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Title: The approaches of strategic environmental management used by mining companies in Finland

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Abstract

Global megatrends such as scarcity of natural resources and urbanization have been the drivers for a mining sector upswing. Therefore, the mining sector in Finland, with attractive ore geology, has recently experienced rapid growth and new mines have been opened. At the same time, society's expectations have increased, resulting in a public debate on mining companies' environmental and social responsibility. Companies have the same positioning choices relative to their competitors, but environmental issues are a new area of interest in order to stand out strategically. In this study of companies with mining operations in Finland, strategic environmental management practices are examined based on companies' own public information. This article takes a closer look at whether their public reporting projects an image of strategic environmental management. The results show that environmental and social considerations are essential elements in companies' commitments and strengthen their business strategy. This study also shows a gap between strategic commitments and their implementation, based on the company reports.

Keywords: Mining, metals and minerals industry, environmental management, sustainable mining, responsibility reporting

Figure captions:

Figure 1. Analytical frame for the research design.

Figure 2. The environmental focus in business strategies.

Figure 3. Management processes and practices in use for environmental strategy implementation. The numbers indicate how many companies out of fourteen have implemented these processes.

Figure 4. The environmental programs for emission and impact reduction. The numbers indicate how many companies out of fourteen have certain programs.

Figure 5. Environmental strategy focus based on companies' public reporting.

Table captions:

Table 1. Sustainability-related value-creating strategy response areas, according to Laszlo and Zhexembayeva (2011), and how they can increase competitiveness.

Table 2. Corporate responsibility (CR) reporting channels and practices among the studied companies.

Table 3. The main environmental response areas and aspects the companies are committed to. The response areas are modified from a sustainability model by Laszlo and Zhexembayeva (2011).

1. Introduction

The Finnish mining industry has experienced rapid growth in recent years in terms of both the volume of mined ore and the number of companies with mining operations in Finland (Hernesniemi et al. 2011, Kokko 2014, TEM 2013, TEM 2018). This trend is likely to increase in the coming years if the profitability outlook remains positive for mining projects and ore prospects, depending on metal and industrial minerals price development (Tuusjärvi et al. 2014). Simultaneously the global mining and metals sector has suffered from an extended period of lower and volatile commodity prices (EY 2015). Therefore, mines are under increased pressure to reduce costs and improve productivity (EY 2015, ICCM 2016).

At the same time, the expectations of society and stakeholders have increased, and public debate on mines' acceptability has increased both in Finland and globally (TEM 2013, Jartti et al. 2014, Rytteri 2012, Sairinen 2011, ICMM 2016). The public debate focuses on both environmental and social impacts of the mines, but issues vary depending on the region. In Finland, the main issues criticized by the stakeholders originate from environmental aspects (e.g. Jartti et al. 2014, Rytteri 2012).

There are several processes to enhance the environmental management of mines in Finland. The Finnish mining industry is currently implementing a national sustainability standard (Kaivosvastuu 2017). Also, a ministry-level action plan for making Finland a leader in the sustainable extractive industry (TEM 2013) exerts pressure on the mining managers to develop best practices for environmental, ecological, and social considerations.

Societal expectations create the need for proper environmental management in order to maintain a license to operate mines. On the other hand, it is crucial to take a strategic approach to environmental management in order to remain competitive in the commodity business.

The existing literature thoroughly covers various issues of social responsibility, pollution prevention, and cleaner production brought to discussion by mining company stakeholders (e.g. Hutchins et al. 2007, Parsons et al. 2014, Prno 2013, Wessman et al. 2014) as well as various technologies and practices required to mitigate those issues (e.g. Basu and Zyl 2006, Kauppila et al. 2011, Moors et al. 2005, Northley et al. 2016).

This paper aims to introduce a strategic environmental management view to this discussion. Environmental management is about responding to stakeholder concerns and taking company actions to mitigate them (Betts et al. 2015, Delmas and Toffel 2004) and reduce impacts on the society (Halme et al. 2014). Strategic environmental management considers how these aspects can be integrated into company strategy in order to maintain and improve the competitiveness of the company instead of adding cost (e.g. Lazlo and Zhexembayeva 2011).

We contribute to the literature of environmental management of the mining industry through empirical analysis of the environmental management practices of mining companies with operations in Finland. The analysis is based on the companies' own public information. The research questions are:

Q1: *Which approaches do mining companies take towards strategic environmental management?*

Q2: *How do the companies describe their implementation practices?*

The following two sections provide a summary of the theoretical frameworks of strategic environmental management and, as background information, mining's environmental aspects in Finnish context. Section 4 describes the research methodology, including a summary of mining companies selected for this study and the research design with identified limitations. Section 5 presents the results of the research. Section 6 provides the discussion with respect to future research, and finally, section 7 provides the conclusions.

