
Corporate sustainability management: a methodology and a case study in the mining and minerals sector

Adisa Azapagic* and Slobodan Perdan

School of Chemical Engineering and Analytical Science,
The Mill, Sackville Street,
The University of Manchester,
Manchester M13 9PL, UK

E-mail: adisa.azapagic@manchester.ac.uk

E-mail: slobodan.perdan@manchester.ac.uk

*Corresponding author

Abstract: This paper proposes an integrated approach to managing corporate sustainability along whole supply chains. The application of the approach is illustrated by a real case study of a company in the mining and minerals sector. The case study describes the main steps of the approach, including identification of sustainability issues, measurement and evaluation of sustainability performance, and communication of progress to relevant stakeholders. In this way, the paper aims to contribute towards a more systematic and structured incorporation of sustainability thinking into corporate practice, as well as providing some practical guidance to companies in their efforts to become more sustainable.

Keywords: corporate sustainability; sustainability management systems; sustainability indicators; supply chain management; life cycle thinking; mining and minerals.

Reference to this paper should be made as follows: Azapagic, A. and Perdan, S. (2010) 'Corporate sustainability management: a methodology and a case study in the mining and minerals sector', *Int. J. Mining and Mineral Engineering*, Vol. 2, No. 4, pp.310–337.

Biographical notes: Adisa Azapagic holds a BSc and MSc in Environmental Chemical Engineering and a PhD in Environmental Systems Analysis. She is Professor of Sustainable Chemical Engineering at the University of Manchester where she is leading the Sustainable Industrial Systems research group (www.sustainable-systems.org.uk). Her research interests include sustainable technology, sustainable production and consumption, life cycle assessment, carbon footprinting and corporate sustainability.

Slobodan Perdan is Research Fellow at the University of Manchester. He holds a BA, MA and PhD in Philosophy, and his research interests are in the areas of sustainable development and moral philosophy. He has written on a variety of issues concerning sustainable development and has researched a wide range of subjects, including environmental philosophy, engineering ethics and corporate sustainability.

1 Introduction

The challenge of sustainable development for any business is to ensure that it contributes to a better quality of life today without compromising the quality of life of future generations. If industry is to respond to this challenge, it will need to demonstrate a continuous improvement of its triple bottom line, i.e., economic, social and environmental performance (Elkington, 1999).

Many companies are actively involved in the sustainability debate trying to identify ways in which they could improve their triple bottom line and contribute to sustainable development (WBCSD, 2010). Often, the outcomes lean towards a ‘technological fix’ with most companies regarding technological improvements and innovation as the best way forward for solving most of the current environmental and social problems (Harrison, 2000). However, while technological solutions are an important component in contributing towards more sustainable industrial (and social) systems, on their own they will not be sufficient to bring about a sustainable future (Fleming, 1996). Rather, wider cultural changes will be needed for that (Dunphy et al., 2003; Doppelt, 2003). This paper argues that if companies are serious about sustainable development, the mindset must change to shift the attention from single, short-term technological solutions to a more systematic approach to managing corporate sustainability beyond company’s boundaries. It, therefore, proposes a Corporate Sustainability Management System (CSMS) to enable a systematic integration of sustainability into all business activities, addressing both technological and cultural changes needed to make an organisation more sustainable along the whole supply chain.

The following sections describe the methodology for developing a CSMS and discuss how such approach could be used by companies to translate the principles of sustainable development into corporate practice and help improve their triple bottom line. The practical application of the CSMS framework is illustrated by a real case study of a company in the mining and minerals sector.

2 Methodology for developing a Corporate Sustainability Management System

To facilitate an easier integration into the organisational structure, the CSMS proposed here has been modelled to be compatible with the familiar structure of the general management system standards such as Total Quality Management (TQM) (ISO, 2005; 2008) and Environmental Management Systems (EMS) (ISO, 2004). This is also in line with the European Commission’s approach, which wishes to promote the uptake of EMS and, in particular, the EU Eco-Management and Audit Scheme (EC, 2001) as a corporate sustainability instrument (EC, 2002). Therefore, similar to the TQM and EMS, the CSMS proposed here consists of five stages (Figure 1):

- 1 policy development
- 2 planning
- 3 implementation

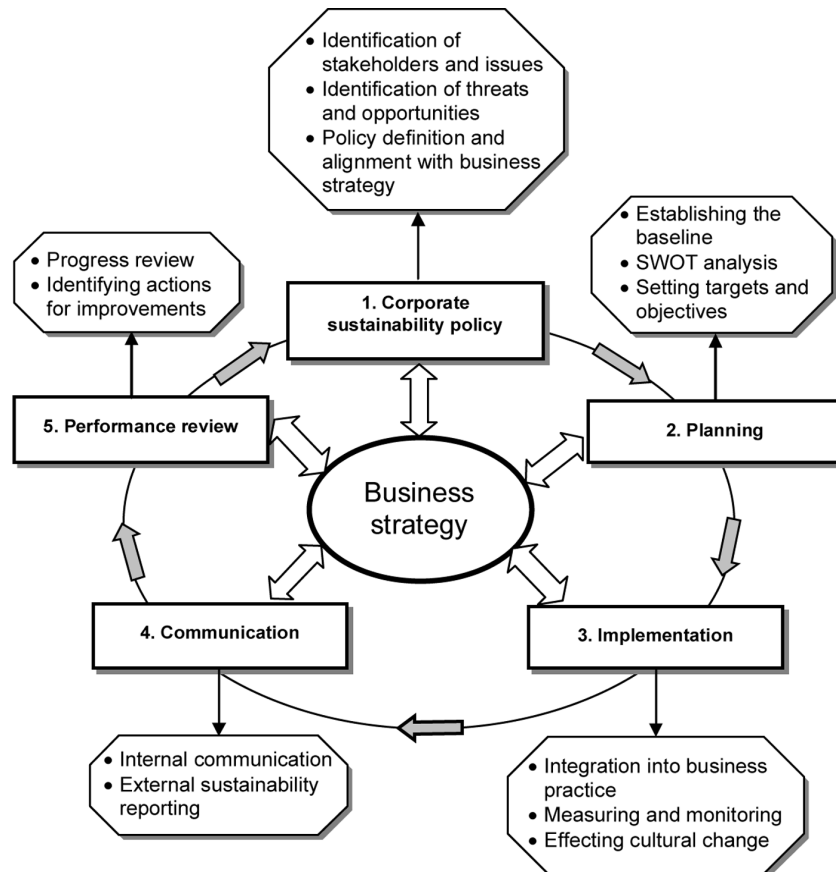
- 4 communication
- 5 performance review.

The system is designed to help companies manage the change needed to become more sustainable through:

- identification of stakeholders and key sustainability issues along the supply chains
- development of policies and actions needed to engage the stakeholders and address their issues
- development of sustainability indicators and measurement of sustainability performance to ensure continuous improvements
- communication of progress to relevant stakeholders.

A brief overview of each step is provided below.

Figure 1 Corporate sustainability management system



2.1 Corporate sustainability policy

The first step in setting up the proposed CSMS is definition of a corporate sustainable development policy (Figure 1). The policy should encapsulate the set of core business values agreed by the company and should contain statements of principles or policies on social, economic and environmental responsibilities and stakeholder relationships.

However, before a sustainable development policy can be formulated and put into practice, the following steps have to be carried out:

- identification of stakeholders and sustainability issues
- identification of sustainability threats and opportunities.

2.1.1 Identification of stakeholders and sustainability issues

Stakeholder identification and involvement are integral parts of a corporate sustainability strategy. Therefore, each organisation needs to think carefully about the many different constituencies upon which its activities and performance have an impact. Understanding interests and concerns of different stakeholders, including investors, customers and local communities, and the time scales over which these interests are important to them, are the prerequisites for a successful and sustainable business. For example, it is likely that creditors would have a strong interest in company's economic performance and, increasingly, a concern for their environmental and social performance. It is also to expect that the time scale of primary importance to them would be short-to-medium term (several months to five years); however, they may also be interested in a longer-term performance (five years and over). This analysis may help businesses to balance the interests of their stakeholders and to decide how to reconcile the different time scales.

