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Sustainability Indicators and Sustainability Performance Management

Professor A. Warhurst
Mining and Energy Research Network,
Warwick Business School,
University of Warwick, UK

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Promoting Corporate Citizenship and Sustainable Development

Professor Alyson Warhurst
Chair of Strategy & International Development
Director, Mining and Energy Research Network
Director, Corporate Citizenship Unit
Corporate Citizenship Unit
Warwick Business School
University of Warwick
Coventry CV4 7AL
UNITED KINGDOM

Tel: +44 (0)24 7657 3130
Fax: +44 (0)24
Email: alyson.warhurst@warwick.ac.uk
Website: www.wbs.warwick.ac.uk/ccu/

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Alyson Warhurst is Professor of Strategy and International Development at Warwick Business School. She also Director the Corporate Citizenship Unit at Warwick Business School and is the founding Director of the international Mining and Energy Research Network (MERN). She has been researching and teaching on the subject of the extractive sectors and sustainable development for over two decades.

Executive Summary

This paper is about the development and use of Sustainability Performance Indicators (also referred to as Sustainability Indicators) to communicate to the internal and external stakeholders of mining companies the extent to which their mining activities are contributing to, or detracting from, sustainable development goals. In particular, it highlights the potential of such indicators to promote sustainable sound investment decisions. The paper also places Sustainability Performance Indicators in the wider context of Sustainability Performance Management Systems, and briefly reviews the other tools available for the development of these systems. It emphasises that indicators can assist in the actual assessment, management and monitoring of impacts of mining on sustainable development goals, as well as the reporting of performance, if they are developed within an overall Sustainability Performance Management System. For this reason, the paper argues that tailor made approaches to developing indicators, that address specific stakeholder concerns and that inform mainstream corporate strategy and support companies' future approaches to managing sustainable development issues, are more likely to contribute to sound investment decision processes than approaches which prioritise reporting against generic 'off the shelf' indicators. Notwithstanding, it is suggested that the latter can inform the former; and, that there are merits to developing combined 'top-down' - 'expert derived' and 'bottom up' - 'stakeholder scoped' approaches to sustainability performance management.

It is argued that those indicator systems that have been developed to date have been mostly about the impact of operations, principally environmental impacts and to a lesser extent about social impacts and rarely economic impacts. Some claim to be Sustainability Indicators but are often little more than combined sets of environmental, economic and social performance indicators, not indicators that are capable of truly describing the extent to which a mining project is contributing or detracting from sustainable development goals over time from an inter-generational equity perspective. Furthermore, few indicator systems have been developed that are capable of describing performance from different stakeholder perspectives, especially the perspectives of local communities that are affected by a project and less still from the perspective of indigenous communities. There are also few indicators systems that are capable of demonstrating changes in performance with respect to two other key areas of sustainable development. First, product use and the extent to which a product is contributing to quality of life, health and well being over time, and second, business practice and the extent to which a project is being managed according to practices that will contribute to sustainable development goals. It is argued, that business practice indicators would be one of the most effective systems for financial investors to use to assist in the evaluation of whether an operation is likely to represent a sound investment from the perspective of sustainability. A business practice indicator system could be quite simple and easy to use. It might involve simply indicators of a proficient Sustainability Performance Management System and indicators pertaining to its verification.

Over the past 5 years, MERN has undertaken research on the development of Sustainability Performance Indicators and management systems for the mining, metals and energy sectors, working in partnership with major mining and oil companies, and a wide range of NGOs, government departments and leading academic institutions. The paper draws on this

research and the results of its application, to give case study examples that illustrate the limitations of different approaches to indicators development and different approaches to both sustainability performance management and reporting. It also draws some conclusions and recommendations for further research.

Chapter 1 argues that there is a growing literature relating to sustainable development on the one hand and corporate social, economic and environmental performance, on the other. Few links are made between these two important areas of work. Chapter 1 does not review these individual areas of literature. Rather it suggests a conceptual and practical approach to creating a bridge between them, using the management tool of Sustainability Performance Indicators within an overall Sustainability Performance Management System. Specifically, Chapter 1 explores the drivers behind the development of indicators at the macro and micro level, and categorises the origins of different methodological approaches to indicators and indicator sets themselves as being either 'off the shelf' or tailor-made, as they relate to company or sector specific initiatives. An important element of MERN's work to date has been the generation of a number of subsets of indicators that have greater relevance to specific stakeholder groups and that are informed by those specific stakeholder perspectives. These subsets supplement generic, core or key performance indicators designed to meet the requirements of a broader range of stakeholders. One such subset might relate to financial indicators, or investment-related business practice or managerial performance indicators (as above), developed in collaboration with the financial sector and industry.

The vast indicator literature is reviewed in Chapter 2 and information is collated in tabular form to generate fresh perspectives as well as to capture succinctly and analyse different methodological approaches, indicator types and characteristics as well as to describe different indicator 'use' possibilities. Based on research to date, Chapter 2 overviews methodologies and different indicator sets, with an assessment of their application and limitations as well as suggestions as to the further work required. Chapter 2 reviews how some approaches can be used to balance the often-disparate requirements of different stakeholder groups. Chapter 2 also attempts to answer the following specific questions, identified within the terms of reference for this study:

- What are the characteristics of and similarities and differences between the various systems currently in use to measure or rate environmental and social performance in the mining and minerals sector? The paper argues that most indicator systems are principally about the environmental impacts of projects.
- What are the drivers, rationale and assumptions, explicit or implicit, behind the current systems? Reporting to external stakeholders is considered to be one of the key drivers.
- Who developed them, why and how? Generic off the shelf indicator systems have generally been developed by institutional reporting initiatives while tailor-made indicator initiatives have generally been developed to address key sustainable development challenges perhaps in the area of human rights or following an environmental incident.
- What processes if any were put in place for dealing with uncertainty, for learning and for revision? Tailor made approaches developed collaboratively within the company alongside consultants are more likely to promote learning, and to leave in place methodologies capable of being adapted to manage uncertainty and change.

- What are the advantages and disadvantages of the various systems from different stakeholder perspectives and what are their most contentious aspects? Most systems are developed from the company perspective or from a broad public interest perspective. There exist few systems capable of commenting from multi-stakeholder perspectives least of all from a community or ethnic minority perspective.
- What needs to be done either to strengthen existing systems or develop an alternative system? There is a need to develop a top-down and bottom up approach as described above and also a need to develop business practice indicators that can assure investors that a proficient sustainability performance management team and system is in place.
- What information needs to be in the public domain to facilitate measurement and evaluation of sustainability performance? There exists a great deal of information in the public domain it is more a question of knowing it is available and access. However, there is a need for more transparency with respect to resource rent agreements and the type of tax frameworks negotiated for each project, its time horizons and the nature and extent of adjustments made to ensure that economic benefits are transferred back to benefit the host communities of mining operations especially where there are fragile ecosystems and vulnerable communities.
- What lessons can be learned cross-sectorally about the measurement of sustainability performance? The oil and metals sectors can provide useful lessons with respect to disseminating information about their approaches to Sustainability Indicators and the management of sustainability performance. This paper does precisely that.

Chapter 3 draws on case studies from MERN research in the mining, metals and energy sectors regarding the development and application of indicators and highlights those findings that have more generic relevance and those that could be used by financial institutions in their assessment of investments and associated social, environmental and political risks. Chapter 3 reviews the methodological processes adopted in this work, and explores how the MERN approach, which focuses on sustainability performance management can be used to balance the often-disparate requirements of different stakeholder groups, as well as provides an overview of the core and supplementary indicators developed by MERN to date.

Chapter 4 provides conclusions, and outlines future research and practical work that is necessary to further develop and implement Sustainability Performance Indicators in the context of mining. The principal conclusions include:

- Management tools, such as Sustainability Performance Indicators, have a role to play in assisting both companies and their stakeholders, particularly financial institutions, to assess the extent to which their production activities are contributing to, and not detracting from, sustainable development goals. The paper addresses the significant new roles and responsibilities of business within a developing paradigm that has shifted from a 'do no harm' approach to operating towards a 'demonstrate positive development benefit' imperative. However, the paper strongly argues that Sustainability Performance Indicators are only one tool of several that can be used by companies within a social or Sustainability Performance Management System to support strategy aimed at ensuring their mining operations contribute to sustainable development over time. The other tools that require research and further refinement and integration include: Impact

assessment - integrated (not just environmental and social) and inter-generational (not just at one point in time); partnerships; stakeholder dialogue; corporate social investment; capacity building and professional development; social/environmental/economic accounting; sustainability reporting; and, auditing & verification.

- This distinction between indicators and data (accounts) should not be overlooked. The apparently simple statement that indicators are derived via processing and abstracting from raw data, underscores the methodological challenge of indicator design and highlights the fact there can be multiple sets of indicators for conveying information to different user groups. The key to designing performance indicators for multiple user groups is first, to ensure that sufficient, high quality data on performance is collected, and second, to design robust and scientifically credible methodologies for processing data into indicators that can be used as tools for environmental, social and economic management (i.e. not only reporting).
- The definition of sets of 'core' indicators that address principally business practice is possible within the mining sector, although further work is required on the standardisation of methodological approaches. Quantitative and qualitative indicators must be used together if the wide-ranging concerns of a diverse group of stakeholders are to be effectively addressed.
- Irrespective of the nature of the indicators used, 'trade-offs' may occur where a positive change in one indicator may lead to a negative change in another. It is essential that mechanisms be found to communicate clearly and transparently to stakeholders from the outset.
- The balance between standardisation (i.e. the production of generic indicators) and the tailoring of indicator sets to the specific needs of a site, company, group or metal has not yet been considered in detail, and further work is required in this area in order to derive benefits from both 'top-down' and 'bottom up' approaches.
- Standardisation for reporting purposes offers several benefits, including enhanced transparency, comparability between site and companies, and the opportunity to continue to develop self-regulation, but may reduce differentiation between companies (and hence effect competitiveness); and, for the purpose of contributing to the management of sustainable development issues, may lead to important site-specific issues being ignored. This is where second party verification may have a role to play; that is, where the verifier engages with the company on an ongoing basis to provide constructive criticism as well as a verification assessment.
- In some areas there is little or no consensus, in particular on the weighting and aggregation of indicators, both within individual dimensions, and across the three dimensions or between generations. Further work is essential to develop the continuing implementation of indicators by consideration of such factors.
- This paper argues that business approaches to sustainable development warrant consideration with respect to three aspects: equity (inter-generational as well as intra-generational), business practice and product use. There is a tendency to presume that indicators are Sustainability Indicators if they address the three dimensions of economic, environmental and social performance of mining operations. Few indicator sets address

intergenerational equity; product use indicators are most immature while the majority of indicators are about operational performance and reputational management within the current period of historic time, and not about managerial performance with respect to managing equitably, ethically and responsibly sustainable development issues.