2. Strategic environmental management

2.1 Environmental strategy framework

Strategy is an integrated and coordinated set of commitments and actions designed to exploit core competences and gain competitive advantage (e.g. Hitt et al. 2005). The concept of strategic management has various meanings and parallel definitions (e.g. Minzberg 1987, Porter and Kramer 2006). Hitt et al. (2005) define strategic management as a continuous process with a “full set of commitments, decisions and actions required for a firm to achieve strategic competitiveness”. Similarly, Pearce and Robinson (2011) approach strategic management as strategy formulation, its implementation and control.

Environmental management is a process for responding to stakeholder concerns and taking company actions to mitigate them (Betts et al. 2015, Delmas and Toffel 2004) and to reduce impacts on the society (Halme et al. 2014). The standard for environmental management systems (Finnish Standards Association 2004) describes environmental management as part of an organization’s management system used to develop and implement its environmental policy and manage its environmental aspects. Strategic environmental management, as opposed to general environmental management, embodies the organization’s commitment to gain competitive advantage while standing out strategically on environmental issues.

In this paper, strategic environmental management is defined as a set of commitments to ecological and social issues as part of a business strategy. Mätäsaho et al. (1999) simplify the definitions from the environmental point of view, suggesting that environmental management is founded on the balance of environmental strategy, its implementation, and communication about it.

Strategic environmental management, provides an overall direction and commitment level for dealing with its effects on society, including ecological and social issues. It involves both formulation and implementation of major environmental and social goals and initiatives. The question is: How are environmental commitments changing or strengthening the company’s strategy?

In the 1990s, researchers (Niskala and Mätäsaho 1996, Roome 1992, Welford and Gouldson 1993, Welford 1998) explored proactive environmental strategies and, particularly, defined strategic pathways for a company to follow based on attitudes towards corporate responsibility. A common denominator in all such models is the shift in thinking from reactive to proactive as well as from noncompliant to leading edge.

Since the 2000s, researchers (e.g. Valentine 2009, Baumgartner and Ebner 2010) have explored sustainability strategies and identified corporate responsibility strategy types and layers while embedding environmental strategies within overall business strategies. Baumgartner and Ebner (2010) have identified four corporate sustainability strategy types focusing on risk mitigation, external relationships and license to operate, process efficiency, and sustainability within all business areas. Valentine (2009) has identified strategic layers, from stakeholder management to functional environmental management, which influence business strategy.

Laszlo and Zhexembayeva (2011) have identified three general strategy frameworks which lend themselves to assessing the connections of sustainability to business strategy. These frameworks are Porter’s general strategy for gaining competitive advantage, Kim and Mauborne’s Blue Ocean Strategy, and Christensen’s Disruptive Innovation.

Porter’s general strategy for gaining competitive advantage evaluates how a company keeps a relative competitive advantage. Porter (1985) describes three main strategies for gaining competitive advantage: cost leadership, differentiation, and market segmentation. Laszlo and Zhexembayeva (2011) narrate broadly under which conditions sustainability contributes to strategic advantage, according to Porter’s positioning school. Strategic positioning means performing different activities from rivals or performing similar activities in different ways (Porter 1996).

Laszlo and Zhexembayeva (2011) assert that operational efficiency is not strategic positioning, if efficiency leads to performing similar activities better than competitors. Sustainability can be a source of cost leadership, when it coincides with using fewer materials and less energy and creating less waste, therefore resulting in responsibly produced products. Differentiation strategy is for those companies whose customers have specific needs that companies can satisfy in ways that rivals cannot imitate easily. Environmental attributes are a source of differentiation, when they can reinforce product, process, and brand uniqueness. Laszlo and Zhexembayeva (2011) give examples of companies such as Henkel and Siemens with differentiation strategies and sustainability performance in their core activities. Sustainability as a source of focused strategy is for companies whose customers demand responsibly and sustainably produced products.

Laszlo and Zhexembayeva (2011) remind readers that, whatever is the company's strategic position, its environmental performance can strengthen that position. Therefore, sustainability-driven initiatives to reduce costs, differentiate products, or enter new markets should be seen as strengthening the company's existing business strategy (Laszlo and Zhexembayeva (2011) and can be a source of opportunity, innovation, and competitive advantage (Porter and Kramer 2006).

Kim and Mauborne's (2005) Blue Ocean Strategy is based on creating markets where there is no or very little competition and making competition irrelevant. Christensen's (1997) Disruptive Innovation offers a framework for addressing global challenges that require radical changes. Both strategies are potentially relevant as innovative strategies for achieving competitiveness (Halme and Laurila, 2009).

Laszlo and Zhexembayeva (2011) created a model based on these three general strategies and identified seven strategy responses (Table 1), which all aim for continued growth, new business opportunities, and cost savings with sustainability.

Based on the literature review, environmental strategy frameworks have developed over the years, and currently the trend is in value-adding proactive strategies which are embedded in overall business strategies. Mining is a very specific context for strategic environmental management which has not been extensively studied. As the industry rarely aims at radical innovations, the positioning strategy of Porter and the analytical framework suggested by Laszlo and Zhexembayeva (2011) were used for the development of the analytical frame, because they allow us to identify the various company approaches for strategic environmental management.