The use and benefits of Stakeholder Analysis in corporate sustainability management as a tool for participation has been widely documented (e.g., Freeman, 2010; Stead et al., 2004). The process involves three logical steps (Chevalier and Bourassa, 2005):

- identification of stakeholders
- analysis of their characteristics and relationship with the organisation/company
- determination of the appropriate level of involvement and method of engagement.

These steps are iterative and inter-linked.

The stakeholder analysis achieves much more than a report describing potential interest groups. By facilitating stakeholder engagement in the negotiation, planning and execution of shared objectives, it can also be seen as part of the overall process of sustainability management.

The stakeholder analysis is closely related to the identification of key sustainability issues relevant to company's activities. Sustainability issues facing a company go well beyond its gates; they span the whole supply chain from 'cradle to grave', including extraction of raw materials, production and use of the product and end-of-life management. Some examples of generic sustainability issues (economic, environmental and social) applicable to many types of industrial activities and companies are given in Table 1.

Table 1 Examples of sustainability issues and related sustainability indicators

<i>Issues</i>	<i>Relevant sustainability indicator</i>
<i>Economic</i>	
Profit	Annual Profit
Turnover	Annual turnover
Shareholder value	Share value/returns
Value added	Value added
Investments	Capital investment
	Human capital investment
Liabilities	Environmental liability
	Social liability
Contribution to GDP	Ratio of value added to GDP
<i>Environmental</i>	
Resource depletion	Rate of non-renewable and renewable resource depletion
Energy use	Amount of energy used
Air emissions	Emissions of SO ₂
	Emissions of heavy metals, etc.
Water emissions	Emissions of nitrates and nitrites
	Total suspended solids, etc.
Solid waste	Amount of solid waste (hazardous and non-hazardous)
Contribution to global warming	Emissions of greenhouse gases
<i>Social</i>	
Health and safety	Lost time accidents (employees H&S)
Employee training and education	Percentage of hours of training relative to the total hours worked
Work satisfaction	e.g., number of hours lost due to absenteeism
Ethical business dealings	Preservation of cultural values
	Abolishment of child labour
Customer satisfaction	Number of complaints
Stakeholder involvement and liaison	Number of consultative meetings with stakeholders
Social partnership and sponsorship	Involvement in community projects

Source: Modified from Azapagic (2004)

Economic issues: The main aim of an enterprise is to create value through producing goods and services, thereby generating profits as well as welfare for society, including through provision of employment. This necessitates consideration of both micro and macro-economic issues. Micro-issues are directly related to company's performance and are normally linked to sales, turnover, cash flow, profit and shareholder value. Macro-economic issues put company's performance in the national and international contexts. They include value added (tax) and contributions to employment and Gross Domestic Product (GDP).

Environmental issues: Most companies already have a good idea of the main environmental issues associated with their business activities, mainly through compliance

or as a result of implementation of an environmental management system. To understand better the key environmental issues and the ways of addressing them, it is important to identify sources of environmental problems ('hot spots') by business activity along the whole supply chains (e.g., processing, products, transport, procurement and so on) so that they can be prioritised for improvements. Tools such as Life Cycle Assessment (LCA) can be used for these purposes (ISO, 2006). Life cycle thinking and LCA are now enshrined in most EU environmental legislation (e.g., the Directives on Integrated Pollution Prevention and Control (EC, 2008) and on Integrated Product Policy (EC, 2003) and their use in industry is increasing.

Social issues: Socially responsible business has to deal with its position in society in as positive a way as possible and pay careful attention not only to its profit and shareholders but also to broader social concerns. Therefore, acknowledging and endorsing wider responsibilities that business has to communities in which it operates and to society in general, including both present and future generations, plays an important part in the process of developing corporate sustainability.

2.1.2 Identification of sustainability threats and opportunities

Once the stakeholders and their main sustainability issues have been identified, it is then easier to identify any threats to the company from unsustainable practices and potential opportunities from more sustainable ways of operating. These may include technical, legislative, environmental, social and other factors, all potentially leading to financial threats or opportunities. Thus, information should be gathered to inform the company on:

- new and proposed legislation
- industry practices, standards and future trends
- technical developments, such as clean technologies
- competitors' strategies
- community interests and pressure-group activities.

This preliminary analysis is then used as an input into a more detailed analysis of the Strengths, Weaknesses, Opportunities and Threats (SWOT), carried out within the Planning stage (see Section 2.2).

2.1.3 Definition of sustainability policy

Corporate sustainability policy reflects company's vision for sustainable development. To be successful, the policy must be aligned with and guided by the business vision and strategy. It should contain statements of principles or policies on social, economic and environmental responsibilities taking into account stakeholder expectations (GRI, 2010). A sustainability policy can only be successful if there is a clear commitment by company's senior management (Holliday et al., 2002). This commitment should be explicitly stated in the policy as well as shown by direct actions. However, this alone will not guarantee that the policy and strategy will be implemented effectively as a 'buy in' by all employees is necessary for their successful implementation (CBI, 2009).

2.2 *Planning*

Policy development is followed by the Planning stage to help the company implement its corporate strategy into practice. Within the proposed CSMS, this involves:

- developing sustainability indicators and establishing the performance baseline
- analysing SWOT
- setting targets and objectives.

2.2.1 *Developing sustainability indicators and establishing the baseline*

While statements of broad policy on sustainable development are important, the policy statement should be supplemented with a series of specific objectives and targets for sustainability improvements. However, before these can be defined, the company must first establish the performance baseline to understand where it is starting from and how easy or difficult it may be to achieve its sustainability commitments. The baseline performance is calculated by using appropriate sustainability indicators, which translate the identified economic, environmental and social sustainability issues into the appropriate quantitative or qualitative measures of performance. The indicators should enable consideration of the whole supply chain and capture the concerns of all relevant stakeholders. They should be quantitative wherever possible; however, for some aspects of particularly social sustainability, it may be more appropriate to use qualitative descriptions.

An example list of indicators linked to the sustainability issues identified in Stage 1 of the CSMS is given in Table 1.

A number of companies, organisations and governments are working actively on the development of indicators for different industrial sectors, including Dow Jones (2011), Global Reporting Initiative (GRI, 2010), UK government (Defra, 2010), Water UK (2010), UN CSD (2007), NEA (2007) and IChemE (2002).

In addition to sustainability indicators, various other tools can be used to help companies put sustainability into practice – SWOT analysis is one of these, as discussed below.

2.2.2 *SWOT analysis*

The baseline performance can help the company to understand better the sustainability threats and opportunities, so that the next stage in the planning process is a detailed SWOT analysis. Following on from the initial analysis of the threats and opportunities, as discussed in Section 2.1.2, the outcome should help the company to set realistic targets and objectives to address the major SWOT.

2.2.3 *Setting targets and objectives*

As in any other business activities, corporate sustainability strategy also requires setting certain objectives and targets. They should be relevant to the key sustainability issues and the SWOT analysis. For example, objectives and targets may be set for reduction of energy consumption and carbon emissions and for maximum tolerable frequency of

work-related injuries. To ensure credibility of the policy and strategy, the targets should be set above legislative limits, if any.

Wherever possible, the objectives should be expressed as measurable targets. This is essential for assessing whether the objectives have been met. Targets also need to be realistic but challenging and related to certain time scales. Possible obstacles to meeting the objectives and opportunities for exceeding targets should be considered.

Once the planning process is completed, the process of implementing the sustainability policy and strategy can start.

2.3 Implementation

As outlined in Figure 1, this third stage of the CSMS involves:

- integration of sustainability into business practice
- sustainability measuring and monitoring
- affecting the cultural change within the organisation.