Recommendations for future research and practical work include:

- The refinement of appropriate methods to ensure the relevance of performance indicators and their reflection of different stakeholder perspectives, including vulnerable stakeholder groups.
- An investment of resources on the part of the financial sector to ensure that indicators are developed that are relevant to their needs and the needs of their company clients and that address actual sustainability performance and not simply 'cosmetic' sustainability reporting. It is recommended that priority indicators here would be business practice indicators, that describe and verify the proficiency and ethical effectiveness of Sustainability Performance Management Systems and indicators that describe accurately and transparently economic impacts at national, regional and local levels.
- The linking of work in the area of Sustainability Indicators with performance management systems more generally, so as to contribute to social accounting, audit and verification processes on the one hand and the appropriate addressing of sustainability issues of concern on the other.

The need for a set of comprehensive methods and tools to be developed – e.g. a 'logical framework' for sustainability performance evaluation and communication. That framework needs an inherent coherence so as to be able to link site level indicators with company and group level and sector level indicators and these in turn with global Sustainability Indicators. Above all, indicators need to be relevant to their frame of analysis.

- Acceptance that indicators cannot simply be pulled "off the shelf", but may need to be developed through research; and that the development process takes time and resources, as well as a commitment on the part of user groups to participate in the development and piloting processes. It is important that companies consider such social science research to be as important and relevant as scientific, geological and engineering research and that it is considered to be an important learning process and not something to be contracted out and managed at arm's length.
- The application of such indicators over periods of time and the extent to they provide possibilities for stakeholders to track performance within and between generations. It is in the area of financial indicators that most work exists and in the area of economic impact indicators at community and local and regional levels, from a current and inter-generational perspective, that most work needs to be done.
- The consideration of Sustainability Indicators as a tool that can be used to promote cultural change within business, as well as to promote the mainstream, not tangential, consideration of sustainable development issues within the investment decision process, to bring about learning and real progress towards sustainable development.

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CONTENTS

1 Indicator Development: Process Drivers and the Role of Corporate Social Responsibility and Sustainable Development

1.1 Overview of Concepts

In order to understand the past and future development of Sustainability Indicators and their role in the management and reporting of progress towards sustainable development to the internal and external stakeholders of the mining industry, research suggests that it is important that a common language is defined and accepted.

1.1.1 Understanding Indicators

Indicators have been defined in a number of different ways: the Dictionary of Environment and Sustainable Development (Gilpin, 1996) defines an indicator as:

> a substance or organism used as a measure of air or water quality, or biological or ecological well-being.

The ISO 14000 (ISO, 1999) series defines an environmental indicator as:

> a specific expression that provides information about an organisation's environmental performance, efforts to influence that performance, or the condition of the environment.

The OECD (1993) provides another useful definition of an indicator as:

> a parameter or a value derived from parameters, which provides information about a phenomenon. The indicator has significance that extends beyond the properties directly associated with the parameter values. Indicators possess a synthetic meaning and are developed for a specific purpose.

Despite the apparent vagueness of the term, indicators have been widely used for monitoring and assessment of numerous environmental impacts of operations, and are increasingly used in social and economic arenas. To date the emphasis of the vast majority of indicators has been placed on reporting, rather than management of impacts on mining on sustainable development. Consequently, to date, the most important criteria that define useful indicators are the capacity to simplify, quantify, analyse and communicate otherwise complex and complicated information, and the ability to make particular aspects of a complex situation stand out and thus reduce the level of uncertainty in the formulation of strategies, decisions or actions.

In recent years, considerable effort has gone into the development of Sustainability Indicators: independent initiatives have come from the UN, OECD, the European Union, national governments, NGOs, academia and the business community (see Adriaanse, 1993; OECD, 1993; WWF and NEF, 1994). Initially, interest was often focussed at the local level, in the form of 'sustainable community' projects (see, for example, Sustainable Seattle, 1992; MacGillivray et al., 1998), but Sustainability Indicators have subsequently developed to incorporate regional, national and international issues. Furthermore, there has been

growing impetus in the policy-making arena towards developing tools to translate the concept and goals of sustainability into real action and into measures to assess progress towards them. It is within this setting that indicators of sustainability have become increasingly important. However, it is necessary to introduce a cautionary note – Sustainability Indicators are often combined sets of environmental, economic and social performance indicators, rather than indicators that are capable of truly describing the extent to which a mining project is contributing or detracting from sustainable development goals over time from an inter-generational equity perspective. This comment also holds for the development of Sustainability Indicators outside of the mining sector. As noted in subsequent sections, few indicator systems have been developed that are capable of describing performance from different stakeholder perspectives, especially the perspectives of local communities that are affected by a project and less still from the perspective of indigenous communities that live within those local communities.

Despite these limitations, there are several reasons to explain the popularity of these indicators: initially the drive to develop them was from a **managerial** perspective. The argument was put forward that only if the environment was measured could coherent policy be formed, accommodating the right priorities and appropriate targets for improvement (see, for example, Department of the Environment, 1996; UK Government, 1994; UNCED, 1992). Since their initial development and widespread use, it has become clear that indicators can best assist in the actual assessment, management and monitoring of impacts of mining on sustainable development goals (in addition to performance reporting), if they are developed within an overall Sustainability Performance Management System, and this concept is explored in greater detail in subsequent sections.

Although first developed from the perspective of management, more recently indicators have also come to be regarded as tools for **communication** and **reporting** (see MacGillivray and Zadek, 1995). This communication concept is that, through such indicators members of the public and other stakeholders will be able to understand the problems and trends that society needs to address – particularly those not otherwise accessible to sensory perception, such as energy consumption, waste production and a whole range of economic and social issues. By providing information in this way, it is claimed that indicators will educate the public and engender a sense of social responsibility for the problems. In turn, it is argued, this will encourage people to change their individual behaviour and their political responses in order to generate solutions; this could equally be applied to the workplace. As UK's Local Government Management Board (LGMB - now the Local Government Association) Project Guidance to local authorities argued:

> Indicators can challenge people to explore how the way they live affects their community/world and thus move the indicators in one direction or another. Indicators can illustrate how each individual can make a difference.
>
> (LGMB, 1994)

The role of information as a tool for system improvement holds true whether the feedback loop remains internal to the organisation - for example, in the form of internal reporting within a corporate management system - or whether the loop extends beyond the organisation into society at large - as in external reporting and the disclosure of environmental and social performance information to stakeholders (see for example,

Hamilton, 1995; Cormier et al, 1993). In both cases, performance information is developed and disseminated with the objective of providing information that will facilitate action - managerial action by corporate representatives or economic and political action by other stakeholders - to improve performance. However, in the context of the mining sector, few indicator systems have been developed that are capable of describing performance from different stakeholder perspectives, especially the perspectives of local communities that are affected by a project and less still from the perspective of indigenous communities – integration of these perspectives is crucial if mining is develop in a sustainable fashion, with the support of those most affected by operations.

Within these limitations, and as noted above, indicators can, however, assist firms internally to develop strategic targets, define milestones along the route to their achievement and report their progress clearly and efficiently to the appropriate stakeholders. It is MERN's thesis that the joint role of **management of issues** and **reporting of progress** that indicators must fulfil requires two types of indicator: **project/site specific** for the former and **off-the-shelf/standardised** for the latter. Subsequent sections explore this concept in more detail, with particular reference to the **Global Reporting Initiative** as the principal source of standardised sustainability reporting guidelines.

Finally, of equal importance to the indicators that have been developed, are those that have not: there are few indicators or indicator systems that are capable of demonstrating changes in performance with respect to two key areas of sustainable development:

- Product use and the extent to which a product is contributing to quality of life, health and well being over time – for the mining sector the benefits of products derived from its many activities is typically overlooked in the overall assessment of the sector's contribution to sustainable development.
- Business practice and the extent to which a project is being managed according to practices that will contribute to sustainable development goals. Subsequent sections argue that business practice indicators would be one of the most effective systems for financial investors to use to assist in the evaluation of whether an operation is likely to represent a sound, sustainable investment.

1.1.2 Sustainable Development/Sustainability

It is generally accepted that the contemporary idea of sustainability hails from the United Nations Stockholm Conference on the Environment in 1972 and subsequent debates in the 1970s over 'limits to growth' (Redclift, 1987; Macnaghten and Urry, 1998). The Brundtland report, "Our Common Future", (WCED, 1987) incorporated the connection between development and environmental limits that was subsequently endorsed by national governments at the Rio Earth Summit (UNCED, 1992). The Brundtland report also coined a definition of sustainability that has become the most widely used by all major institutions:

> development which meets the needs of the present without compromising the ability of future generations to meet their own needs
>
> (WCED, 1987)

The IUCN publication Caring for the Earth (1991) provided an alternative definition of sustainable development that is also often quoted:

> to improve the quality of life while liv*i*ng within the carrying capacity of living ecosystems.

Furthermore, Viederman (1994) defined sustainability as:

> a participatory process that creates and pursues a vision of community that respects and makes prudent use of all its resources - natural, human, human-created, social, cultural, scientific etc. Sustainability seeks to ensure, to the degree possible, that present generations attain a high degree of economic security and can realise democracy and popular participation in control of their communities, while maintaining the integrity of the ecological systems upon which all life and all production depends, and while assuming responsibility to future generations to provide them with the where-with-all for their visions, hoping that they have the wisdom and intelligence to use what is provided in an appropriate manner.

MERN's definition of sustainable development is:

> an intra- and intergenerational development process defined by sustained improvements in health and well-being
>
> (MERN International Collaborative Research Workshop, December 2000).

All these definitions share a view that long-term economic and social change can only be sustainable and beneficial when safeguarding the natural resources upon which development depends. Implicit in all definitions is the concept of "intragenerational and intergenerational equity" (i.e. the fair distribution of, and access to resources within the same generation, and between succeeding generations).