2.2 Environmental strategy implementation

Far too often, effectively formulated strategies are not successfully implemented (e.g. Kaplan and Norton, 2001). Epstein and Buhovac (2014) found that for effective implementation of sustainability strategies, organizations need leadership, organizational structure, and systems. Various management systems such as quality management (EFQM, 2003) and environmental management (Finnish Standards Society, 2004) build on models that systematically proceed from strategy and objectives to implementation, with feedback systems that aim for continuous improvement.

In turn, proactive corporate environmental strategy invokes certain resource-based capabilities, such as those for stakeholder interaction, higher-order learning, and continuous innovation, finally leading to competitive advantage (Sharma and Vredenburg 1998). Aragón-Correa et al. (2008) studied environmental strategies and found the importance of certain organizational capabilities such as shared vision, stakeholder management, and strategic proactivity for positive financial performance.

Epstein and Buhovac (2014) created a corporate sustainability model for implementing a sustainability strategy, which includes perspectives for strategy inputs, processes for implementation, outputs, and outcomes. Epstein and Buhovac (2014) argue that to drive a

sustainability strategy through an organization, various business processes need to be implemented to produce financial and sustainability success. These processes include leadership commitment, incorporating sustainability into the strategy process and the organizational structure, and applying processes for sustainability systems and programs.

For studying the implementation of environmental strategies, this study uses the sustainability model by Epstein and Buhovac (2014) because the model includes generic business processes leading to financial and sustainability success.

3. Sustainability in the mining industry in Finnish context

3.1 Mining industry in Finland

Securing a sustainable supply of metals and minerals raw materials has become increasingly important to the EU's economy, growth, and competitiveness. Geologically, Finland belongs to the Fennoscandian Shield with significant potential for new ores and mining operations (Eilu 2011), and therefore Finland plays an important role in the European Union's (EU) raw materials policy.

The mining industry is an important contributor to the Finnish economy, as it provides metals and minerals for a wide swath of the export industry and brings economic activity to those regions with mining operations (Kokko 2014, TEM 2010). Finnish mineral resources were opened to foreign companies in connection with the conclusion of the Agreement on the European Economic Area (EEA Agreement) in 1994. Spurred by the strong rise in metal and other mineral prices in the early 2000s, several domestic and foreign exploration and mining companies became interested in Finland, and new mines were opened in the early 2010s. In Finland, about 12 metal mines are operating while industrial minerals are mined in about 30 mines. In 2012, the mining industry's sales was approximately EUR 1.5 billion. Mines directly employ about 4,500 people (TEM 2013). The metal mining focuses on base metals and gold. The major industrial minerals mined in Finland are carbonates, apatite, and talc, providing raw material to the chemical industry.

Conditions for competitiveness are based on several factors. The global mining and metals sector is characterized by being capital-intensive and subject to fluctuation as to both commodity demand and prices. The quality and magnitude of the ore deposit together with commodity prices and cost structure affect a mine's profitability (Paalumäki et al. 2015). For a mine to be attractive to investors, it needs, among other things, predictable taxation and legislation, certainty of access to land and infrastructure, political stability, and available labour, including skilled labour (Stedman and Green 2018).

Finland has attractive geology and also, as a Fraser Institute survey (Stedman and Green 2018) shows, a competitive policy climate for both exploration and mining investments. Finland is ranked the most attractive jurisdiction in the world for mining investments, moving up from fifth place in the previous annual survey.

Mining companies provide employment and create economic activity, but mines always have impacts on the environment. The debate over mining industry acceptance has created activities such as a ministry-level action plan for making Finland a leader in the sustainable extractive industry (TEM 2013), the technology program Green Mining for intelligent and minimum-impact mines, academic research on social acceptance of mining (Jartti et al. 2014, Kohl et al. 2013, Rytteri 2012, Sairinen 2011), and formation of the Network for Sustainable Mining (Yrjö-Koskinen 2015). The mining industry's own responsibility is raised as a key factor in achieving social acceptance (TEM 2013). Even though the number of programs is growing and the amount of research on mining operations' sustainability is vast, the mining companies' strategic environmental management view is lacking in the present research agenda.

3.2. Environmental considerations

Each ore deposit has its unique characteristics: mineralogy, concentrations, complexity, as well as size and shape, all of which affect the selection of mining method and beneficiation technology to exploit the deposit economically. In addition, the geographical location with its unique flora and fauna means each ore deposit has its own characteristic environmental effects.

Mining activities cause environmental impacts such as changes to the landscape, water contamination, and air pollution, as well as water and energy consumption. The environmental challenges are related to biodiversity, climate change, and water and natural resource scarcity. The general environmental aspects are well known (Hilson and Murck 2000, Ranängen and Lindman 2017) although each mine has its unique environmental effects. With Finnish conditions in focus, Kauppila et al. (2011) propose their latest solution models for the best environmental practices in metal ore mining. These include emission reduction during the life cycle of a mine as well as reduction of social impacts.