2.3.1 Integrating sustainability into business practice

This is probably the most challenging part of implementation of a sustainability policy and strategy. It involves defining sustainability priorities and aligning them with business priorities as well as identifying specific projects to make business more sustainable. However, more fundamentally, it also involves changing the corporate culture and attitudes (see e.g., Dunphy et al., 2003; Doppelt, 2003). These changes cannot be achieved overnight and normally a three-to-five-year plan with one-year milestones will be needed (DTI, 2001).

To enable an easier integration of sustainability into business practice, it is useful to break down the overall business activities into the key activities and areas of interest along the supply chain, e.g., resources, production, products, transport and so on. Specific projects should be identified to help achieve the objectives and targets by addressing the key sustainability issues for each of the key business areas. Some examples of projects that demonstrate how different companies have addressed sustainability issues at the practical level are available from WBCSD (2010).

2.3.2 Sustainability measuring and monitoring

Measuring and monitoring is one way to ensure that the sustainability objectives and targets are being met (Searcy, 2009). Over the years, this will give a good indication of the direction in which the company is going-either towards or away from sustainability. The information obtained by measuring and monitoring can also be used for internal and external communication on progress with respect to sustainability (GRI, 2010).

2.3.3 Cultural change

Cultural change is critical for a successful implementation of any management system, including the CSMS proposed here. The change should be evident throughout the company and among all employees. Awareness raising and training are the main vehicles

for effecting the change (Daily and Huang, 2001). For example, the usual training activities (e.g., health and safety) could be broadened to include an introduction to sustainability and its relevance to a particular training activity. Leadership courses could be expanded in a similar way to encourage management to be innovative and take a lead in corporate sustainability.

Various financial and non-financial incentive schemes could be put in place to encourage employees to put forward innovative ideas that could lead to improved levels of sustainability. The increased awareness and participation of employees will not only generate practical ideas but will also increase enthusiasm for the sustainability programme itself as most employees enjoy being part of an organisation that is committed to operating in a socially and environmentally responsible manner.

2.4 Communication

Effective communication is essential for promoting the concept of corporate sustainability as well as for promoting company's achievements (Bartels et al., 2008). Therefore, it is important to develop meaningful internal and external reporting procedures.

As already mentioned, internal reporting on company's achievements with respect to sustainability and the related benefits can have a significant effect on corporate culture. For example, the company could ask line managers to include in their regular reports a statement on whether they have achieved the sustainability targets for a particular period. The board of directors could request similar periodic reports from directors and senior management. A summary of progress should also be communicated to all employees at regular intervals.

In addition to internal reporting, a large number of companies produce external reports on their sustainability performance (see e.g., KPMG, 2008; GRI, 2010). Sustainability reporting helps maintain transparency of business dealings by providing relevant information to the stakeholders. Companies that wish to communicate their achievements with respect to sustainability also use it as a marketing tool. The Global Reporting Initiative (GRI) is probably the most prominent sustainability reporting standard which is followed by over a thousand companies. The GRI gives recommendations and guidelines on both the report structure and the type of sustainability indicators (GRI, 2010) to use for reporting.

2.5 Performance review

To establish whether the objectives and targets set by the sustainability policy have been met, progress reviews should be carried out at regular intervals. The review periods can vary and normally range from three months to one year. If the targets have not been met, the reasons should be identified and an appropriate corrective action should follow. Alternatively, the objectives should be reviewed and more realistic targets set. However, if the targets have been met and the achievements clearly communicated, the process starts again with the policy review and re-alignment with the business strategy. In this way, the company will be fully aware of their performance and direction in which it is going-towards or away from sustainability.

The review process should ensure continuous improvement and progress towards sustainability. It should also help the company to answer practical questions on what exactly and how much it needs to do to improve its performance in a particular area to become more sustainable. Answering this question is indeed one of the most important aims of developing and implementing a CSMS, such as the one proposed here.

The above-described methodology to develop a CSMS has been applied and tested in a company in the mineral and mining sector. This is presented and discussed in the rest of the paper. To preserve confidentiality, the company and its products are not named. It suffices to say that the company operates in Europe and has around 600 employees; prior to this work, the company did not have a sustainability strategy in place.

Although the application of the framework is specific to a company in the mining and minerals sector, the same approach could be used by any company in the same or other sectors – the difference will be in the specific issues faced by that company or the sector and the type of activities that can be undertaken to improve sustainability performance.

3 Case study

The mining and minerals industry faces some of the most difficult sustainability challenges of any industrial sector (EC, 2000; IIED & WBCSD, 2002; Azapagic, 2004). To secure its continued ‘social licence’ to operate, the industry has started to respond to some of these challenges as, for example, demonstrated by its flagship project “Mining, Minerals and Sustainable Development” (IIED & WBCSD, 2002). Since then, the industry has been working on addressing some of the most pertinent sustainability issues at the sectoral level through a range of activities. The notable examples of such activities are provided by the International Council on Mining and Metals and include projects on human rights (ICMM, 2009), health risk assessment (ICMM, 2010a) and management of chemicals (ICMM, 2010b).

However, while these and other individual projects are useful for tackling specific sustainability issues in the mining and minerals sector, they could have much greater impacts if carried out as part of an integrated corporate sustainability strategy. The case study presented in the rest of the paper illustrates how this could be done.

3.1 Methodology

The development and application of the CSMS for the company has been carried out over several months. It started with an initial analysis of the company’s stakeholders and sustainability issues based on the available corporate reports by the company, information from literature and other mining and minerals publications as well as the authors’ own knowledge of the sector. The analysis characterised each stakeholder group according to two criteria:

- the type of sustainability issues (economic, environmental and social) and the importance they place on these
- the time scales over which these issues are important to them.

This enabled identification of a provisional list of the key stakeholders and sustainability issues, which was then refined through a series of successive interviews and meetings with stakeholder representatives and the company's management and employees. The interviews were carried out mainly with middle and senior managers on an one-to-one basis, where possible, following the established social research techniques for semi-structured interviewing (e.g., Denzin and Lincoln 2000).

The interviews and meetings provided qualitative and quantitative data for the further steps in the development of a CSMS, including:

- development of sustainability indicators for measuring the company's performance along the supply chain as well as for monitoring future performance
- development of policies and actions needed to engage the stakeholders and address their issues and communicate progress.

The sustainability indicators were selected and designed using the GRI methodology (GRI, 2010) and the specific indicators for the mining and minerals sector developed by Azapagic (2004).

A series of iterative consultations were held with the company's senior and middle management to analyse the information provided in the previous stages of the process. Initially, a conventional SWOT analysis was used to position the company in the light of sustainability challenges. In the later stages of the CSMS development, however, a more detailed SWOT analysis was conducted, which took into consideration wider sustainability issues highlighted by the stakeholders analysis and sustainability indicators.

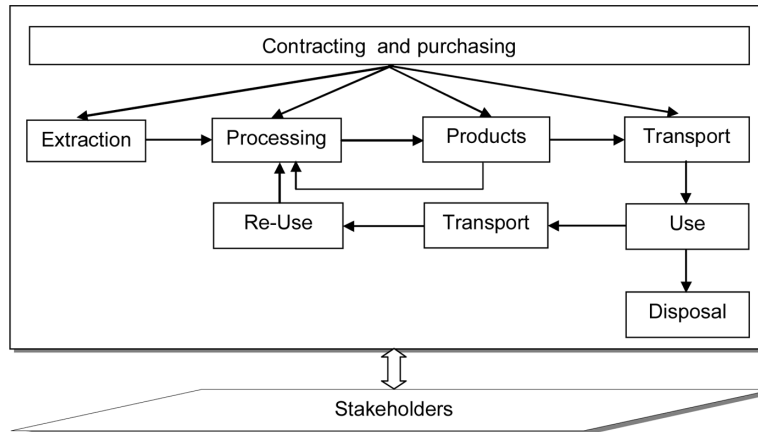
The results and findings of the CSMS process were then reported back to the management board to inform the company's sustainability strategy and help identify appropriate actions and policies for engaging stakeholders and addressing sustainability issues.

