* 4, 630–639. <https://doi.org/10.1016/j.exis.2017.04.008>.
- Hitt, M., Ireland, D., Hoskisson, R., 2005. *Strategic Management. Competitiveness and Globalization Concepts*. South-Western, Mason, Ohio, USA.
- International Council on Mining and Metals (ICMM), 2018. Our history. Retrieved from <https://www.icmm.com>.
- International Institute for Environment and Development (IIED), 2002. Breaking new ground - executive summary. Final report from the mining, minerals and sustainable development project (MMSD). Retrieved from <https://www.iied.org/mmsd-final-report>.
- ISO 14001:2015, 2015. *Environmental Management System*. International Organization for Standardization, Geneva, Switzerland.
- Jenkins, H., Yakovleva, N., 2006. Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure. *J. Cleaner Prod.* 14 (3–4), 271–284. <https://doi.org/10.1016/j.jclepro.2004.10.004>.
- Kaivosvasto, 2015. Success Through Dialogue: Annual Report of the Network for Sustainable Mining 5/2014-5/2015. Network for Sustainable Mining, Helsinki.
- Kickler, K., Franken, G., 2017. Sustainability Schemes for Mineral Resources: A Comparative Overview. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover, Germany.
- Kirkland, L.-H., Thompson, D., 1999. Challenges in designing, implementing and operating an environmental management system. *Bus. Strategy Environ.* 8 (2), 128–143. [https://doi.org/10.1002/\(sici\)1099-0836\(199903/04\)8:2<128::aid-bse193>3.0.co;2-n](https://doi.org/10.1002/(sici)1099-0836(199903/04)8:2<128::aid-bse193>3.0.co;2-n).
- Kotler, P., 2000. *Marketing Management. The Millennium Edition*. Prentice Hall, New Jersey, USA.
- Laszlo, C., Zhexembayeva, N., 2011. *Embedded Sustainability. The Next Big Competitive Advantage*. Stanford Business Books, Stanford, California, USA.
- Lee, K.-H., 2017. Does size matter? Evaluating corporate environmental disclosure in the Australian mining and metal industry: a combined approach of quantity and quality Measurement. *Bus. Strategy Environ.* 26 (2), 209–223. <https://doi.org/10.1002/bse.1910>.
- Lodhia, S., Hess, N., 2014. Sustainability accounting and reporting in the mining industry: current literature and directions for future research. *J. Cleaner Prod.* 84, 43–50. <https://doi.org/10.1016/j.jclepro.2014.08.094>.
- Lokuwaduge, C., Heenetiigala, K., 2017. Integrating environmental, social and governance (ESG) disclosure for a sustainable development: An Australian study. *Bus. Strategy Environ.* 26 (4), 438–450. <https://doi.org/10.1002/bse.1927>.
- Mangione, T., 1995. *Mail Surveys: Improving the Quality*. SAGE Publications, Inc., London.
- Mzembe, A., Downs, Y., 2014. Managerial and stakeholder perceptions of an Africa-based multinational mining company's Corporate Social Responsibility (CSR). *Extract. Ind. Soc.* 1, 225–236. <https://doi.org/10.1016/j.exis.2014.06.002>.
- Northey, S.A., Mudd, G.M., Werner, T.T., Haque, N., Yellishetty, M., 2019. Sustainable water management and improved corporate reporting in mining. *Water Resour. Ind.* 21, 100104. <https://doi.org/10.1016/j.wri.2018.100104>.
- Porter, M., 1996. What is Strategy? 74. *Harvard Business Review*, pp. 61–78.
- Potts, P., Wenban-Smith, M., Turley, L., Lynch, M., 2018. Standards and the Extractive Economy. The International Institute for Sustainable Development, Manitoba, Canada.
- Ranängen, H., Lindman, Å., 2017. A path towards sustainability for the Nordic mining industry. *J. Cleaner Prod.* 151, 43–52. <https://doi.org/10.1016/j.jclepro.2017.03.047>.
- Ruokonen, E., Temmes, A., 2019. The approaches of strategic environmental management used by mining companies in Finland. *J. Cleaner Prod.* 210, 466–476. <https://doi.org/10.1016/j.jclepro.2018.10.273>.
- Sairinen, R., Tiainen, H., Mononen, T., 2017. Talvivaara mine and water pollution: an analysis of mining conflict in Finland. *Extract. Ind. Soc.* 4, 640–651. <https://doi.org/10.1016/j.exis.2017.05.001>.
- Salim, H., Padfield, R., Hansen, S., Mohamad, S., Yuzir, A., Syayuti, K., Tham, M., Papargyropoulou, E., 2018. Global trends in environmental management system and ISO14001 research. *J. Cleaner Prod.* 170, 645–653. <https://doi.org/10.1016/j.jclepro.2017.09.017>.
- Sitra, 2015. Responsible mining in Finland targets next stage. Finnish innovation fund. Retrieved from <https://www.sitra.fi/en/news/responsible-mining-finland-targets-next-stage/>.
- Tost, M., Chandurkar, V., Hitch, M., Moser, P., Feiel, S., 2017. Is it time for a global mining initiative 2.0? In: *Proceedings of the 8th International Conference on Sustainable Development in the Minerals Industry*. Beijing, China.
- Tost, M., Hitch, M., Chandurkar, V., Moser, P., Feiel, S., 2018. The state of environmental sustainability considerations in mining. *J. Cleaner Prod.* 182, 969–977. <https://doi.org/10.1016/j.jclepro.2018.02.051>.
- Tuusjärvi, M., Mäenpää, I., Vuori, S., Eilu, P., Kihlman, S., Koskela, S., 2014. Metal mining industry in Finland – development scenarios to 2030. *J. Cleaner Prod.* 84, 271–280. <https://doi.org/10.1016/j.jclepro.2014.03.038>.
- Van Mol, C., 2017. Improving web survey efficiency: The impact of an extra reminder and reminder content on web survey response. *Int. J. Soc. Res. Method.* 20 (4), 317–327. <https://doi.org/10.1080/13645579.2016.1185255>.
- Virgone, K., Ramirez-Andreotta, M., Mainhagu, J., Brusseau, M., 2018. Effective integrated frameworks for assessing mining sustainability. *Environ. Geochem. Health* 40 (6), 2635–2655. <https://doi.org/10.1007/s10653-018-0128-6>.
- World Economic Forum (WEF), 2016. Voluntary responsible mining initiatives - a review. white paper - august 2015. Retrieved from [www.weforum.org](http://www.weforum.org).
- Yrjö-Koskinen, E., 2015. Building Trust in Finnish Mining Activities. Euromines Newsletter 2 2015. Retrieved from <http://www.euromines.org/news/newsletters/2-2015/building-trust-finnish-mining-activities>.