It can be argued that there is a growing need for companies to acquire a '**sustainability license**' to operate as well as its more customary regulatory license. The criteria for the 'award' of the former are far more intangible than the latter and pertain to track record and demonstrated intent. As yet, unlike in the environmental arena where a failure to comply can be clearly linked by law to the penalty of withdrawal of permits, the sustainability/social license exists on an iterative and informal basis and requires collaboration and mutual trust and a self-governing structure for monitoring performance. Research and recent events suggest that companies ignore this imperative at their peril. Furthermore, this again underlines the importance of developing the capacity to describe performance from different stakeholder perspectives, particularly the perspectives of local communities that are affected by a project.

1.1.3 Corporate Social Responsibility/Corporate Citizenship

The development of the concept of corporate social responsibility (CSR) has fast expanded since the days when it was considered that:

> … the social responsibility of business is to increase profits…
>
> (Friedman, 1970).

For example, Andrews (1988) argued:

> … corporate strategy …is the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for

> achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organisation it is or intends to be, and the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, ustomers and communities…

And, more recently, Drucker (1993) stated:

> …[corporate] citizenship means active commitment. It means responsibility. It means making a difference in one's community, one's society, and one's country….

Corporate social responsibility is suggested here to involve: **the internalisation by the company of the social and environmental effects of its operations through pro-active pollution prevention and social impact assessment so that harm is anticipated and avoided and benefits are optimised. It is suggested that corporate social responsibility contributes to social justice in the work place as well as human rights and development within the host countries of the operation** (Warhurst et al, 2000). In essence, this means that it is the company that takes responsibility for impacts on the natural and social environments and paying for avoiding or mitigating these impacts. Ultimately, the cost of internalising the impacts may be passed to the consumer, but the true cost of operations or production is initially incurred directly by the company. Under this concept, the natural and social environments are no longer available to the operator at zero cost (e.g. for unregulated disposal of waste, untreated atmospheric emissions). Equally, the concept is about companies seizing opportunities and targeting capabilities that they have developed to enhance competitive advantage in order to contribute to sustainable development goals beyond traditional responsibilities to shareholders, employees and the law.

1.2 The Need For Indicators: Why Measure?

As noted above, indicators are an effective way of packaging and conveying performance information to target user groups. They serve to summarise large or complex sets of performance-related data in a manageable quantitative or qualitative form. This latter is an important aspect of indicators – until recently the majority of indicators have been derived from environmental or financial aspects of business, and these have lent themselves to quantitative measures. However, the continuing development of indicators, particularly in the social dimension, has demonstrated that qualitative measures are equally useful in many cases, particularly where impacts have a larger degree of subjectivity, and cannot be readily distilled down to one or more numerical measures. In essence, both quantitative and qualitative indicators convey essential elements of the data by abstracting from the wealth of specific detail. Ott (1978, cited in Mitchell, 1996), for example, defines an indicator as:

> a means devised to reduce a large quantity of data down to its simplest form, retaining essential meaning for the questions that are being asked of the data.....if the [indicator] is designed properly, lost information will not seriously distort the answer to the question.

In addition to responding to the demands of the numerous drivers described in section 1.3 (below), the principal objective in developing indicators and measuring performance is to generate information on which future action (i.e. management initiative) can be based. For example, Smeets and Wetering (1999) note three major uses of environmental indicators:

- To supply information on environmental problems, allowing policy-makers to prioritise issues.
- To support policy development and optimise the assignment of resources to addressing priority issues.
- To effectively monitor the effects of policy responses.

In generic terms, these could equally be applied to social and economic indicators.

Within the context of performance measurement, specific goals vary; for example, fault diagnosis, early warning, assessment of trends, competitor benchmarking, identifying options for improvement, assisting external stakeholders in understanding and reacting to performance trends - yet all measurements of performance share the common premise that timely, accurate and meaningful information on the current situation is a prerequisite to achieving improvement in the future. The measurement, processing, and dissemination of information on performance can be seen, therefore, as an integral feedback loop within management systems, and ultimately to meeting the aims and objectives of sustainable development. If designed correctly, measurement can provide information on the capacity of the system to deliver performance and facilitate intervention to change key system parameters to improve the delivery of performance. However, it is important to recognise the gap between indicators and a coherent and effective management system. Chapter 3 addresses the absence of links between the growing literature on sustainable development and literature on corporate social, economic and environmental performance, and suggests a conceptual and practical approach to creating a bridge between them, using the **management tool of Sustainability Performance Indicators within an overall Sustainability Performance Management System**.

The demand for performance measurement has a number of precedents. The techniques of financial performance measurement, for example and the design of widely available, easily accessible financial performance indicators have been perfected over several decades. However, it is important to distinguish between standard "corporate economic performance indicators" (which are largely used to report internally or to shareholders and financial institutions) and the economic indicators required as a part of measuring sustainability, where the wider economic implications of mining operations on the local, regional, national and international communities must be fully integrated. The latter indicators are examined in more detail below.

Further precedents are seen in the quality revolution in manufacturing, which placed a premium on the measurement of information regarding product quality that could then be used as part of a feedback and/or feedforward system to adjust technological and managerial parameters of the production process to accommodate continuous improvement. Similarly, the rise of 'just-in-time' flexible manufacturing systems was based on the availability and rapid communication and assimilation of product and market performance information. Both these manufacturing paradigms share a need for indicators of performance which were able to capture, summarise, and convey essential elements of plant performance without getting lost in the site-specific complexity of the plant.

Several commentators have pointed to the design of performance indicators as the principal methodological challenge in the area of environmental management. Mitchell (1996), for example, notes that in the wake of the data explosion and the rapid growth in the range of techniques for measurement, storage, and retrieval of data,

> there is a widening sea of data but, in comparison, a desert of information.

Similarly James (1994) observes that, in designing environmental performance indicators, the difficulty is not how to measure performance, but how to convert large amounts of data into information as a useful decision tool for environmental management. The same concern also applies to economic performance indicators. In terms of social performance indicators, further problems arise from the often-qualitative (and also more subjective) nature of the data being acquired and analysed.

This distinction between indicators and data should not be overlooked. The apparently simple statement that indicators are derived via processing and abstracting from raw data underscores the methodological challenge of indicator design, and highlights the fact there can be multiple sets of indicators for conveying information to different user groups. The key to designing performance indicators for multiple user groups is first, to ensure that sufficient, high quality data on performance is collected, and second, to design robust and scientifically credible methodologies for processing data into indicators that can be used as tools for environmental, social and economic management.

A number of factors and drivers have converged to create a common interest within business, the public sector, and academia in the development of indicators for environmental, social and economic performance. These are reviewed in below. It is worth noting, however, that just as the financial sector has been in the vanguard of performance measurement more generally (albeit largely as an internal measure or for reporting to shareholders), so it is also at the leading edge of research into the design of appropriate indicators of environmental performance for integrating into conventional financial evaluations of risk, return, and credit worthiness (James, 1994; Jaggi and Freedman, 1992; Haines, 1993; Hamilton, 1994; Cormier et al, 1993; White, 1996; Schmidheiny and Zorraquin, 1996). The prediction of Greeno and Robinson (1992) nearly a decade ago is now becoming a reality:

> in the same way that public companies are measured by their financial results, environmental performance will increasingly become a critical factor to scrutinise.

1.3 Drivers Behind the Development of Indicators

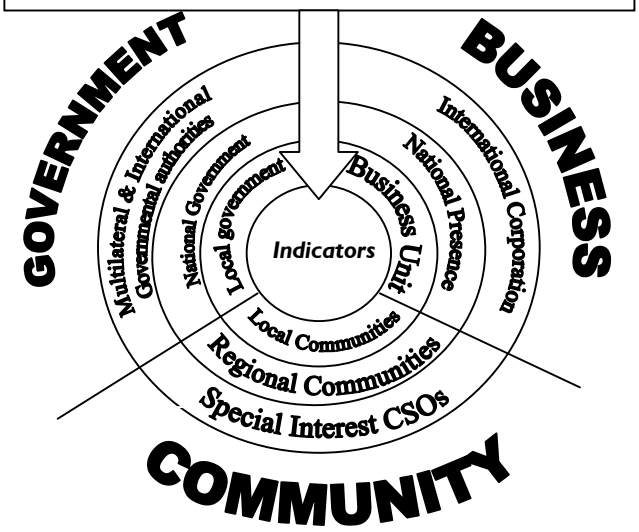
This section reviews both global (macro-level) and project-specific (micro-level) 'drivers' of an indicator approach to addressing sustainable development in the extractive sectors (i.e. mining, oil and gas). Broadly, global-level drivers encourage the development and uptake of indicator schemes, while project-specific drivers encourage project managers and staff to ensure those indicators describe tangible benefits to business, government and local communities. The key drivers are illustrated with a number of examples. Drivers can also be categorised according to the relevant stakeholder group and the manifestation (issue) of their interest. The list below summarises micro- and macro-level drivers according to this

categorisation. This approach may be more useful in some cases where the division between micro- and macro-scale is unclear or arbitrary.

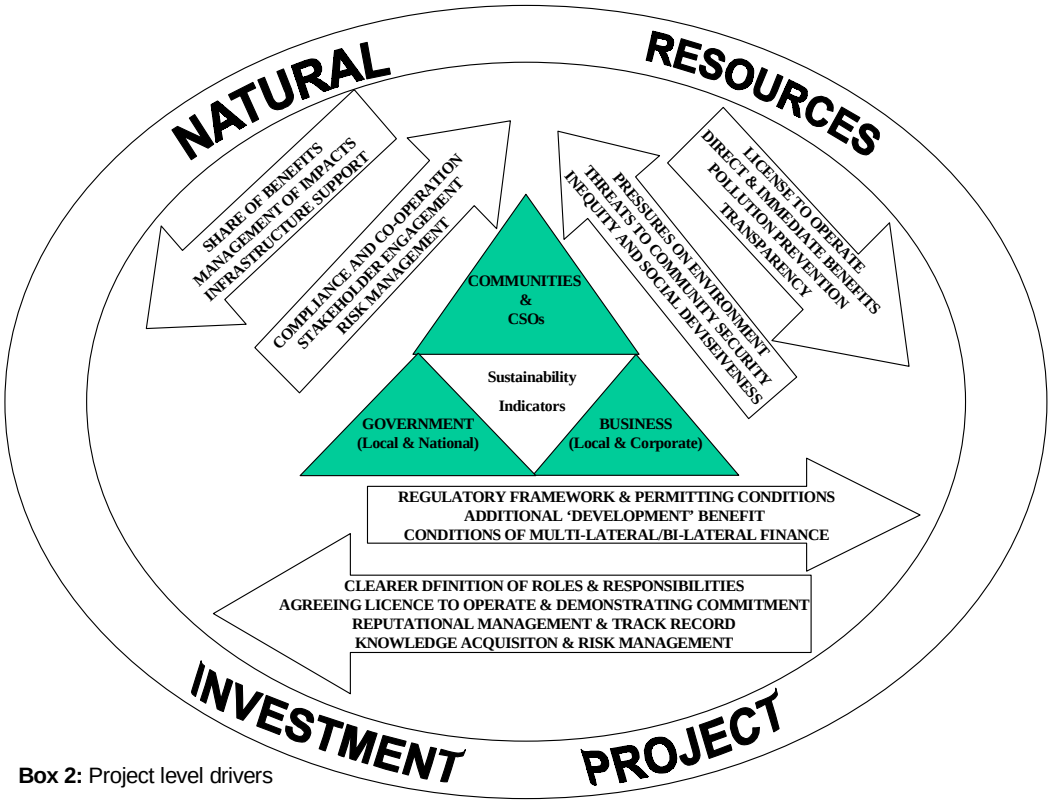
Stakeholder Group	
Workers	Special interest groups
Company	Non Governmental Organisations
Shareholders	Financial community
Local community	Intermediate and final consumers
Regional community	Sectoral community
National regulators	Service/product suppliers (e.g. chemicals)
International regulators	