The following sections discuss each stage of the process as well as the obtained results. It should be noted that, although the whole CSMS has been defined and put in place, at the time of writing it is still in its early stages of implementation. Therefore, some parts of CSMS are yet to be effected, in particular those that take longer time, including realisation of some sustainability projects as well as the cultural change (Steps 3, 4 and 5 in Figure 1).

3.2 Developing corporate sustainability policy

3.2.1 Identification of stakeholders and sustainability issues

As discussed in the previous sections, sustainability strategy and policy should address the whole supply chain, rather than just the company's immediate activities. The supply chain for the company considered here is shown in Figure 2; this comprises all activities from 'cradle to grave', including the extraction and processing of minerals, production of products and their transport to the use stage and any recycling of the mineral products at the end of their useful life. As shown, contracting and purchasing span the stages from 'cradle to gate', plus transports to customers.

Figure 2 The supply chain related to the company's operations

The company's stakeholders have been identified by mapping the key players onto each part of the supply chain and by taking into account the players with which the company has direct interactions. The list of the stakeholders is given in Table 2, indicating the importance they place on various sustainability issues and the time scales over which these issues are important to them. The stakeholder preferences for different sustainability issues have been elicited through the company's long-term knowledge of and consultation with some of the stakeholders (e.g., customers, contractors, investors, local authorities etc.) as well as through direct discussions with key representatives of some stakeholder groups (e.g., local communities and NGOs). For example, customers tend to have a strong concern over economic issues (prices of products) and some concerns over environmental (e.g., carbon footprint) and social issues (mainly health and safety of products). The primary time scales over which these concerns are important to them are short to medium (several months to 5 years). However, NGOs tend to have a strong interest in the environmental and social issues, both short-to-medium and long terms. Overall, most stakeholder groups shown in Table 2 (70%) appear to have strong concerns about economic issues, around half of the stakeholders may be concerned about social issues and about 40% have strong interests in environmental issues. All the stakeholders consider sustainability issues primarily over short to medium term but some are also interested in longer-term issues, e.g., policy makers and NGOs.

The key sustainability issues for the stakeholders and the company are summarised in Table 3. As mentioned above, these have been identified through various stakeholder consultations as well as by drawing on the findings of the project on the sustainability of the mining and minerals sector (IIED & WBCSD, 2002). For example, the key economic issues for the company include cash flow, profit and shareholder value, while the main social issues include health and safety of employees and customers. Given the sector in which the company operates, the environmental issues include resource depletion, energy consumption and carbon footprint (IIED & WBCSD, 2002; Azapagic, 2004). A more detailed breakdown of the environmental issues, showing their impact and sources along the supply chain, is given in Table 4. For instance, the main contribution to biodiversity loss is extraction of the minerals while the CO₂ is emitted along the whole supply chain, from extraction through processing to transport. These three stages in the life cycle also represent the main hot spots for most environmental impacts related to the company's

activities and products. This is substantiated further in the section on establishing the baseline (Section 3.3.1).

The above information has helped to decide which aspects of sustainability the company should target in engaging the appropriate stakeholders in the implementation stage. It has also been useful for identifying the potential threats and opportunities, as discussed below.

Table 2 Company's stakeholders and their concerns

<i>Stakeholders</i>	<i>Sustainability concerns</i>			<i>Time scales</i>	
	<i>Economic</i>	<i>Environmental</i>	<i>Social</i>	<i>Short to medium</i>	<i>Long term</i>
Competitors	◆	□	□	<i>P</i>	<i>S</i>
Creditors	◆	□	□	<i>P</i>	<i>S</i>
Customers	◆	□	□	<i>P</i>	
Employees	◆	□	◆	<i>P</i>	<i>P</i>
Local authorities	□	◆	◆	<i>P</i>	<i>S</i>
Local communities	□	◆	◆	<i>P</i>	<i>P</i>
NGOs	□	◆	◆	<i>P</i>	<i>P</i>
Policy-makers	◆	◆	◆	<i>P</i>	<i>S</i>
Shareholders	◆	□	□	<i>P</i>	<i>S</i>
Suppliers and contractors	◆	<i>X</i>	<i>X</i>	<i>P</i>	

Symbols

◆ Strong concern

□ Some concern

X No concern

P Primary time scales

S Secondary time scales

Time scales

Short to medium: Several months to 5 years

Long term: 5 years and longer

Table 3 Key sustainability issues for the company and the stakeholders

<i>Economic issues</i>	<i>Environmental issues</i>	<i>Social issues</i>
Cash flow	Biodiversity	Customer satisfaction
Contribution to GDP	CO ₂ emissions	Employee training and education
Investments (capital, employees, communities)	Dust emissions to air	Employment contribution
Profit	Energy use land use, management and restoration energy use	Equal opportunities and non-discrimination
Sales	Resources and reserves	Health and safety (employees and citizens)
Shareholder value	Solid waste	Noise and visual nuisance
Turnover	Toxic emissions to air	Stakeholder involvement and liaison
	Water use and discharges	Social partnership and sponsorship
		Wages and benefits

Table 4 Environmental issues, associated impacts and their sources along the supply chain

<i>Environmental issue</i>	<i>Environmental impact</i>	<i>Source in the supply chain</i>
Biodiversity	Loss (or enhancement) of biodiversity	Extraction (land use/restoration)
Contribution to global warming (CO ₂ emissions)	Climate change	Extraction (gas oil combustion in mobile equipment) Production (fossil fuel combustion for energy generation) Transport (diesel and petrol combustion)
Dust emissions to air	Local air pollution	Extraction Production (dryers) Transport (particles generated from diesel combustion)
Energy use	Depletion of fossil fuel reserves Climate change (CO ₂ emissions) Local air pollution (SO ₂ , NO _x , particles)	Extraction (gas oil combustion in mobile equipment) Production (fossil fuel combustion for energy generation) Transport (diesel and petrol combustion)
Land use, management and restoration	Land disturbance Loss (or gain) of amenity Destruction or disturbance (or creation) of natural habitats	Extraction Production (land occupied by the plant)
Resources and reserves (availability and depletion)	Non-renewable resource depletion Future resource availability for the company	Extraction
Solid waste	Landfill space Eco and human- toxicity (hazardous waste)	Extraction Production
Toxic emissions to air (dioxins, heavy metals)	Eco-toxicity Human toxicity	Production (combustion of waste oil)
Transport	Fossil fuel depletion Climate change Local air pollution	Extraction Product transport Business travel
Water use and discharges	Water loss Water pollution (pH, suspended solids, oil spills)	Extraction Production

3.2.2 Identification of threats and opportunities

Table 5 gives an overview of the identified potential threats for the company from unsustainable practices and opportunities from adopting and implementing a sustainable development strategy. These threats and opportunities span technical, legislative, environmental and social aspects, all potentially impacting on the economic performance of the company. For example, one of the social threats are disputes and conflicts with the local communities and pressure groups resulting in delays in permit approvals or

rejections of planning permissions, leading to major financial losses. However, at the same time, there is an opportunity to work with the local communities and other stakeholders towards addressing their concerns at an early stage, thus avoiding conflicts and losing the ‘social licence’ to operate.