Based on the mine stress tests conducted in 2013 by the Ministry of Environment, the typical hazards at the mines are related to waters, e.g. handling of process waste and waters as well as dam safety (YM 2014). In addition, Kauppi et al. (2013) raised awareness of the environmental impacts of sulfate discharge as well as dam safety issues.

The 2013 round-table discussion aiming to raise sustainability in the Finnish mining industry, led by the Ministry of Employment and Economics, came to similar conclusions in its action plan (TEM 2013). For mining companies, the plan includes recommendations for continuous improvement in mines' environmental performance, stakeholder engagement, and communication. The continuous improvement actions are related to resource efficiency, including water balance management and closed water circuit processes, new technologies for water purification, energy efficiency, and waste management with a focus on reusing mine waste and tailings (TEM 2013). The Finnish mining industry produces about 59 per cent of the total waste generated in Finland (Häkkinen et al. 2014), and from that perspective, actions to minimize waste generated from the mines contribute to resource efficiency. The Finnish Association for Nature Conservation defines responsible mining in their blog: "Mining is responsible, when it promotes the well-being of people and the environment in the long term" (Barber 2015). Laurence (2011) reports similar conclusions, affirming that leading practices in environmental management are essential for mines.

Technological innovations in the metals and minerals industry have improved both productivity and environmental performance (Warhurst and Bridge 1996, Moors and Mulder 2005). Incremental change is made continuously, but radical change with commercially significant technologies is rare.

In a Finnish context, the present focus and public debate on environmental considerations are on waters, dam safety, mine waste, and overall resource efficiency. From the mining company's point of view, mining operations can become more sustainable by developing and integrating practices that reduce the environmental impact of their operations while improving their social responsibility.

4. Research methodology

4.1 Scope of the study and data used

This study examines parent companies which have metal and industrial minerals mining operations in Finland (Appendix A). The companies which we selected for this study represent 99.1 per cent of ore production in 2014 in Finland.

This study is based on secondary data, which is publicly available information in companies' stand-alone 2014 sustainability reports or annual 2014 financial reports, if sustainability reports are not published (Appendix B). Since the terminology used for reporting sustainability issues varies between companies, content related to corporate responsibility, sustainability, social responsibility, and environmental responsibility reports is included. Company websites were used to supplement

the findings or used as the data source if other reports were not available. For comparing how environmental commitments have changed over five years, the 2009 stand-alone sustainability reports were used as secondary data (Appendix B). Because not all companies report as comprehensively, this study does not compare companies with each other, but seeks generalizations and highlights best practices.

Publicly available data was chosen since if environmental issues are publicized, companies use their own media to provide information to stakeholders. Other researchers have used annual reports and websites as data sources for the same reasons (e.g. Bowman 1982, Han Onn and Woodley 2014, Rusto 2012, Sihvonen and Partanen 2017, Tost et al. 2018, Villiers et al. 2014). Bowman studied corporate strategies and Rusto studied Nokia's strategic turning points. Han Onn and Woodley, Tost et al. and Villiers et al. have studied mining company sustainability disclosures, while Sihvonen and Partanen examined environmental targets within the information and communications technology (ICT) sector.

The use of secondary data (i.e. publicly available company reports and websites) sets limitations on the results, since the companies have different reporting practices. The data is also published by parent companies, and in large global companies, an individual mine perspective can be obscured. This research concerns companies with mining operations in Finland, and the results are limited to companies operating in similar societies and jurisdictions.

4.2. Reporting practices

A regular corporate responsibility report is a mainstream business practice worldwide, and around three-quarters of companies report corporate responsibility (KPMG 2017). As reporting practices have changed, mining companies have also substantially improved their stand-alone environmental reporting (Jenkins and Yakovleva 2006), even though the progress has been slow (Lodhia and Hess 2014). Based on a recent KPMG survey (2017), sectors with high environmental and social impacts, such as mining, typically have high Corporate Responsibility (CR) reporting rates. In 2017 eighty percent of mining companies reported CR performance, and the mining sector is in third place behind the oil and gas sector and the chemicals sector. Based on Jenkins and Yakovleva (2006), reporting styles among top global mining companies are not uniform, and there is considerable variation in the maturity of reporting practices. Rytteri (2012) presents similar results in a study of mining companies operating in Finland. Rytteri argues that in order to gain stakeholders' acceptance, sustainability information should be reported as comprehensively as possible. Ranängen and Lindman (2017), in their study of sustainability for the Nordic mining industry, argue that companies are in different stages of implementing sustainability criteria in their businesses. Therefore, we can assume this accounts for the differences in maturity of their CR reporting practices.