Issue	
Stakeholder expectations and local community development	Globalisation
	Supply-chain pressures
Corporate policy and practice	Industry peer pressure
Local reputational management	Human rights
Global reputational management	Environmental change
Government development plans	Social change
Regulation	Sustainable development
Conditions of finance	CSR
Voluntary codes of conduct	Local economic development

The interrelationship between stakeholder groups and drivers at global-level is shown graphically in Box 1, and the project-level in Box 2. The major global- and project-level drivers and the role that indicators can play in responding to them are briefly reviewed below.



Box 1 Global drivers of indicators



Box 2: Project level drivers

1.3.1 Global-Level Drivers

'Voice of Society'

A growing literature both in academic journals and the media is chronicling increasing 'voice of society' concerns about corporate environmental and social responsibility. Conceptually the 'voice of society' is a term to reflect public interest concerns – it is an aggregation of the concerns of the many stakeholders that make up civil and business communities at local, regional, national and international scales (Warhurst, 2000) Although it can be considered a driver in its own right, it is the many global and site-specific drivers that exist within it that exert the 'pressures' that cause changes in the management of environmental, social and economic issues by industry and those directly and indirectly responsible for its regulation and control. Although social aspects of 'voice of society' are an integral component of the concept, it is often the more narrowly defined 'environmental disasters' or human rights incidents that have, and continue to hold, the highest profile. Some key incidents are categorised in Table 1. It is notable that many of these have taken place in the mining and petroleum industries.

TABLE 1. Changing corporate operating paradigms defined by environmental disasters and human rights incidents[1]

	Phase I: 1960-1983 Awakening of post-facto societal concerns	Phase II: 1984-1994 Engaging in addressing implications	Phase III: 1995-today Networking to prevent future incidents
Critical Incidents	Aberfan, Wales '66 Seveso '74 Wankie Colliery '75 Amoco Cadiz Oil '78 Nationalisation in South America 60s-70s	Bhopal '84 Strava, Italy '85 Chernobyl '86 Exxon Valdez '89 Wheal Jane '92 Summitville '92 Ok Tedi and Fly Rivers, PNG '94	Shell – Brent Spar '95 Saro-Wiwa execution '95 Omai '95 Grasberg '95 Marcopper '96 Los Frailes, Spain '98 Remin & Esmeralda, Romania '00

This growing 'voice of society' is demanding that corporations, particularly those that have benefited from privatisation, address past inequalities and broaden the distribution of business benefits. Society also calls for these corporations to mitigate the more far-reaching and indirect effects of their activities on the quality of life of local communities, including environmental damage and health liabilities resulting from previously unregulated pollution, as well as past social exclusion. Increasing demands for information, accountability and, particularly, community participation, have encouraged the private sector to adopt various voluntary initiatives. Indicators may represent a means to visibly address some of these grievances. Similarly, Agenda 21, the action plan resulting from the Rio Earth Summit in 1992, obliges industry – though morally, not legally – to contribute to local capacity building in developing countries and to assist in transferring clean technology. Indicators can provide a vehicle for companies to address their progress towards these goals.

Globalisation

Over the past three decades, multinational corporation activity has expanded significantly. Their number has risen from 7,000 in 1970, to around 40,000, with more than 200,000 globally spread affiliates. As the President of the World Bank states:

> In the space of the last ten years, the private sector has taken an increasingly important role in terms not only of our economic life, but of development. Ten years ago, the flow of funds to developing countries was $30 billion [from the private sector]. Nine years later, it was $300 billion. Ten years ago, official development assistance was $60 billion. Ten years later, it's $45 billion. So from being half the size of development assistance ten years ago, the private sector is now five, six, seven times the size, depending on the year
>
> (Wolfensohn, 2000).

[1] Adapted from Andriof and Warhurst, Mining and Sustainable Development, presented at World Mines Ministries Forum, Toronto, 1999.

In the extractive sectors multi-national corporations are particularly active in developing countries and are potentially major conduits for technology transfer and economic benefit. In addition, since 1989 more than 75 countries have liberalised their investment regimes for mining and oil and gas exploration, and have privatised state mining companies such as COMIBOL in Bolivia and CENTROMIN in Peru. This privatisation has led to significant downsizing and reduced state provision (via these companies) of "social wages", e.g. subsidised food, health services and education, with consequent negative socio-economic impacts. An indicator initiative may offer a vehicle for recently privatised state-owned corporations to continue to demonstrate a contribution to social investment whilst avoiding the past problems of community dependency.

Voluntary Codes of Conduct

Public concerns have given rise to various voluntary codes of conduct for corporate social and environmental responsibility. These codes are becoming important levellers of corporate activity and provide useful guidelines for social reporting. Examples include the Amnesty International Principles for International Business, the SA8000 and AA1000 Accreditation Scheme, the World Bank's Environmental Guidelines and Participation Handbook and the International Chamber of Commerce's Business Charter for Sustainability. Voluntary codes of conduct exist at the sector level also – for example, the mining sector has the International Council on Mining and Metals (formerly the International Council on Metals and the Environment), which was established in October 2001 with a focus of providing sustainable development leadership for the mining industry and promoting the uptake of best practice standards.

Special Interest Groups And NGOs

Non-governmental organisations (NGOs) and other civil society organisations are increasingly important agents of change. Friends of the Earth and Greenpeace not only have high-profile exposé campaigns but, recognising the creative and shaping role of business in the global economy, are also seeking to develop a "solutions agenda" with the business community. The role of special interest groups and NGOs has grown in part in response to the "retreat of government". Special-interest groups especially active in regard to the natural resource sectors include Minewatch, the Third World Network, Survival International and the World Wide Fund for Nature (WWF). Due to the increasing significance of NGOs, companies may elect in the future to use a Sustainability Indicators framework to address requirements for public consultation or to monitor stakeholder dialogue throughout an investment project's development and implementation.

> The cost of civil issues is rising rapidly….How then can it be that an area which can add considerable cost to a project and certainly escalate project costs to a stage that the project may no longer be viable, be still so poorly understood and lack the necessary tools and expertise to assess and manage the associated risks?
>
> (Corporate Executive, Western Mining Corporation Resources, Personal Communication, 2000).

Regulation

The environmental arena has seen a fundamental shift from the regulatory paradigm of "command and control" – single-medium, end-of-pipe regulation, incrementally enforced through inspectorates, the courts and penalties – to one of "integrated pollution control" with pollution prevention from the outset, promoted through market incentives and innovative rehabilitation bonds. 'Market based instruments' are a growing means of achieving environmental objectives (although not necessarily in the context of an integrated approach – market incentives can relate to single media).

Similarly, the social arena has moved from the paradigm of "do no harm" to that of "net positive development benefit". Considered a key driver of a company's social performance, regulation in developing countries is often weakly developed and poorly enforced, its principal role to define the conditions attached to the permitting of industrial activity – the formal "licence to operate". Rarely does a formal licence to operate specify that the company should deliver on its social obligations and report on these against pre-defined indicators. However, companies may voluntarily elect to use Sustainability Indicators to meet requirements for public consultation (such as the Colombian constitutional requirement for "prior consultation" before developing oil or minerals on indigenous peoples' land), or to address requirements for public consultation or to monitor stakeholder dialogue throughout an investment project's development and implementation. Such a strategy may assist the company to acquire that more intangible 'sustainability license to operate'. As noted above, this will ultimately require collaboration, mutual trust and a self-governing structure for monitoring performance, and the participation of local communities in decision making through all stages of a project.

Conditions of Finance

In mining, investment costs are high (most projects have one-third equity: two-thirds debt financing). Often the equity investment or credit has attached to it environmental or social conditions to reduce any future liabilities. In recent research, the University of Warwick's Mining and Energy Research Network found that more than 90 international banks undertake environmental financial risk assessment of borrowers, and 50 of these incorporated environmental liability into loan terms. Having in place an indicators framework that addresses liability-related concerns and that helps to predict future performance could conceivably boost the risk-related credit rating of a country, company or project.

> It is only through exploring new ways to promote dialogue and build partnerships between donors, corporations, security organisations, NGOs and the diplomatic community together with host governments that a more conducive environment for investment, economic growth and stability can be achieved.
>
> (Business Strategy Analyst, anonymous[2]).

[2] Quoted from Warhurst, A (2000b) 'The Development of a Tri-Sector Partnership Model (Business – Government – Community) for Industry Sponsor', proposal to Industry Club Sponsors, Mining and Energy Research Network.

There is a requirement to ensure indicators that are developed are relevant to the needs of the investor and the company receiving that investment and that they address actual sustainability performance and not simply 'cosmetic' sustainability reporting. It is recommended that priority indicators would be business practice indicators, that describe and verify the proficiency and ethical effectiveness of Sustainability Performance Management Systems and indicators that describe accurately and transparently economic impacts at national, regional and local levels.

Supply-Chain Pressures

The extractive sectors, particularly, are organised around extensive networks of subcontractors. Increasingly, firms are purchasing products from local suppliers and environmentally proficient or ethically sound sources, driving environmental and social performance upward along the supply-chain. As accreditation schemes diffuse and social auditing increases, having an effective set of indicators in place that monitors ethical purchasing and supply may enhance market advantages in strategic supply-chain management, as well as license/permit acquisition.