Table 5 Opportunities to benefit from sustainability and threats from unsustainable practices

<i>Aspect</i>	<i>Opportunities and benefits</i>	<i>Potential threats and possible effects</i>
Technical	Increased production efficiency and product quality through the use of clean technologies, decoupling profits and costs Increased energy efficiency leading to direct financial benefits	Continued use of old and inefficient technologies leading to financial and environmental inefficiencies
Legislative	Improved ability to respond to and influence legislation change through forecasting and better planning Improved relationships with government and regulatory bodies through proven accountability	Unprepared to participate in the carbon trading scheme leading to a financial loss Lack of awareness of the forthcoming legislation
Environmental	Reduced environmental risks (including reduced risk of a pollution incident) leading to possible reduction in insurance premiums Identification of inefficiencies in production through environmental monitoring	Increased environmental incidents through poor planning and management Lack of understanding of key sustainability issues and areas of business which impact on sustainability
Social	Increased motivation of staff who are able to see and measure real achievements Ability to attract and retain good quality people in the company through commitment to staff development and through proven environmental and social responsibility Improved health and safety leading to lower costs Trust building with NGOs and local communities	Disputes and conflicts with communities and pressure groups resulting in a lengthy planning process and delays in permit approvals or rejection of planning permissions, leading to major financial losses Poor external image and distrust by communities, NGOs and other stakeholders
Other	Raised profile and improved reputation Improved relationship with investors and customers	Short-term thinking and planning oriented only towards quick pay-backs Loss of customers

3.2.3 *Definition of sustainability policy*

Taking into account the key sustainability issues and the stakeholders, as well as the related threats and opportunities, the company has defined their sustainable development policy as:

“The Company and the Board of Directors are committed to contributing to sustainable development by working together as the leading provider of minerals-based solutions for customers. We aim to achieve this through:

- long-term sustainable growth
- development of value-added and environmentally benign solutions
- responsible supply of our products and increased customer base
- establishment of high performance and socially-responsible culture
- active engagement with our stakeholders and commitment to addressing their concerns”.

This top-level sustainable development policy has then been developed further to incorporate other relevant company policies such as those related to environmental issues (including energy and carbon footprint, restoration and biodiversity), health and safety, purchasing and community relations. For example, the energy policy has been defined as:

“The Company is committed to the most efficient and sustainable use of energy throughout all of our sites and premises. We aim to achieve this objective through our Sustainable Energy Management System, by targeting the following key areas:

- reducing our energy consumption and cost
- increasing our energy efficiency
- reducing our emissions of CO₂ and other environmental impacts arising from our consumption of energy
- investing in renewable and clean energy technologies where practicable.

We are committed to setting objectives and targets for continuous energy efficiency improvement through a strategic action plan, which will be reviewed and updated each year. We also encourage and support individual voluntary initiatives aimed at increasing the energy efficiency”.

3.3 Planning

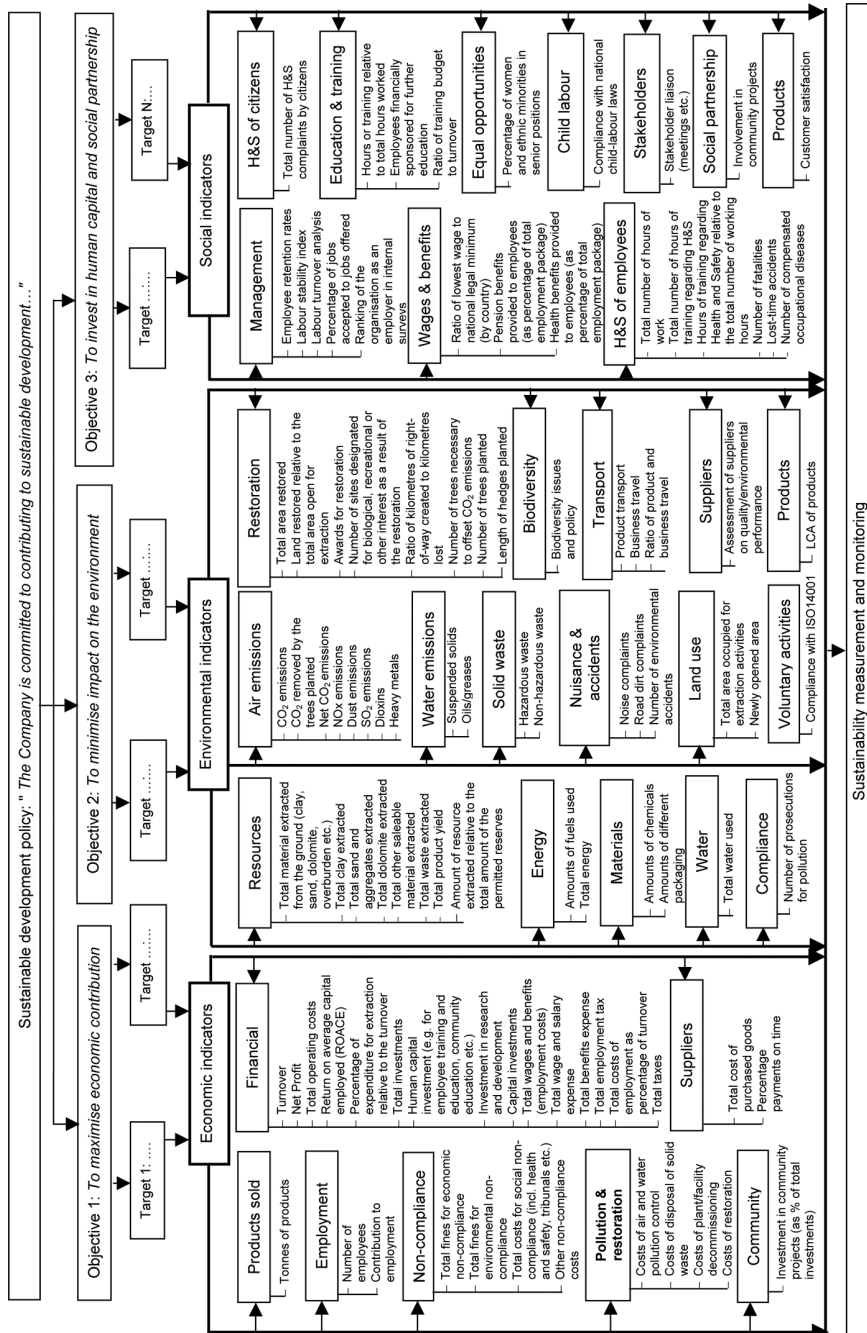
3.3.1 Developing sustainability indicators and establishing the baseline

Using the key sustainability issues identified in the previous stage of the CSMS, a set of sustainability indicators has been developed to enable measuring the baseline performance along the supply chain as well as monitoring future performance. As mentioned previously, the indicators have been defined following those developed by Azapagic (2004) and the GRI (2010). The overview of the indicators is given in Figure 3, which also shows the relationship among the sustainability policy, objectives, targets and indicators.

As shown in the figure, seven categories of economic indicators have been defined to capture the key economic issues listed in Table 3. These include employment provision, costs of non-compliance and financial indicators (e.g., costs and profits). The environmental indicators have been grouped into 16 categories, including resource use, environmental pollution, land use and biodiversity, to measure the environmental

issues identified in Table 3. Finally, the social issues are broken into 10 categories, including wages and benefits, health and safety, equal opportunities and stakeholder involvement.

Figure 3 An overview of the indicators, also showing the relationship with the sustainability policy, objectives and targets



The baseline results are presented in Table 6; due to space restriction, only selective results are shown. For example, the total energy used in the baseline year by the company is equivalent to 1,044,450 GJ/yr. The majority (72%) of the energy used is for the production of minerals, with the rest consumed in the transportation activities (product transport and business travel). This indicates that to reduce energy consumption, the priority should be given to process improvements, although optimising logistics could also lead to a significant reduction in energy use. A similar analysis for the other sustainability issues has helped to give the company an idea of where it is starting from, where the 'hot spots' are and how to set realistic targets and objectives for improvements.

Prior to that, it is also useful to revisit the results of the initial analysis of the threats and opportunities and carry out a more detailed SWOT analysis to inform better the implementation of the sustainability strategy.