Among the studied companies, there are differences in reporting channels (Table 2). The majority of the parent companies have reported extensively or moderately on environmental issues, either in separate reports or on the company website. One company did not have any environmental disclosures, and one company had minor remarks in its annual report. Half of companies have published stand-alone corporate responsibility reports or the equivalent. Several of the companies are using social media to communicate to their stakeholders.

Six out of fourteen companies are using specific guidelines such as the Global Reporting Initiative standards (GRI) for reporting sustainability issues, while globally two-thirds of CR reports apply GRI guidelines (KPMG 2017). Only three companies are using external assurance to verify their reports, even as external assurance should be seen as a means to increase stakeholder trust in the reporting process (Epstein and Buhovac 2014). None of the studied companies have published an Integrated Report (IR), even as the trend is shifting towards integrated reports (KPMG 2017, PwC 2015).

In summary, the companies have a public platform to report and communicate their environmental positions even as reporting practices vary between studied companies. Based on the reports, it is possible to analyse aspects of strategic environmental management.

4.3 Research design

The type of survey is descriptive research. Collected data is qualitative with content analysis. This research has positioned strategic environmental management as a two-dimensional approach, namely strategic commitment and implementation (Figure 1). The external factors, which affect strategic choices, and the outputs were not studied. The external factors include conditions for competitiveness, business context, and sustainable mining requirements. The outputs are environmental, ecological, and social performance information.

The model by Laszlo and Zhexenbayeva (2011) was used in this study with some modifications for assessing strategy response areas to identify strategic commitment. The strategic commitment was studied by working through all the texts with a deductively formulated category system and registering the occurrence of those strategy responses if found in the text. The aspects within a response category were formed when a topic stood out from the texts. Also, new response areas were formed when they stood out from the text. The focus has been on exploring the CEOs' and boards of directors' disclosures, as those are the main source for strategic commitments.

The strategy response aspect "risks" was expanded to "risks and opportunities", since the companies emphasize both perspectives. Also, the strategy response aspect "radical innovation" was generalized to "innovations", since the companies emphasize incremental change with continuous improvement.

The environmental strategy implementation practices were studied by searching evidence of applied management processes for leadership, strategy, organizational structure, and systems, applying the model by Epstein and Buhovac (2014). However, among the studied companies the implementation practices for management processes were not reported comprehensively; therefore the research design (Figure 1) was simplified from the model of Epstein and Buhovac (2014).

5. Results

5.1 Corporate environmental commitments

The main response areas of environmental commitments in company strategies are related to risks and opportunities, production processes, brand, products and markets, business context, and innovations (Table 3). The aspects within response areas which stand out from the data are also presented in Table 3.

The companies are emphasising sound environmental performance in their operations by mitigating risks, being in compliance, minimizing emissions, and employing stable production processes.

Continuous improvement, which is a key to incremental change, is emphasized by the majority of studied companies. Another common factor to which the companies state they are committed is cooperation with stakeholders, although approaches vary greatly. Boliden highlights open dialogue with all stakeholders. Companies such as Agnico-Eagle, Dragon, First Quantum Minerals, and Nordkalk emphasize the importance of actively being present and openly providing information in the areas where the operations are. These activities serve both for mitigating risks and for brand building.

When companies address philanthropy, they do so mainly in a traditional, non-strategic way, in which they donate a portion of company resources to a social cause, such as local sports and hobbies, activities, and culture. However, some organizations practice strategic philanthropy, where benevolent activity serves to meet marketing and other business-related objectives. For example,

Yara is committed to sharing its knowledge and expertise by educating its customers in developing countries while also expecting more business from the outreach.

Companies address current megatrends such as climate change and scarcity of raw materials while communicating their commitments to solve these global challenges. Outokumpu is aiming to make steel with zero waste and Nordkalk's goal is to utilize all of its extracted raw materials, while both companies are both companies are making decisions based on scarcity of raw materials. Meanwhile, companies also show commitments to developing products and services which have positive environmental and social impact on their customers or society.

The change from 2009 to 2014 in environmental and social disclosures has been minor. Of the fourteen companies which showed some changes, four show development towards emphasizing global megatrends, social responsibility, and benefits from environmental considerations. Meanwhile, four companies showed no change in their disclosures, and the remaining six companies did not have comparable reports to be studied.

5.2 Strategic objectives

Among the studied companies, the environmental commitment perspectives they present are diverse (Figure 2), and most companies are seeking environmentally sound and socially acceptable operations. Companies with a focus on their operations' internal efficiency are stressing goals such as good risk mitigation, processes, and material efficiency. For them, business benefits with environmental aspects are tied to operational efficiency. Companies with a focus on customers and society emphasize competitive advantage through differentiation by providing products and solutions to address customers' environmental concerns and responding to global megatrends. Also, some companies emphasize to some extent both operations efficiency and the customer/society perspective, gaining competitive advantage in both simultaneously.

5.3 Processes for implementation practices

Five out of fourteen companies (Agnico-Eagle, Boliden, Outokumpu, Paroc, and Yara) describe in detail the management practices they intend to follow for environmental strategy implementation. The business processes and practices are related to leadership, strategy processes, organizational structure, and systems in use (Figure 3).