> This is new territory. This is a new way of thinking. It is saying that as a business you cannot do it alone.
>
> (James D. Wolfensohn, President, The World Bank Group[3].)

The development of product use indicators will also act as a driver towards greater levels of sustainability in the mining industry – in addition to defining the greater role of mining in sustainable development at a societal level, they will also enable consumers to identify and choose between products with differing sustainability ratings, allowing consumers in turn to apply pressure directly or indirectly to the mining industry and intermediate manufacturers.

Industry Peer Pressure

In the natural resource sectors, the best environmental performer may still be judged by the performance of its peers. Therefore, it is in the interest of the better performers to influence and improve performance in other companies that perform less well. Some leading companies are also seeking 'Environmental Management System' ISO 14000 accreditation as an independent and robust assessment of environmental performance. In the mining sector, companies are in the process of responding to the Global Mining Initiative looking at, amongst other issues, best practice in social and environmental performance. Sustainability indicators could contribute to a more coherent and consistent approach across the sector, and a levelling of the 'playing field' regarding strategic approaches and responses to regulation, reducing the risk of the entire industry being judged by its worst performers.

Internal Pressures

Shareholders and employees alike are increasingly pressuring extractive corporations to be more environmentally and socially responsible. Some NGOs are even purchasing shares to be able to raise strategic questions at AGMs. There is as yet no conclusive evidence as to

whether such pressures promote companies to work in collaboration with campaigners. In some instances, the activist nature of such internal advocacy fosters a hardening of attitudes within the corporation. Social justice in the workplace is arguably as important as having in place a sound strategy for managing social responsibility in the external environment, particularly given the interrelated nature of the workforce and the local community in many cases. Indicators can bring logic to an overall approach to sustainability performance management with regard to internal corporate social responsibility and especially towards employees.

Environmental Change

Pollution hazards – such as volcanic dust, acid rock drainage, rising sea levels, changing precipitation levels and natural variations in biodiversity – are also prompting companies, governments and communities to consider the advantages of responding proactively to reduce the risks of environmental disasters.

In recognition of these concerns, Sir John Browne, CEO, BP Amoco has stated:

> Business is a continuing activity, not a one-off event, and that's the context in which we invest and reinvest in communities. Because we want and intend to be part of their communities, not just today but for years to come, and so we have a direct interest in their successful development.[3]

In addressing these issues, business are increasingly drawing on the expertise of environmental groups and universities, and linking into government's national biodiversity conservation plans and international conventions. Indeed, the newly formed International Council on Mining and Metals has appointed Dr Jay Hair – formerly President and CEO of the National Wildlife Federation (1981-1995) and President of the World Conservation Union (1994-1997) – as its Secretary General. Indicators have a key role to play in describing a company and sectors' contribution to addressing responsibly environmental change and concerns.

Competition And Clean Technology

The fear of environmental liability has driven companies to adopt cleaner technologies and better management techniques. Furthermore, evidence on the relationship between environmental and economic performance has generally supported the concept that poorer environmental performance translates into poorer economic performance (Johnson, 1995). Also encouraging were the findings of Hart and Ahuja (1996), using data from the USEPA's Toxic Release Inventory. They concluded that there was a positive relationship between pollution prevention and financial performance.

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[3] Quoted in Warhurst, A (2000a) 'Tri-Sector Partnerships for Social Investment: Business Drivers', Working Paper Number 4 (Natural Resources Cluster of the Business Partners for Development, CARE International UK, London).

Ethical Investment

The rise in environmental awareness has manifested itself in the form of ethical investing. Managers of ethical funds can help to promote environmental awareness through disclosure and transparency. The most common type of funds in the UK is unit trusts followed by investment trusts, pension funds and life insurance bonds[4]. However, the performance of such funds has not been good in recent years. Yet this is not surprising since the funds have less choice of investments than ordinary funds because of their ethical criteria[5]. A collaborative, on-going study of institutional investors[6] suggests that sustainable development is of mainstream importance and that companies are increasingly, having to behave according to the new values of society. The results to date are summarised below.

- 66% of the respondents agree that sustainability applies to corporate strategy
- 70% apply it in some form when evaluating companies
- 33% believe in its increasing importance
- 79% consider the environmental issues in their evaluation
- 31% considered image and reputation
- 75% agreed that good environmental management is a good indicator of good overall management

1.3.2 Project-Level Drivers

In addition to the influence of the global drivers, company or project-specific drivers may account for the development of indicator development initiatives in specific socio-economic and political contexts. Major drivers can be summarised as:

- Stakeholder expectations and local community development
- Corporate policy and practice
- Local reputational management
- Government development plans
- Local economic development

Stakeholder Expectations and Local Community Development

Company/project-specific stakeholder expectations and local community needs may drive indicator development in a number of key ways:

- Framing and monitoring contributions to local community development, dialogue and social investment
- Legal funding frameworks for multi-stakeholder partnership approaches

[4] The Cooperative Bank, Triodos Bank and the Ecology Building Society are also run according to ethical or green criteria.

[5] In the UK, this excludes up to 75% of London based companies.

- Integrating local communities and the local workforce with the core business process
- Responding to the demands and expectations of local NGOs and other special-interest groups

The degree to which these have been taken into consideration to date varies according to the indicator type and indicator system (see Table 2 and 3) but generally, further refinement is required to ensure the relevance of performance indicators to, and their reflection of, different stakeholder perspectives, including vulnerable stakeholder groups.

Implementing Corporate Policy and Practice

Possessing a track record in responsible business practice can reduce a project's permitting time and enhance corporate–community relations, as well as contribute to the overall competitive advantage in future operations world-wide. Increasingly, corporate policy and board-level support for its implementation drive closer collaboration with governmental, NGO and community partners at the operational level. Most mining and oil and gas corporations have policies that guide local businesses and operators in the areas of the environmental management and community relations. Some also have policies that address indigenous peoples, human rights and corporate governance. A key challenge for each business unit is in translating these policies into a practical strategy at the project level, underpinned by the 'business-case' and which can be implemented with the capacity and resources available. Managers of local businesses are increasingly looking to performance indicators to assist them in meeting these performance requirements.

Local Reputational Management

An increasingly relevant project-level driver of sustainability initiatives such as indicator development is the need of the local operating company to protect and promote its local reputation. Indicators which describe and evaluate social investment and performance by companies, if developed to be fully inclusive of civil society and relevant public sector agency interests, can demonstrate to government regulators and special interest groups that the company is genuinely committed to promote social development alongside business goals. Increasingly, being able to demonstrate this commitment practically rather than through paper policies improves the attractiveness of the company when competing for concessions or when acquiring operating permits. Stakeholder perceptions and protest action based on the economic, environmental and social impacts of mine development are becoming increasingly important issues for mining companies and their financiers. Eurogold started to develop its Turkish mining operation eight years ago and has been faced with an arduous approval procedure. The project, costing US$46 million with plans to produce 3 tonnes of gold and silver a year, has been a contentious development. Over 700 local villagers, politicians and environmentalists have fought a long battle to close the mine. In October 1997, a Turkish court ruled that Eurogold had to halt its operations and in March 1998 this decision was upheld. As part of their protest, local villagers walked naked through the mine, occupied it and held picnics there, blocked the access roads and held unofficial

[6] Noranda Inc undertook the survey in collaboration with CICA, Deloitte & Touche, Ernst & Young, and NRTEE.

referendums. The basis of their opposition centred on the perceived environmental degradation that the mine would cause and the impact that it would have on tourism and farmland. This case has serious consequences for the company and highlights the role of the political and legal risks involved in mining.

Government Development Plans

Local and national governments hosting mineral investment projects are increasingly identifying the advantages of full alignment of corporate social development initiatives with national and regional plans. Such alignment can add value to the efforts of all parties involved in implementing the plan, government departments, company, NGOs, small and medium-sized companies and community based organisations. An infrastructure development programme in Colombia, initiated by the mining company Cerro Matoso, has involved road building through partnership in accordance with government infrastructure plans. The local council has supplied raw materials, the company the managerial expertise and the community labour. In another example, a multi-sector dialogue, supported by a Rio Tinto subsidiary, QIT Madagascar, has helped to frame a Regional Plan for Development in the area of the mine. Partners in this dialogue have included local government, local community groups and the national government, with further support sought from the World Bank. MERN is contributing to the development of Sustainability Indicators for biodiversity conservation, that can assist in the mapping and monitoring of the progress the initiative achieves.

Local Economic Development

Local economic development refers to the specific benefits and costs to the economy of a company or project and thus impacts on economic wealth and quality of life. In particular, a mining business has an interest in demonstrating its contribution to local businesses, employment, taxation etc. as part of local reputational management, community development and defining the extent to which a project is being managed according to practices contributing to sustainable development goals.

1.4 The Specific Role of Financial Institutions in Driving the Development of Indicators in the Mining Sector

1.4.1 Project Risks

Mining is distinct from other industries because ore bodies are neither mobile nor can they be worked indefinitely. Mining is a high risk-reward industry, has high sunk costs and requires huge capital expenditure. The decline in ore grades over the last ten years has increased competitive pressures in the mining industry. It has forced many companies to reassess corporate strategy, prompting the adoption of more sophisticated technologies and increased mine sizes.

Capital requirements can only be secured after a variety of project risks have been assessed, and remedial or preventative actions planned in detail, including:

- Management risk

- Political risk
- Technical risks
- Ore reserve risk
- Construction risk
- Commodity risk
- Social and environmental risks

Management Risk

Given the high risks involved in mining, it is of fundamental importance that the project can be effectively and efficiently managed. Managerial expertise at all levels of the company reassures investors and the larger the company, the greater is this need. Sustainability performance indicators, as part of a Sustainability Performance Management System, are one important facet of managerial capacity.

Political Risk

In light of the fact that ore bodies are not mobile, mining companies do not have the option, available to companies in other industries, of choosing the most attractive political climate within which to operate. The processes of liberalisation and globalisation have encouraged banks to lend to countries that they would have avoided in the past e.g. Kazakhstan, South Africa. Although liberalisation is indicative of a more open business climate, the economic growth that characterises this process changes ownership and income distribution patterns. These issues can precipitate political risk in newly liberalising economies since they can create resentment and civil unrest.

The political risks and challenges associated with operating in newly liberalising economies are very different from those faced by mining companies in developed countries. As such, companies who wish to operate in the transitional economies of the world will seek political risk insurance. Again, financial institutions will wish to ensure that the political risk is minimised, and Sustainability Indicators can contribute to that process by facilitating effective communication and relationship building with local communities, and regional/central government departments and making transparent the direct and indirect economic and social contributions and impacts that the project makes at local, regional and national levels.