Table 6 The baseline sustainability performance for the company (only selective sustainability indicators shown)

<i>Economic indicators</i>		
Products sold	3,535,000	t/yr
Turnover	31,970,000	€/yr
Total investments	1,861,850	€/yr
Return on average capital employed (ROACE)	39	%
Total wages and benefits (employment costs)	5,445,000	€/yr
Total costs of employment as percentage of turnover	17	%
Costs of pollution prevention, decommissioning and restoration	334,000	€/yr
Investment in community projects as percentage of turnover	0.5	%
Total cost of purchased goods	12,919,000	€/yr
<i>Environmental indicators</i>		
<i>Use of resources</i>		
Total minerals extracted	4,670,000	t/yr
Minerals extracted relative to the total amount of the permitted reserves	14	%
Energy used (electricity, diesel, petrol and natural gas)	1,044,450	GJ/yr
Materials used (explosives, chemicals and packaging)	9450	t/yr
Total area of permitted developments (quarries and production facilities)	1451	ha/yr
Total land area newly opened for extraction activities	28	ha/yr
Percentage of newly opened land area relative to total permitted development	2	%
Total area restored in the year	36	ha/yr
Land restored compared to the total area open for extraction purposes	130	%
Number of sites officially designated for biological, recreational or other interest as a result of restoration	2	–
Net number of trees planted	13,775	–
<i>Emissions to air</i>		
Total CO ₂ emissions	74,158	t/yr
Particulates	590	t/yr

Table 6 The baseline sustainability performance for the company (only selective sustainability indicators shown) (continued)

<i>Environmental indicators</i>		
<i>Transport</i>		
Total number of kilometres for product transport	17,468,400	km/yr
Average distance to customer per tonne of product	4.9	km/tonne
Total number of kilometres travelled on business by road	1,998,220	km/yr
Ratio of product-kilometres to business-travel-kilometres	8.74	–
Total kilometres for transport-related activities	19,466,620	km/yr
Total kilometres for transport-related activities per tonne of product	5.5	km/tonne
<i>Social indicators</i>		
<i>Provision of employment</i>		
Number of employees	592	–
<i>Wages and benefits</i>		
Ratio of lowest wage to the national legal minimum	1.3	–
Pension benefits provided to employees (as percentage of total employment package)	15	%
Health benefits provided to employees (as percentage of total employment package)	5	%
<i>Employee health and safety</i>		
Total number of hours of work	1,206,790	–
Total number of hours of training regarding health and safety	3760	–
Number of fatalities at work	0	–
Number of working hours lost per year due to accidents at work (lost-time accidents)	3900	–
Number of compensated occupational diseases	0	–
<i>Education and training</i>		
Percentage of hours of training (excl. H&S) relative to the total hours worked	4	%
Percentage of employees financially sponsored by the company for further education	5	%
Percentage of training budget to annual turnover	0.5	%
<i>Equal opportunities and non-discrimination</i>		
Percentage of women in senior executive and senior and middle management ranks	10	%
Percentage of ethnic minorities employed relative to the total number of employees	3	%
<i>Stakeholder involvement</i>		
Number of meetings with the stakeholders	30	No/yr

3.3.2 *SWOT analysis*

The results of the SWOT analysis are summarised in Table 7. Examples of the company strengths include large secured mineral reserves, an opportunity to penetrate into new markets, a good health and safety record and strong partnership with local communities. However, there are a number of weaknesses with respect to sustainability, including short-time economic drivers, emphasis on quantity rather than quality of production,

high energy consumption and difficulties in recruiting staff (a generic issue in the mining and minerals sector).

Table 7 Sustainability SWOT analysis

<i>Current strengths</i>	<i>Current weaknesses</i>
Large mineral reserves	Emphasis on short-term returns and lack of long-term vision (10 years and beyond)
Possibility to penetrate new markets	Emphasis on quantity rather than quality, leading to faster depletion of reserves
Possibility for the production of higher value-added products	Large volumes of potentially useful and profitable products wasted
Initiatives to move from supplying commodities to providing solutions	High energy consumption and emissions of CO ₂
Relatively good reputation	Relatively high number of fatalities and accident-lost time
Generally, good relationships with local communities	Majority of products transported by road
Very good success in obtaining planning permissions	Company car policy does not encourage the use of more sustainable cars and fuels
Demonstrated environmental responsibility through restoration works	Lack of planning for future succession of the current senior and middle-ranking management
Bold emphasis on health and safety	Insufficient internal communication
The energy efficiency initiative	Low percentage of women and ethnic minorities in senior positions
Relatively high interest of employees in the environment and sustainability	
<i>Opportunities</i>	<i>Potential threats</i>
Further improvement of relationship with local community through demonstration of commitment to sustainability	Increasingly difficult permitting process
Improving relationships with government and regulatory bodies through proven track-record	Increasingly stringent legislation
Improving financial and environmental performance through the energy efficiency initiative	Increased public awareness of sustainability and pressure-group activities
Reducing environmental risks and incidents and future liabilities	Disputes and conflicts with communities and pressure groups
Improving internal and external communication	Continued lack of understanding of key sustainability issues and areas of business which impact on sustainability
Improving public relations	Increased environmental and health and safety incidents and occupational diseases leading to litigation and negative publicity
Using the achievements through the adoption of a sustainability strategy as a marketing tool	Inability to penetrate new markets in the longer term through poor environmental and social image
Increasing motivation of staff and attracting and retaining good quality people in the company	

This information, together with the estimation of the baseline sustainability performance, has been used to set the objectives and targets for improvements.

3.3.3 *Setting targets and objectives*

The objectives and targets set for all the key sustainability issues are listed in Table 8. Among others, these include resource use, emissions of CO₂, health and safety, welfare of local communities and stakeholder engagement (see Figure 3 for the related sustainability indicators). For example, the target for energy use and CO₂ emissions is a reduction of 3% annually over the next three years. The implementation of the objectives and targets is discussed next.

Table 8 Objectives and targets for key sustainability issues

<i>Objectives</i>	<i>Targets over 3 years</i>
To work with customers to provide value-added solutions	To increase quality of products by 10%
To maximise efficient utilisation of resources at minimum environmental impact	To reduce energy use and emissions of CO ₂ by 3% annually To increase recycling of products by 10% To reduce the amount of waste by 10% by increasing the amount of by-products sold
To optimise social and economic contribution to society	To improve employment opportunities by securing a minimum of 20 new jobs annually
To protect the safety and health of employees and other stakeholders	To reduce the number of injuries by 50%
To enhance the human potential and welfare of employees and communities	To increase human capital investment by 1% of the profit annually
To continue active engagement with the stakeholders and commitment to addressing their concerns	To increase interactions with the stakeholders through meetings etc. by 15% To reduce the number of complaints by the stakeholders by 30%

3.4 *Implementation*

3.4.1 *Integrating sustainability into business practice*

To help achieve the set objectives and targets, a number of specific projects have been identified by the company. The projects target the ‘hot spots’ identified for each business area along the supply chain with a specific action plan. A summary of the projects and activities to address the key environmental and socio-economic issues is given in Table 9. As can be seen, the projects address different parts of the supply chain and business areas (see Figure 2); this is discussed below. Note that most of the projects have not been implemented yet, so only the potential impacts and improvements can be discussed at this stage.

Extraction and production: To help achieve the targets and objectives set out in Table 8, two priority areas of action have been identified in the first instance for these parts of the supply chain:

- improving energy efficiency and reducing CO₂ emissions
- more sustainable utilisation of mineral resources.

The baseline energy consumption related to the extraction and processing has been estimated at around 1.044 million GJ/yr, resulting in the emissions of CO₂ of just over 74,000 t/yr (see Table 6). The aim is to reduce both by 3% over the next three years (see Table 8) or around 31,300 GJ and 2200 t of CO₂. Within their energy policy (see section 3.2.3), the company are pursuing a number of energy efficiency projects. These include installation of smart meters and sub-metering, switching from oil to natural gas, use of 'green' electricity, replacement of the old with more efficient motors and introduction of low-energy lighting. In addition to higher energy efficiency and lower CO₂ emissions, these changes will also help to reduce operating costs. However, some up-front capital investment is necessary to enable these changes.