The top management commitment is a common practice for leadership in the studied companies with CEOs' or boards of directors' disclosures in company reports. Some of the companies are assessing materiality to identify critical environmental issues for their own businesses and stakeholders. Also, some are assessing risks and opportunities the companies are facing. Some companies reveal how environmental responsibilities and matters are governed internally.

Only a few companies, namely Agnico-Eagle, Boliden and Outokumpu, have numerical goals and objectives for environmental matters. The numerical targets have to do with climate change, energy efficiency, waste landfilled, fresh water use, number of environmental incidents, and air and water emissions. However, group-wide key performance indicators (KPI) are reported more often. Among the studied companies, Agnico-Eagle differs from others by reporting environmental and social performance data with site-specific results in its sustainability report.

Several companies are committed to the ISO 14001 environmental management standard. Seven companies report that they have certified their management systems or are in the process of certifying all their sites. Three additional companies are committed to following ISO 14001 practices, but they are not aiming to certify the system.

Most of the companies are reporting various environmental programs to reduce emissions and impact (Figure 4). Besides the environmental programs, five companies report various stakeholder engagement programs.

Half of the fourteen companies emphasize the positive environmental and social impact their products and services can provide to their customers or society. These companies are creating new markets and products and exploiting the possibilities that increasing environmental and social awareness is providing to their business.

Based on this study, even though most of the companies communicate through stand-alone CR reports, annual reports, or company websites, few show clear evidence of systematic management practices for implementing strategic commitments to ecological and social matters. Also, the site-specific information is limited. Due to the lack of comparable numerical information, overall conclusions of mining industry achievements cannot be drawn.

6 Discussion

In this study, the strategy model by Laszlo and Zhexenbayeva (2011) to identify strategy commitment aspects together with the strategy implementation model by Epstein and Buhovac (2014) is a practical combination to assess overall environmental strategic management.

The findings indicate that sample companies see the potential of business benefits from their environmental commitments (Q1). The environmental focus in companies' business strategies mainly emphasizes either operations' internal efficiency or their positive impact on external factors, i.e. customers and society (Figure 2). The common denominators in most sample companies are the commitment to continuous improvement and different kinds of stakeholder interactions. Therefore, the business benefits are related to efficiency by improving internal processes and/or to differentiation by providing products and solutions to address customers' environmental challenges and responding to global megatrends. This study shows the gap between a strategic intent and its implementation, which corresponds to findings by Kaplan and Norton (2001) for companies in general. Most sample companies show top management commitment, but only a few companies show clear evidence on systematic management practices for environmental strategy implementation (Q2). Even though almost half of the companies report KPI's for environmental performance, only a few companies have numerical goals and objectives for environmental matters. It is therefore appropriate to question whether the strategy implementation they describe is effective.

As mentioned, the relationship of strategy, implementation, and results could not be assessed, because the reporting practices are not comprehensive enough. The site-specific numerical information is very limited, and when key performance indicators (KPI) are reported, they are commonly group-wide information. It is argued that information on corporate responsibility, specifically for mining companies, should be site-level and reported as comprehensively as possible (Rytteri 2012, Fonseca et al. 2014) and also that there must be a link between strategic commitment and its implementation (EFQM 2014, Engert and Baumgartner 2016, Mätäsaho 1999, Pearce and Robinson 2011).

As a summary, among the studied companies, the environmental commitment perspective they present is diverse, but with a few exceptions, the implementation practices or the results are not reported comprehensively (Figure 5).

This study reveals some global and national topical issues (ICMM 2016, TEM 2013, YM 2014), which are largely missing in the companies' environmental programs, such as managing water balance and water usage, contributing to a circular economy, managing tailing ponds and discharging sulfate to water.

Even though the change in environmental disclosures through time has been minor, external drivers have changed environmental strategies. Therefore, we may expect that in the future, mining companies will adapt new elements to their environmental and social disclosures as the society's demands changes.

The outcome of this study (Q1 + Q2) is that the companies show the strategic nature of their environmental management in those cases where there is a balance among top management commitments, their implementation, and results. In general, the companies which have stand-alone responsibility reports and are using specific reporting guidelines have a more mature grip on reporting practices. However, in most cases, the "strategy" ends with top management disclosure and examples of various environmental programs. It is appropriate to question whether those companies have really realized all the potential that strategic environmental management can provide them.

7 Conclusions

The results indicate that companies' commitments on environmental considerations are evident. To what extent and through what approach a company intends to create value with environmental considerations vary between companies, although all are seeking environmentally sound and socially acceptable operations. The strategic approach varies between companies, and the strategic commitment is to emphasizing operations' internal efficiency, solving customers' environmental concerns, or addressing global megatrends. It is notable that the change through time in environmental and social disclosures has been minor.