Technical Risks

Ore reserve definition is a type of technical risk which covers geological uncertainty, hydrology and rock stability[7]. Equity financing is used to define reserves. Lenders will then require an independent audit to verify the presence of proved and probable reserves to a level that will satisfy loan obligations within the life cycle of the mine. This process will

[7] Freeport's Grasberg mine in Irian Jaya is a prime example of the importance of such risks. The mine is situated in an area of seismic activity and high rainfall.

identify whether the mine will be an open pit or underground operation. Nevertheless, risks remain because companies may still use the wrong equipment, mining method etc. The issues raised here can be highlighted with recourse to the experience of RJB Mining in the UK. After investing £10 million to develop a mine at Ashford, unforeseen geological problems caused the company to abandon the project.

Construction risks must be viewed within the context of project location, level of infrastructure and accessibility to end-user markets. Ore body size and grade are fundamental to the economic viability of the project and become particularly important if the mine is located a long way from key ports. Some mines are located in remote regions that rely upon waterways for transportation to key ports. Rainfall and sedimentation become important issues for the company in this context. In 1997, BHP suspended production at its Ok Tedi mine in Papua New Guinea because unusually low rainfall lowered water levels in the Fly River to unnavigable levels. This prevented the shipment of copper concentrate to coastal ports.

Commodity Risk

Each commodity will carry a certain risk profile that is shaped by economic fundamentals and expectations. Although some risk is unsystematic, lenders need to be confident that demand will be greater than supply once production has commenced. Lenders will also need to consider issues like technological progress and management techniques at the level of the firm and developments in end-user markets such as substitution and recycling. When evaluating the risks associated with any one project, lenders will also assess the economics of alternative projects in different time periods.

Social And Environmental Risks

Social and environmental risks have increased in importance in recent years and if these challenges are not effectively managed then mines may be forced to close. The development of a mining project can prompt a number of social and environmental problems and may include the following:

- Alcoholism
- Compromised road access
- Cultural disruption
- Crime and violence
- Damage to archaeological sites
- Land rights issues
- Migration
- Prostitution
- Resentment/local tension
- Social displacement
- Inadequate sanitation and health care

Not only do companies have to comply with the environmental regulations of host countries, but they also have to respond to the environmental demands of financial institutions. Loan conditionality requiring the adoption of specific technology to reduce pollution or the establishment of a fund to generate non-mining related employment to

sustain the local economy after the mine has closed are examples of how financial institutions deal with the environmental imperative.

Sources Of Finance

In order to analyse the role of financial institutions in the development of performance indicators, it is first necessary to examine the different funding mechanisms that are commonly used within the mining sector, as these in part define the potential exposure of the funding bodies. Financial institutions in the 1990s are supporting mining projects in a way that would have been unthinkable in the 1970s and 1980s. The nationalisation programmes undertaken by many of today's mineral rich emerging markets did not encourage foreign investors and the debt crisis of the 1980's led to the withdrawal of commercial bank interest in Latin America. The high political and economic risks of the region and the lack of sensible mining related policies deterred foreign investors. As a result of these circumstances, the provision of project finance became more complex and multilateral and bilateral agency involvement increased. Multilateral and bilateral agencies like the World Bank, International Finance Corp. (IFC), International Bank for Reconstruction and Development (IBRD), European Bank for Reconstruction and Development (EBRD) and the Commonwealth Development Corporation (CDC) amongst others have filled the gap left by commercial banks on grounds of overexposure. The increase in the availability of finance in light of the opportunities presented by liberalisation alongside deregulation has led to an increase in private sector finance.

Equity and **debt** are the two main types of finance available to mining companies. Equity financing means that investors will receive a share in the company as a result of a cash contribution. Debt on the other hand involves lending a sum of money that has to be repaid at market rates over a specified time period.

Equity funding used to be the only form of finance available for mining companies wishing to develop projects in high-risk countries. Equity is still an important route for finance and is sometimes the only option where banks deem the risks to be too high even when ore reserves have been verified. Liberalisation has provided unprecedented opportunities for mining companies to seek out new projects and has changed the structure of the world's mining industry. The traditional equity markets that grew up as a consequence of major mineral discoveries earlier this century remain strong providers of equity[8].

Lenders do not usually accept a project that has a debt:equity ratio higher than 70:30. Debt is more expensive than equity and lenders must be confident that debt can be repaid within the life cycle of the mine. Equity investors on the other hand, do not expect returns until the mine is in the production phase. Equity investment is risky as the Bre-X affair illustrates but the returns can be high and investors will take into consideration commodity market fundamentals and exploration trends before committing funds.

It is worthy to note here the role of joint ventures that have become popular as a way of sharing risks and for vertical integration. Joint ventures facilitate equity finance with investment coming from another company rather than through an unrelated source. There

[8] The Toronto Stock Exchange raised C$14 billion in equity finance between 1991 and 1995.

are also 'debtequity' instruments that serve as last resort mechanisms such as Going Public bonds and notes linked to commodity prices.

In the same way that equity markets have responded to the demands of the mining industry as a result of liberalisation, so too have providers of debt. The provision of project finance debt by commercial banks[9] has increased in popularity due to competitive forces and greater risk appetites spurred by hedging activities by lenders to mitigate price exposure risks.

Lender requirements stretch from export assurances, sensible and transparent foreign investment, mining and environmental codes to attractive fiscal policies prior to debt provision. All the same, full assignment of the debt may not be completed until production is well under way. This issue is indicative of high risks involved. Although the newly liberalising economies have committed to opening up their markets, it does not necessarily follow that liberalisation mitigates the political risks of operating in such economies. This is especially true when one considers the way in which the liberalisation process can cause resentment and civil unrest. Consequently, lenders often require political risk insurance as a matter of course for debt lending.

1.4.3 Political Risk Insurance

Political risk simply defined is:

> the probability of the occurrence of some political event that will change the prospects for the profitability of a given investment
>
> (West 1996).

Although many multilateral organisations have established risk transfer mechanisms of various kinds[10] it is the Multilateral Investment Guarantee Agency (MIGA) that specifically deals with political risk insurance. MIGA was established in 1986 and is part of the World Bank group. MIGA's membership has grown rapidly since its inception and now has 143 members with another 18 waiting to fulfil membership requirements. Its purpose is to encourage the flow of foreign direct investment to developing member countries through the provision of guarantees against political risk and technical assistance and advice on how to encourage foreign investment. MIGA provides insurance for new investments and for contributions that extend from expansion and modernisation to restructuring and privatisation. MIGA is also a useful facilitator of co-insurance and re-insurance. The importance of sustainable development is reflected in the way in which MIGA assesses individual projects on economic, financial and environmental grounds so that the project contributes to the economic development of the host country in terms of employment, technology transfer and exports without compromising the needs of future generations.

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9 For example; Barclays Capital, CSFB, JP Morgan, Merrill Lynch, NatWest Markets, Rothschilds and SBC Warburg

10 The IBRD and the IADB have similar guarantee programmes that protect lenders against payment default.

MIGA provides long-term political risk insurance in the same way as the Overseas Private Investment Corporation[11]. As a US federal agency, it provides insurance for US companies with overseas interests. Political risk insurance is an effective risk management tool that is used to cover the social and political eventualities of operating in emerging markets since it protects against currency transfer risk, expropriation, war and civil disturbance.

1.5 Responses To Drivers: Sustainability Performance Management Systems

The key quest that business has now to embrace, is: how can industrial development be undertaken without damaging the environment or undermining the development opportunities of local communities – across generations as well as across geographies; and, can the benefits be distributed amongst stakeholders equitably while promoting economic growth?

Such a quest requires a point of entry; as well as a 'project management system', which provides structure and milestones along the way. Our suggested point of entry here is our working definition of sustainable development and corporate social responsibility; and, the project management system is a framework of indicators supported by other tools that defines operational targets, milestones, strategies and responsibilities and that is in effect a 'Sustainability Performance Management System'.

Our definition of sustainable development – as a working concept – builds on other definitions that suggest it is a process whereby future generations receive as much capital per capita as, or more than, the current generation has available (Serageldin, 1996a, 1996b). This includes natural capital, physical (or produced) capital, and social (including human) capital. Together, their measurement provides indicators of the wealth of nations and they might be considered as forming the basis of sustainable economic development and growth[12]. In this process the composition of capital changes: some natural capital will be depleted and transformed into physical capital; and social capital would be expected to expand. Physical capital will depreciate, and it is expected that technological change will generate more efficient replacements. It is the effects of this transformation process on human health and wellbeing that are at the heart of public interest concerns about both achieving a sustainable economy and the related role of corporate environmental and social responsibility.

The United Nations Development Programme (UNDP, 1994) usefully described sustainable development as a process for realising human development

> … in an inclusive, connected, equitable, prudent and secure manner.

Key elements of sustainable development, according to Bansal and Howard (1997) are that:

- Connectivity embraces ecological, social and economic interdependence.
- Equity suggests fairness, within and across generations and species.

[11] There are other, private insurers in the market but they tend to provide short-term coverage *e.g.* Lloyds of London.

[12] "Expanding the Measure of Wealth, Indicators of Environmentally Sustainable Development", Environmentally Sustainable Development Studies and Monographs Series No. 17, The World Bank.

- Prudence connotes duties of care and prevention, technologically, scientifically and politically.
- Security demands safety from chronic threats and protection from harmful disruption.

By extrapolation, any form of development that fails to satisfy each of these elements could be deemed to be unsustainable. Research suggests there is little evidence to date that these four elements combined have been sufficiently acknowledged by business, although there are governments world-wide - and specifically the UK - that are endeavouring to address the issues both in law and through research and education initiatives, and civil society organisations and industrial associations that in turn are promoting global codes of conduct, as discussed below.

These recent working definitions of sustainable development are more 'operational' than the original albeit seminal definition proposed by the World Commission on Environment and Development – "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987) – and reflect a research and activist agenda that is moving from theory and vision to operational reality and 'solutions'.

This paper therefore builds on these advances and understands sustainable development as an 'intra- and inter-generational development process defined by sustained improvements in human health and well-being, quality of life and ecosystem health' (Warhurst et al, 1998).