Table 9 Projects and activities to address key sustainability issues

<i>Environmental issue</i>	<i>Source/target area</i>	<i>Projects and actions</i>
Biodiversity, land-use and restoration	Extraction (land use/restoration)	Continue land restoration and re-introduction of lost species
Energy, CO ₂ emissions and contribution to global warming	Production (electricity)	Energy efficiency measures (e.g., energy efficient motors, low-energy lighting etc.) Switch from diesel to natural gas where possible 'Green' electricity supply
	Transport (diesel and petrol use)	Optimised product transport logistics and increased use of rail Reduced business travel through car-share and teleconferencing Other measures: Introduction of internal carbon trading schemes to drive company-wide reduction in energy use
Dust emissions to air	Extraction	Use of 'low-dust' explosives
	Production (dryers)	Improvement of process control and installation of filters
	Transport (diesel combustion)	Improvement of equipment and vehicle maintenance
Resources and reserves (availability and depletion)	Extraction	Intelligent extraction of mineral reserves with the emphasis on product quality rather than quantity (value-added solutions)
Solid waste	Extraction	Maximise use of 'waste' mineral by increasing the amount of by-products sold Keep different grades of minerals separate to enable their use for different product grades Recycle waste products
	Production	Re-use packaging and use recycled packaging

Table 9 Projects and activities to address key sustainability issues (continued)

<i>Environmental issue</i>	<i>Source/target area</i>	<i>Projects and actions</i>
Toxic emissions to air (dioxins, heavy metals)	Production (waste oil combustion)	Improvement of the combustion control for dioxin formation and installation of filters to capture heavy metals
Visual impact	Extraction	Screening of the facilities by vegetation Land restoration and conversion into recreational or other facilities
Water use and discharges	Extraction Production	Introduction of water usage monitoring programmes and improvement of settling systems for removal of suspended solids
<i>Socio-economic issue</i>	<i>Target</i>	<i>Projects and activities</i>
Health and safety	All operations	Improvement of the company's H&S training programmes
Wages and benefits	Employees	Enhancement of the pay and benefit schemes Introduction of reward schemes for innovative ideas related to sustainability
Training and education	Employees	Development of new training programmes (including sustainability-related) for employees Increasing further education sponsorship for employees
Noise	Extraction Production Transport	Replace old noisy equipment where possible Observe the 'good neighbour' practice (e.g., low-level or no noise and minimised transport during night-time)
Stakeholder partnership	All stakeholders	Programmes for stakeholder involvement

More sustainable utilisation of the mineral deposits is another key area where significant improvement could be made. Currently, the company is co-extracting different minerals at most sites but only the mineral present in the largest quantity at any one site is used, with the co-extracted minerals left as waste. This practice has in many cases wasted large amounts of good quality minerals and has generated huge piles of mixed waste, which cannot be utilised. The company is now considering changing this practice and utilising all minerals where possible. In addition to helping to prolong the life time of deposits and minimise waste, this approach could enhance financial returns through a wider range of products being produced. However, the prohibitively short pay-back times stipulated by the company could impede the implementation of this project.

Transport: The main transport activities are related to getting the products to customers. All products are currently transported by road. Given the total volume of the products (3,535,000 t/yr) and the number of kilometres that they travel (~17.5 million km/yr), transport has a significant impact on all three components of sustainability,

including operational costs, energy use, environmental pollution and road congestion. Most of the transport is contracted out (which is typical in the sector), which makes it difficult for the company to take direct action in this part of the supply chain. However, the company is considering how they could work with the contractors to optimise the logistics to reduce the impacts from transport. A further option being considered is to reduce gradually the road transport by switching to rail and shipping, where feasible.

Another important, but often ignored, transport-related activity is business travel. In the baseline year, staff travelled on business year around 2 million kilometres, contributing around 400 tonnes of CO₂ per year. The current company car policy does not encourage staff to buy cars with lower CO₂ emissions. Options for changing this policy are being considered, including car pooling. However, this is probably one of the most difficult aspects to change due to staff resistance (many perceive company car as a job perk and tend to buy bigger cars) and is an example where cultural change is necessary.

Products: The vast majority of the mineral products are only slightly processed before being dispatched to the customer. The short production chains mean that the operating costs are relatively low; however, so is the value added. Hence, by concentrating on higher value-added products, the company could develop a more sustainable business.

Therefore, rather than selling just the minerals, the company is starting to work together with customers to provide bespoke solutions, thereby adding value, reducing waste and building a long-term relationship with customers.

Another sustainability issue is related to the markets in which the products are being sold. Currently, one of the minerals produced by the company in a developing country is exported to developed countries, stripping the country off the valuable resource at little return. To prevent this, the company is considering the opportunities that may help open up local markets in the future.

Health and safety issues related to the production and use of the products are also among the most important sustainability issues for the company. Although the company has a good health and safety record in the developed countries in which it operates, this is less so in the developing countries where it has facilities. This is another typical example where cultural change is paramount – while the company has been trying to unify its approach to health and safety across the different countries in which it operates, this has been impeded due to different attitudes to health and safety in different countries.

Purchasing and contracting: Several areas of action are being considered in relation to procurement. They include purchase of cleaner fuels (natural gas instead of oil) and ‘green’ electricity mentioned above but also recycled packaging and wastes from other companies to use as raw materials, where feasible.

Workforce: Human capital and its development is one of the central themes of sustainable development. The following are some examples of how the company aims to demonstrate its commitment to the development of human capital:

- fair remuneration packages, including pension and health benefits
- equal opportunities and non-discrimination
- reward schemes for innovative ideas for improvements that lead to financial and environmental benefits

- training and transferable skills development, including raising sustainability awareness
- succession planning and clear career progression (including mentoring of high-potential individuals).

3.4.2 Sustainability measuring and monitoring

The establishment of the baseline performance has not only helped the company to set the targets and objectives but also to develop a system for measuring the performance over the next years. This will be facilitated through the development of a centralised data collection system, which will enable acquisition of the data from different parts of the company and their integration into sustainability performance datasheets and reports.

3.4.3 Cultural change

Although the parts of the CSMS developed and implemented so far provide a good starting point, on its own, the system will not bring about the required cultural change throughout the company and among all employees. As one of the vehicles for effecting the cultural change, companies are setting up awareness raising and training activities. As shown in Table 9, all training activities will involve an element related to sustainability and its relevance to a particular part of the business. All employees will be included in training, from labour to senior management. They will be encouraged to propose innovative ideas, projects and activities that could lead to an improvement in the company's sustainability performance. Company awards will be given for best ideas related to sustainability.

3.5 Communication

Staff awareness raising will also be effected through internal reporting on sustainability performance. Furthermore, the managers will include in their reports to the company board a statement on whether they have achieved the sustainability targets for a particular period.

Annual external sustainability reports aimed at company stakeholders will be produced once the monitoring system has been in place for a couple of years.

3.6 Performance review

To establish whether the objectives and targets have been met, the company will aim to carry out progress reviews annually and take appropriate actions to ensure continuous performance improvement. This will help to monitor performance and the direction in which the company is going – either towards or away from sustainability.

4 Conclusions

Building a sustainable business is a long-term and multi-level challenge, which requires strategic thinking and a change in organisation's culture. This change, like all other business activities, must be managed in an appropriate and systematic way.

The CSMS proposed in this paper offers a framework for a systematic and structured incorporation of sustainability thinking into corporate practice. Compatible with other management systems such as EMS, it provides a practical guidance on:

- identification of stakeholders and key sustainability issues
- development of policies and actions needed to engage the stakeholders and address their issues
- continuous measurement and evaluation of sustainability performance
- communication of progress to relevant stakeholders.

The implementation of the CSMS has been illustrated by a real case study in the minerals and mining sector. The case study has described the main steps of the CSMS, such as: identification of stakeholders and key sustainability issues; development of policies and actions needed to engage the stakeholders and address their issues; measurement and evaluation of sustainability performance and communication of progress to relevant stakeholders. In this way, the paper aims to contribute towards a more systematic and structured incorporation of sustainability thinking into corporate practice, as well as providing some practical guidance to companies in their efforts to become more sustainable.