Some of the sample companies widely report their management processes for environmental strategy implementation. However, most companies rely mainly on adequacy of top management commitment with minor information on management processes, environmental targets, and performance. However, regarding the limitations of this study, it should be noted that companies do not necessarily report publicly the elements of their strategic environmental management.

This study showed the need to open up environmental management practices as well as outcomes. This suggests also a further study on the mining industry's environmental management implementation to determine which management and leadership practices are exemplary for an environmentally sound and sustainable mining industry.

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Appendix A. Companies which have metal or industrial mineral mining operations in Finland and are included in this study.

Parent company	Mining operations in Finland		Minerals	Ore production (t) in 2014
	Company name	Municipality/ Mine		
Agnico-Eagle Mining Ltd., Canada	Agnico-Eagle Finland Oy	Kittilä/Suurikuusikko	Gold	1,168,993
Boliden AB, Sweden	Boliden Kylylahti Oy	Polvijärvi/Kylylahti	Copper, zinc, nickel, cobalt	671,465
Dragon Mining Ltd., Australia	Dragon Mining Oy	Huittinen/Jokisivu Orivesi	Gold	125,844
Endomines AB, Sweden	Endomines Oy	Pampalo	Gold	170,782
First Quantum Minerals Ltd., Canada	Kevitsa Mining Oy	Sodankylä/Kevitsa	Nickel, copper, PGE	343,062
Juuan Dolomiittikalkki Oy, Finland	Pyhäsalmi Mine Oy	Pyhäjärvi/Pyhäsalmi	Copper, zinc, sulphur	6,933,615
Mondo Minerals B.V., Netherlands	Mondo Minerals B.V. Finnish branch office	Paltamo	Dolomite	1,376,572
Rettig Group, Finland	Nordkalk Oy Ab	Polvijärvi Sotkamo	Talc, nickel	55,000
		Lappeenranta	Talc, nickel	469,918
		Parainen	Dolomite, calcite, wollastonite	504,013
		Others 8 mines	Calcite	1,217,593
Omya International AG, Switzerland	Salon Mineraali Oy	Salo/Hyypiämäki	Dolomite, calcite	1,446,603
Outokumpu Oyj, Finland	Outokumpu Chrome Oy		Calcite	710,020
Paroc Group Holding group, Finland	Paroc Oy Ab	Lapinlahti, Parainen	Chromium	125,348
Sibelco Group, Belgium	Sibelco Nordic Oy Ab	Kemiönsaari, Kuopio	Chromium	2,284,970
SMA Mineral AB, Sweden	SMA Mineral Oy	Tornio, Pieksämäki	Aluminum, magnesium, feldspar, quartz	124,985
Yara International ASA, Norway	Yara Suomi Oy	Siilinjärvi	Feldspar, quartz	159,476
			Dolomite	137,002
			Apatite	10,909,606

The statistics are from 2014 (Materia 2015) and the ore production describes the magnitude of the operations.

Appendix B. List of secondary data used for the study

Company	Data used for this study
Agnico-Eagle Mining Ltd.	The Future Is Mine, 2014 Sustainable Report Discovering Value, Annual Report 2014 2009 CSR Report
Boliden AB	GRI Report 2014 Boliden Annual Report 2014 Sustainability Report 2009
Dragon Mining Ltd.	Dragon Mining Limited Annual Report 2014 http://www.dragon-mining.com.au Annual Report 2009
Endomines AB	Årsredovisning 2014 http://www.endomines.com Bokslutskommunik'e 2009
First Quantum Minerals Ltd.	Sustainability Report 2013 Respect First Quantum Minerals LTD. 2014 Annual Report http://www.first-quantum.com Corporate Sustainability Report 2010
Juuan Dolomiittikalkki Oy	http://dolomiittikalkki.fi
Mondo Minerals B.V.	http://www.mondominerals.com/en/the-talc-company/
Rettig Group/ Nordkalk Oy Ab	Nordkalk and Sustainability, Report 2014 Rettig Group Annual Report 2014 Nordkalk Environmental Report 2009
Omya International AG	http://www.omya.com Our journey towards sustainability, sustainability brochure
Outokumpu Oyj	Outokumpu Sustainability Report 2014 Outokumpu Sustainability Report 2009
Paroc Group	Paroc 2014 Sustainability Report http://www.paroc.com Paroc Book of Sustainability 2009-2011
Sibelco Group	http://www.sibelco.com
SMA Mineral AB	http://www.smamineral.com/Home.aspx
Yara International ASA	Impact Review 2014 http://yara.com/sustainability/ Yara Citizenship Report 2009

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Table 1.

Strategy response areas	How competitiveness is increased within strategy response areas
Risk	For mitigating risks. Sustainability-related risks are about avoiding potentially costly liabilities and negative business consequences.
Process	For reducing energy, waste, and material. Improving efficiency creates cost-cutting opportunities.
Product	For differentiating products and services. Environmental and social components are additional attributes to differentiate from competitors.
Market	For entering new markets. Growing ecological and social needs create new markets.
Brand	For protecting and enhancing brand. Companies can gain or lose significant market value based on stakeholder perceptions of environmental, health, and social impacts.
Business context	For influencing industry standards. Companies can try to shape government regulation and set self-regulation standards to lift them over the competition.
Radical Innovation	This is for all above-mentioned strategy responses. There is potential with environmental performance to drive innovation by rethinking the nature of the business.