Corporate strategy is considered as the prime-mover in ensuring industrial production and product use contributes to, and does not detract from, these constituents of sustainable development; and we argue that **Corporate Social Responsibility (CSR)** is key to operationalising the strategic role of business in contributing towards this sustainable development process beyond traditional responsibilities to shareholders, employees and the law; and to seizing opportunities and targeting capabilities that they have developed to enhance competitive advantage in order to contribute to sustainable development goals. In effect, business is able to engage in and contribute to society as a **corporate citizen**; and a **Sustainability Performance Management System** can assist business in managing and reporting on that process.

This in turn implies a need for both internal change and adjustment on the part of companies and external pro-activity with respect to their relationships with stakeholders. Hence we argue Sustainability Indicators, as management tools, have a special role to play with respect to evaluating and communicating progress to stakeholders both internally and externally, and in particular to local communities.

For those rich in natural capital or the technology and skills to transform it, such as developing countries in the former regard, and particularly industrialised economies in the latter, this suggests three areas that merit analysis in the process of developing and using indicators for understanding better the contributions of business to sustainable development. These are:

- **Product Use** in society and the contribution of industrial products to improved health, well being and quality of life.

- **Business Practice**, that is the way in which the business is run – corporate governance – and in particular the extent of social (including environmental) responsibility integrated within corporate strategy.
- **Equity**, and the intra- and inter-generational distribution of the benefits of industrial production across different societies, especially within host communities.

These three areas, product use, business practice, and equity lie at the heart of new concepts of strategies of corporate social responsibility, and the growing imperative for business to manage and report on their sustainability performance.

1.6 Towards a 'Sustainability Licence' To Operate

This chapter has discussed the imperative of corporate citizenship and the role and potential of Sustainability Performance Indicators. It has suggested that public policy, particularly regulation, is important but that there exists substantial potential and a growing number of global and project-specific drivers for companies to act pro-actively and become a prime mover of progress towards sustainable development goals. This is all the more so in some developing countries where local communities, disillusioned with weak government and failed promises by those in power to return to them portions of royalties and taxes, are engaging directly with companies so as to ensure at least a minimal and direct receipt of economic benefit within the host-community. We are witnessing a trend towards civil society groups 'granting' what amounts to a 'sustainability license' to operate alongside normal regulatory licenses and permits. This is heralding a need for formalising approaches to sustainable development by business and monitoring progress towards sustainable development goals and hence the rationale for a 'Sustainability Performance Management System' and for Sustainability Indicators. Here we could call it a 'sustainability license', since we suggest that increasingly communities and special interest groups, and some governments, will require from the outset that industrial development projects meet pre-defined criteria of sustainability on the one hand; and, on the other, that the ongoing project demonstrates good progress towards contributing to sustainability goals of enhanced human health, wellbeing, quality of life and ecosystem health. More than ever there is a need for management tools to guide and communicate to stakeholders the extent and direction of progress. Sustainability Performance Indicators are one such mechanism; tri-sector partnerships to assist in the management of stakeholder relationships are another. This paper explores and makes the case for corporate consideration of the former, as a framework for both managing sustainability performance and for increasing corporate social investment and in turn as a means of demonstrating to different stakeholder groups that a mining project is contributing to, and not detracting from, sustainable development goals and that in an 'aggregated' sense that the sector is also contributing to national and international global sustainable development processes.

2 Indicators of Sustainable Development – An Overview

2.1 Introduction

An ever-increasing number of environmental, social and economic indicators are available. Generally, these indicators are either used in isolation to analyse the performance of sites, companies and sectors as they relate to one of the three dimensions, or, increasingly, in combination as a means of measuring progress towards and away from sustainability. However, the simple combination of sets of environmental, economic and social performance indicators does not necessarily represent the creation of indicators that are capable of truly describing the extent to which a mining project is contributing or detracting from sustainable development goals over time from an inter-generational equity perspective.

In turn, while indicators allow the complexity of events and trends to be reduced, and more easily understood and managed, there is a danger that the proliferation of indicators and different approaches to their development and use could ultimately undermine their effectiveness.

As noted above, indicators are often partitioned into the three dimensions – environmental, social and economic – or integrated in some way to give a means of measuring progress towards or away from sustainability. However, in many instances, the indicators that are used to assess performance in the individual dimensions are identical to those used to measure sustainability, although in the latter case indicators from different dimensions are often considered in combination to show the positive or negative impact of performance in one dimension on performance in the remaining dimensions. Recent MERN research (2001) has demonstrated that improving environmental performance may sometimes negatively impact social or economic performance, or vice versa – showing that progression across the three dimensions may not occur at the same rate, or even in the same direction at the same time. Where "aggregation" of indicators from different dimensions is necessary, data normalisation, (subjective) weighting factors, or other statistical manipulation may need to be applied. The concept of sustainability or sustainable development is a complex one, with many definitions of what is and what not sustainable (see, for example, Common, 1995, Beckerman, 1996 for examples of widely differing views on sustainability). Much of the debate is about ways in which the concept can be operationalised. For clarity, the following sections focus on the development of indicators in the individual dimensions, although the integration of indicators is also considered where appropriate.

Tables 2, 3, 4 and 5 summarise the types of indicators that are in common use, the major reporting and indicator initiatives, the range of indicator systems that is available and specific economic indicator categories. Subsequent sections explore their content in more detail.

Table 2. Summary of indicator types		Application		
Indicator Type	Overview	Environmental	Social	Economic
Descriptive	Descriptive indicators can relate to drivers, pressure, state, impact, or response (as set out in the DPSIR Framework - see Table 2) across the three dimensions of sustainable development. Quantitative and qualitative descriptive indicators describe the factual situation, but do not assess whether this is good or bad - they are in practical terms a statement of fact	✓	✓	✓
Performance	Performance indicators compare the actual situation with targets, allowing progress towards such targets to be measured. Relevant targets include those set at national and international levels, and voluntary targets that relate to more explicitly to sustainable development	✓	✓	✓
Efficiency	Efficiency indicators provide insights into the efficiency of processes and product use. They are, therefore, largely limited to environmental applications at present	✓	✖	✖
Sustainable Reference Values	These relate to target levels of environmental quality set from the specific perspective of sustainable development. At present, only environmental SRVs are available, and these relate to acid deposition, and air quality (used by the European Environment Agency)	✓	✖	✖
Production	Production-related indicators are drawn from standard engineering approaches to process management and relate to both environmental and economic aspects of the production process. These indicators are limited in the scope of their application, representing as they do a narrow focus, largely internal to the company (the typical end-user)	✓	✖	✓
Regulatory	Regulatory indicators are drawn from consideration of legal compliance and typically are limited to the environmental dimension (e.g. release of pollutants to air, land and water). The use of regulatory indicators fails to capture the significance of moving 'beyond compliance' and are static relative to the kinetic sustainable development process	✓	✖	✖
Accounting	Accounting indicators may be used for internal or external reporting with a focus on liability management, and efficient and transparent tracking of costs associated with waste production, management and disposal	✓	✖	✓
Economic	Economic indicators can be used to value external environmental and social costs and allow their internalisation. These are potentially powerful tools and are an essential input to any lifecycle-based assessment of environmental performance	✓	✓	✓
Quality	Similar to production-related indicators, quality-based indicators have as their focal point waste minimisation during the production process (assessed from dual aspects of costs savings and minimisation of pollutant release)	✓	✖	✓
Ecological	Ecological indicators relate to the local, regional, national and international impacts on ecosystem health resulting from all aspects of human activity	✓	✖	✖

Table 3. Characterisation of different indicator systems

NAME	Overview	Application			Developer	Users
		Environmental	Social	Economic		
DPSIR Framework [Drivers Pressures State Impact Responses]	The DPSIR Framework represents a systems analysis view of the relations between the environmental system and the human system. Social and economic activity exerts pressure on the environment, causing changes in the state of the environment. These may lead to impacts that require a response. The response modifies the driving forces, reducing pressure and impacts.	✓	✖	✖	OECD & various	European Environment Agency (adopted as standard methodology), most nations and international bodies reporting on the environment use the DPSIR Framework or some variant
Input-Output-Outcome-Impact	The project level equivalent of the DPSIR framework	✓	✖	✖	World Bank	World Bank and related organisations
Sustainability Performance Management System	This is the architecture of that performance system that provides both the analytical structure for the qualitative evaluation of performance as well as the logic for combining that evaluation with quantitative measurement so as to be able to track the extent to which a business activity, at whatever unit size one wishes to measure, is contributing to or detracting from sustainable development goals.	✓	✓	✓	Mining and Energy Research Network	Companies, government, NGOs, local communities
In-house	Typically used by those responsible for the development of indicator – implemented at specific sites or at	✓	✓	✓	Various	Companies

	company level					
Quality of Life	Designed to assist in the preparation of community-based strategies to promote environmental, social and economic well-being in the relevant local area	✓	✓	✓	Audit Commission (UK)	Local authorities (regional governmental bodies in the UK)
Best Performance Value Indicators	Designed to balance the promotion of sustainability issues with the cost of implementing data acquisition, analysis and reporting	✓	✓	✓	Department for the Environment, Food and Rural Affairs UK)	Local authorities (regional governmental bodies in the UK)

Table 4. Summary of major reporting/ indicator initiatives

		Application				
NAME	Significance	Environmental	Social	Economic	Geographical relevance	Major users
Global Reporting Initiative	High	✓	✓	✓	Local → Global	All
Mining and Energy Research Network	High	✓	✓	✓	Local → Global	All
World Business Council for Sustainable Development	High	✓	✓	✓	Local → Global	Business
United Nations Environment Programme	High	✓	✓	✓	Local → Global	All
UN International Standards of Accounting and Reporting	High	✖	✖	✓	Local → Global	Government, business
International Standards Organisation	High	✓	✖	✖	Local → Global	Business
AccountAbility AA1000	High	✖	✓	✖	Local → Global	Government, business, civil society
Sectoral initiatives	Medium (specific to sector)	✓	✓	✓	Mainly local and national, more limited at global level	Business (although reported to other stakeholder groups)

Table 5. Economic indicator characterisation[13]

Issue Categories	Examples of Indicators	Financial or Non-Financial	Results or Determinants[14]	Principal Stakeholders
Financial Performance	Profitability	F	R	Company Shareholders
	Economic Value Added	F		
Competitiveness	Relative market share	N-F	R	Company Shareholders
	Sales growth	F		
Quality of Service	Reliability	N-F	D	Company Business customers
Flexibility	Volume and delivery flexibility	N-F	D	Company Business customers
Resource Utilisation	Productivity	N-F	D	Company
	Resource efficiency	N-F		
Innovation	R&D Investment	F	D	Company
Supply Chain Impacts	Contribution to supply chain businesses	F		Supplier business Customer businesses
Local Economy Impacts	Contribution to local economy	F		Local community
Taxation	Contribution to tax revenues	F		Central and local Government National and local community
Corporate Social Investment	Corporate philanthropic donations	F		Local community Other recipients
Employment	Primary employment	N-F		Company employees Supply chain employees Local community

[13] An overview of the discussion in section 2.5 on issues relevant to economic performance indicator frameworks and different means of categorising such indicators.