However, further work is needed to refine the proposed CSMS, in particular, with respect to the sustainability indicators and the ways of identifying and incorporating activities for promoting a cultural change within organisations. Nevertheless, it is hoped that the case study has illustrated that the proposed CSMS provides a powerful approach to managing corporate sustainability and that it can help guide companies on what they need to do to become more sustainable.

Finally, it must be made clear that a sustainability management system on its own will not make a business sustainable. Whilst it can facilitate this process, it is only an instrument and a tool that will have a limited success without a full cultural change needed to make business more sustainable.

Acknowledgements

This work has been funded by the UK Engineering and Physical Sciences Research Council (EPSRC) (grants no. EP/F001444/1 and EP/F007132/1) and the Royal Academy of Engineering. The authors gratefully acknowledge this funding. We would also like to acknowledge the (anonymous) reviewers for their very helpful and constructive comments on the paper.

References

- Azapagic, A. (2004) 'Developing a Framework for Sustainable Development Indicators for the Mining and Minerals Industry', *J. Cleaner Prod.*, Vol. 12, No. 6, pp.639–662.
- Bartels, W., Iansen-Rogers, J. and Kuszewski, J. (2008) *Count Me In: The Readers' Take on Sustainability Reporting*, KPMG and Sustainability, Amsterdam-London.
- CBI (2009) *Getting Involved: A Guide to Switching Your Employees on to Sustainability*. <http://climatechange.cbi.org.uk/> (accessed on 6 January 2011).

- Chevalier, J.M. and Bourassa, M. (2005) *Social Analysis System*, IDRC, Ottawa.
- Daily, B.F. and Huang S. (2001) 'Achieving sustainability through attention to human resource factors in environmental management', *International Journal of Operations & Production Management*, Vol. 21, No. 12, pp.1539–1552.
- Defra (2010) *National Indicators*, Department for Environment, Food and Rural Affairs. <http://www.defra.gov.uk/sustainable/government> (accessed on 5 January 2011).
- Denzin, N.K. and Lincoln, Y.S. (Eds.) (2000) *Handbook of Qualitative Research*, 2nd ed., Sage, Thousand Oaks.
- Doppelt, B. (2003) *Leading Change Towards Sustainability: A Change Management Guide for Business, Government and Civil Society*, Greenleaf, Sheffield.
- Dow Jones (2011) *Dow Jones Sustainability Indexes*, <http://www.sustainability-index.com> (access on 5 January 2011).
- DTI (2001) *Sustainable Development: Improving Competitiveness through Corporate Social Responsibility*, A Directors Guide, Department of Trade and Industry, London, May 2001.
- Dunphy, D., Griffiths, A. and Benn, S. (2003) *Organizational Change for Corporate Sustainability*. Routledge, London.
- EC (2000) *Communication from the Commission on Promoting Sustainable Development in the EU Non-energy Extractive Industry*, The European Commission, Brussels, 3.5.2000, COM(2000) 265 final.
- EC (2001) 'Regulation (EC) No. 761/2001 of the European Parliament and of the council of 19 March 2001 allowing voluntary participation by organisations in a community eco-management and audit scheme (EMAS)', *Official J., of the EC*, L114, 24 April 2001.
- EC (2002) *Communication from the Commission Concerning Corporate Social Responsibility: A Business Contribution to Sustainable Development*, Com(2002) 347 Final, Brussels, 2.7.2002, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2002:0347:FIN:en:PDF> (accessed on 5 January 2011).
- EC (2003) *Integrated Product Policy: Building on Environmental Life-Cycle Thinking. Communication from the Commission to the Council and European Parliament*, COM(2003) 302 Final. Brussels, 18.06.2003.
- EC (2008) 'Directive 2008/1/EC of the European Parliament and of the council of 15 January 2008 concerning integrated pollution prevention and control (Codified version)', *Official Journal*, L024, 29/01/2008 pp.0008–0029.
- Elkington, J. (1999) *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Capstone Publishing, Oxford.
- Fleming, D. (1996) 'Beyond the technical fix', Chapter 4, in Welford, R. and Starkey, R. (Eds.): *Business and the Environment*, Earthscan, London, pp.145–159.
- Freeman, R.E. (2010) *Strategic Management: A Stakeholder Approach*, Cambridge University Press, Cambridge.
- Global Reporting Initiative (GRI) (2010) *Reporting Framework*: GRI, Amsterdam. <http://www.globalreporting.org/ReportingFramework/> (accessed on 10 November 2010).
- Harrison, N.E. (2000) *Constructing Sustainable Development*, State University of New York Press, New York.
- Holliday, Ch., Schmidheiny, J. and Watts, Ph. (2002) *Walking the Talk: The Business Case for Sustainable Development*, Greenleaf, Sheffield.
- ICHEME (2002) *The Sustainability Metrics*, The Institution of Chemical Engineers, Rugby.
- ICMM (2009) *Human Rights in the Mining & Metals Industry: Overview, Management Approach and Issues*, May 2009 <http://www.icmm.com/page/225/our-work/projects/articles/business-and-human-rights> (accessed on 5 January 2011).
- ICMM (2010a) *Good Practice Guidance on Health Impact Assessment*, January 2010, <http://www.icmm.com/page/14606/our-work/projects/articles/health-risk-assessment> (accessed on 5 January 2011).

- ICMM (2010b) *Minerals and Metals Management 2020: Responsible and Integrative Chemicals Management in the Mining and Metals Supply Chain*, <http://www.icmm.com/page/235/our-work/projects/articles/chemicals-management> (accessed on 5 January 2011).
- IIED & WBCSD (2002) 'Breaking new ground: mining, minerals and sustainable development', *Final Report on the Mining, Minerals and Sustainable Development Project (MMSD)*, International Institute for Environment and Development and World Business Council for Sustainable Development 2002, <http://www.iied.org/sustainable-markets/key-issues/business-and-sustainable-development/mining-minerals-and-sustainable-development> (accessed on 6 January 2011).
- ISO (2004) *ISO 14001:2004 Environmental Management Systems – Requirements with Guidance for Use*, International Organization for Standardization, Geneva.
- ISO (2005) *ISO 9000:2005 Quality Management Systems – Fundamentals and Vocabulary*, International Organization for Standardisation, Geneva.
- ISO (2006) *ISO 14044:2006 Environmental management – Life Cycle Assessment – Requirements and Guidelines*, International Organization for Standardization, Geneva.
- ISO (2008) *ISO 9000:2008 Quality Management Systems – Requirements*, International Organization for Standardisation, Geneva.
- KPMG (2008) *International Survey of Corporate Responsibility Reporting 2008*, KPMG International, Netherlands.
- NEA (2007) *Risks and Benefits of Nuclear Energy*, OECD, Paris.
- Searcy, C. (2009) *The Role of Sustainable Development Indicators in Corporate Decision-making*. International Institute for Sustainable Development (IISD), Winnipeg.
- Stead, W.E., Stead, J.G. and Starik, M. (2004) *Sustainable Strategy Management*, ME Sharp, New York.
- UN CSD (2007) *Indicators of Sustainable Development: Guidelines and Methodologies*, Third Edition, The Department of Economic and Social Affairs, United Nations, New York.
- Water UK (2010) *Sustainability Indicators 2009/10*, Water UK, <http://www.water.org.uk/home/news/press-releases/sustainability-indicators-09-10/sustainability-2010-final.pdf> (accessed on 5 January 2011).
- WBCSD (2010) *Projects. World Business Council for Sustainable Development*, <http://www.wbcd.org/templates/TemplateWBCSD1/layout.asp?type=p&MenuId=Njg&doOpen=1&ClickMenu=LeftMenu> (accessed on 10 November 2010).