Table 2.

Corporation	CR and company annual reports (2014)						CR in company Website		Activity in social media**
	Stand-alone CR report	CR as part of annual report	Integrated report IR	CR external verification	CR language*	Reporting guidelines	Yes/No	Language*	
Agnico-Eagle Mining Ltd	Yes	Yes	No	No	E	GRI***	Yes	F, E	Yes
Boliden AB	Yes	Yes	No	Yes	E	GRI	Yes	F, E, S	No
Dragon Mining Ltd	No	Yes	No	-	-	-	No	-	No
Endomines AB	No	Yes	No	-	-	-	Yes	F, E, S	No
First Quantum Minerals Ltd	Yes	Yes	No	No	E	GRI	Yes	E	Yes
Juuan Dolomiittikalkki Oy	No	No	No	-	-	-	No	-	No
Mondo Minerals B.V.	No	No	No	-	-	-	Yes	E	No
Rettig Group/ Nordkalk Oy Ab	Yes	Yes	No	No	F	-	Yes	F, E, S	Yes
Omya International AG	No	No	No	-	-	-	Yes	E	Yes
Outokumpu Oyj	Yes	Yes	No	Yes	E	GRI	Yes	F, E, S	Yes
Paroc Group Holding group	Yes	No	No	No	E	GRI	Yes	F, E, S	Yes
Sibelco Group	No	No	No	-	-	-	Yes	E	Yes
SMA Mineral AB	No	No	No	-	-	-	Yes	F, E, S	Yes
Yara International ASA	Yes	Yes	No	Yes	E	GRI	Yes	F, E, S	Yes

* F = Finnish, E = English, S = Swedish

** Activity in Social Media (Twitter, LinkedIn, Facebook, YouTube)

*** GRI = Global Reporting Initiative

Table 3.

Response area	Aspects	Examples of company commitments
Risks and opportunities	Risk mitigation and compliance	<p>“We are committed to assess potential impacts and risks...” Agnico-Eagle</p> <p>“We shall control safety and environmental matters from a risk perspective” Endomines</p> <p>“Compliance with host country laws and regulations” First Quantum Minerals</p> <p>“Shall meet the environmental requirements...” SMA Mineral</p>
	Future megatrends	<p>“...In many ways, it (product) is the perfect answer to global challenges such as resource scarcity, urbanization, and global climate and water challenges.” Outokumpu</p> <p>“Resource scarcity, food security and climate change are at the top of our agenda” Yara</p> <p>“Global megatrends are shaping the business environment and offer us further opportunities.” Paroc</p> <p>“A variety of international and regional initiatives designed to reduce the impact of climate change are likely to benefit our business” Boliden</p> <p>“Addressing critical global challenges.... and applying our innovative competences” Omya</p>
	Social license to operate and community relations	<p>“We are determined to contribute positively to the future of our employees and surrounding communities” Agnico-Eagle</p> <p>“Commitment to constructive community relations.” Dragon Mining</p> <p>“Objective is to improve the quality of life for our employees, their families and their immediate communities” First Quantum Minerals</p>
Processes	Reducing emissions and impacts	<p>“Use industry best practice to continuously improve our environmental performance” Agnico-Eagle</p> <p>“We always seek to minimize the environmental impact” Endomines</p> <p>“We will strive to make the smallest possible impact on the environment” Mondo Minerals</p> <p>“No accidents, no waste, no complaints are the main goals” Omya</p>
	Process efficiency	<p>“We are continuously working to reduce our environmental footprint, seeking greater energy efficiencies and improved processes across all operations.” Sibelco</p> <p>“Focuses on stable processes and resource efficiency” Boliden</p>
Brand	Philanthropy, programs and stakeholder dialogue	<p>“...Donations to various charitable enterprises and events...” Outokumpu</p> <p>“We strive to meet our social commitment (sponsors, donations)...” Mondo Minerals</p> <p>“We share knowledge to grow our customers’ business profitably...” Yara</p>
Products and markets	Differentiation and new markets	<p>“Value-added sustainable solutions for society’s needs” Omya</p> <p>“We strive to create environmentally friendly applications for our products” Mondo Minerals</p>
Business context		<p>“Our vision is to be an industry shaper, aiming to set industry standards...” Yara</p>
Innovations	Incremental change	<p>“Strive for continuous improvement...” Agnico-Eagle</p> <p>“Continuous improvement is a common effort” Nordkalk</p> <p>“Works actively towards continuous improvement...” Omya</p>

Figure 1.1

Figure 2.2

Figure 2.3

Figure 4.2

Figure 5.2