[14] Results/determinants refer to direct indicators of success or otherwise in meeting primary business goals. Determinants refer to indicators that measure factors determining success or otherwise of primary business goals. These are only relevant for indicators where the company is the main stakeholder.

At the broadest level, the proliferation of indicators and methodological approaches is driving the need to define common methodological standards and indicator sets, and to develop appropriate mechanisms for the incorporation of existing indicators and methodologies into these 'universal' frameworks. The Global Reporting Initiative is the pre-eminent example of this (see section 2.2, below). The mining sector must consider how best it might integrate its continuing development of indicators with such universal standards as they themselves continue to develop.

2.2 Indicators and the Global Reporting Initiative

The Global Reporting Initiative (GRI) is a long-term, multi-stakeholder, international undertaking whose mission is to develop and disseminate globally applicable sustain-ability reporting guidelines for voluntary use by organisations reporting on the economic, environmental, and social dimensions of their activities, products and services. GRI has recently produced a set of Sustainability Reporting Guidelines (GRI, 2000) (www.globalreporting.org).

2.3 Development of Environmental Performance Indicators

2.3.1 Introduction

The ability of certain sensitive species to flag changes in biotic and abiotic conditions has been instrumental in reflecting changes and impacts on the environment caused by humans and their activity. Various species of amphibians, fungi, algae, birds etc., have all been employed as useful indicators. The most common method for the biological assessment of pollution in aquatic systems is based on assessment of the range of species present, and each species' abundance. The overall productivity or health of a local or regional environment can also be assessed. In essence these are different facets of biodiversity, which is itself a powerful indicator of environmental quality.

In addition to assessment of biodiversity many other environmental indicators have been devised. In 1987 the UN Economic Commission for Europe produced an experimental compendium of environmental statistics covering Europe and North America (UNECE, 1987). It was prepared following several years' intensive work on the concept of environmental statistics and concluded that two primary strands should be followed in the work: a compilation of time-related data relating to specific variables and a compilation of an ideal, exhaustive list to describe complex environmental situations. The latter comprised a series of draft statistical classifications in a number of areas of environmental concern: land use (e.g. current land use and changes in land use); water use (e.g. water abstractions); ambient water quality (e.g. results of waste-water treatment); ambient air quality (e.g. sulphur dioxide concentrations in commercial and industrial city centres; suspended particulate matter in residential suburban areas); flora and fauna (e.g. population of selected threatened species); solid wastes (e.g. generation of industrial solid wastes; hazardous wastes: generation, imports and exports) and environmental indicators (although no definition is provided to distinguish statistics from indicators). The 1987 document was superseded by a further publication in 1992 (UNECE, 1992).

In 1985 the Organisation for Economic Co-operation and Development (OECD) published an Environmental Data Compendium (OECD, 1985). This became a two-yearly report (last published in 1999 (OECD, 1999)), the aim of which is to present the best internationally available data on the environment and related areas; to respond to public demands for environmental information and assist in the implementation, development and harmonisation of environmental policies. It is intended that the data will assist the incorporation of environmental concerns into decision-making processes at both national and international levels.

Based on these compendia, a preliminary set of indicators was prepared by the OECD in 1991 (OECD, 1991). Subsequently, in 1993 the "Core Set of Indicators of Environmental Performance Reviews" (OECD, 1993) was presented, which was later revised following comment from member nations and published in 1994 (OECD, 1994). These publications resulted from the OECD Council's request in 1989 and subsequently, for a framework to integrate economic and environmental decision-making, and also similar requests from G7 nations. Further the OECD had been, on behalf of its member nations, developing a series of environmental performance reviews whose primary aim was to improve member nations' environmental performance, both collectively and individually in the area of environmental management. In the light of the 1992/1997 Rio conferences the document held more significance as an international tool to stimulate governments to incorporate environmental concerns into economic decision-making.

Three basic selection criteria were used in the OECD work: policy relevance, analytical soundness and measurability. The document acknowledges that different users of indicators have differing needs and four major categories of use are outlined: measurement of environmental performance; integration of environmental concern into sector policies; integration of environmental and economic decision making in the wider context; and reporting on the state of the environment.

2.3.2 Prerequisites for the Development of Environmental Indicators

Environmental policy

Environmental policies establish the objectives and intentions of the company regarding environmental performance. At a minimum they state the intention to comply with all applicable laws and regulations (and often voluntary codes of conduct), but are often structured around a more specific set of objectives which relate not solely to external compliance, but also to the strategic goals of the corporation – such as continuous improvement in emissions reduction, meeting waste minimisation targets, or establishing an industry leadership position with respect to environmental management. There is consensus that environmental policies should be generic enough in form to be applied to all plants within the corporation, but that in many cases these generic goals will then be translated into specific objectives for individual sites. This is broadly in line with the GRI methodological approach. Policy objectives need to be set sufficiently high so as to inspire public confidence, yet not so high as to be unrealistic, unattainable or excessively expensive (relative to the benefits). There is general agreement that these policy objectives should not only represent corporate goals, but also relate to tangible objectives defined by groups and organisations

other than the firm - for example, local community goals of economic growth, environmental conservation or social participation, or international treaties on biodiversity, wetland protection, or species preservation. The significance of environmental policies as guiding documents should not be overlooked since they define the aims and objectives of environmental improvement and all other management tools and methodologies are structured accordingly to meet these objectives.

Environmental Management Systems

An environmental management system (EMS) comprises a formalised framework of inter-linked procedures - checks, reports, plans, and actions – which is implemented at the plant level to facilitate the achievement of the environmental policy objectives. An environmental management system need not be explicit or discrete in form but, to the extent that it addresses environmental issues, it can be made up of the actions and procedures involved in routine operations management and/or those that are common to other formalised management systems at the plant such as those for product quality. Indicators may play a fundamental role in structuring and monitoring progress within the wider framework of the environmental management system.

Eco-audits

The collection of data on which environmental performance indicators are based forms part of the eco-audit process. Eco-audits are implemented at the plant level and involve a trained auditor conducting a site-tour to collect data on plant performance. In practice it will involve the collection of statistical data on parameters such as emissions and resource use, the ranking of the plant according to various pre-set criteria, and professional judgements on qualitative indicators of performance. From this base set of raw data, the audit processing team can devise and disseminate - as appropriate - sets of indicators for specific target audiences. Two common forms of dissemination include the Annual Report (or corporate Environmental Report if separately available) as a communication tool with external stakeholders, and internal memos, containing information of a sufficiently sensitive nature to warrant it suitable only for internal consumption. The format and content of the format should be in line with GRI Guidelines, as these establish a common format, that is both consistent between companies, and over time, allowing progress to be transparently assessed. Several reviews of current environmental reporting have pointed to the need for third-party verification of data in external environmental reports and the long-term interests of providing clear, consistent, and scientifically defensible data and once again GRI is a major proponent of this.

2.3.3 Functional Relationship Between Environmental Performance Indicators, Policy, Management Systems and Eco-Audits

The functional relationship between environmental performance indicators, policy, management systems and eco-audits outlined above is similar to that put forward by a number of other observers (e.g. Azzone et al, 1996, Young, 1995). These models can all be characterised as hierarchical cascade models, in which a determination of top-level objectives leads to a series of subsequent decisions concerning the design of management systems, the

selection of indicators, and the development of data gathering techniques in an effort to meet the initial objectives. As a matter of practicality, the design and selection of indicators is therefore dependent on a prior, clearly articulated objective. If, for example, the objective is to diagnose the reasons for consistently poor environmental performance at a plant in order to prioritise and target environmentally-related investment, the function - and therefore the design - of appropriate indicators will be different to those for communicating corporate environmental performance to the financial markets and to shareholders. While it is possible to have multiple objectives in designing indicators (Cairns et al, 1993), these objectives - and the possible trade-offs between them - need to be made clearly, explicitly, and prior to the selection of indicators. Both the theoretical and applied literatures on indicators are in agreement on this, stressing the importance of explicitly defining objectives prior to compiling performance indicators. Mitchell (1996) and practitioners such as BHP (1995), for example, both argue that a clear, unambiguous definition of purpose – which also involves specifying the target user group(s) – is essential to constructing meaningful indicators.

The model described above suggests a close articulation between environmental performance indicators and the eco-audit process, yet, although central to the design and implementation of effective indicators, the precise relationship between indicators and the data produced by the audit process has not received as much scholarly attention as other parts of the model. An initial review of business practice, however, confirms the practical significance of this linkage, demonstrating that where attempts have been made to develop environmental performance indicators they are derived primarily from data collected during an environmental audit. Environmental performance indicators are complementary to the audit process, yet are significantly different to the audit in terms of their objective, the amount of detail they contain, and the target audiences to which they are typically disseminated. For example, while communication of raw environmental audit data may be limited to the plant manager and technical experts who will use it to plan a strategy of improvement at the plant, environmental performance indicators are derived from this raw data but serve a wider function in that they can convey concise information on plant performance to senior management, and can be used in a controlled fashion to communicate information to other stakeholders.

Data from the environmental audit can be seen as the total set of data available for the construction of indicators. The specific set of indicators chosen will depend on the objectives/user groups for which they are being developed; yet all indicators will draw on the audit's data set. Braat (1991) and Mitchell (1996) have represented this relationship as a "data pyramid". The pyramid sits on a broad base of disaggregated, detailed raw data obtained through the auditing process that, with rudimentary processing, is compiled into a set of specific indicators. Writing in the context of nationally based indicators of sustainability, Mitchell (1996) has suggested that this primary set of specific indicators is suitable mainly for use by the scientific community. This can be extended to suggest that in the field of corporate environmental management, specific indicators might by used chiefly by engineers and environmental scientists at the plant level. From these specific indicators a smaller set of composite indicators can be developed by aggregating data sets to produce information that can be conveyed to those with some technical and scientific knowledge, but no familiarity with specific plant details. In the corporate context this may be suitable for conveying information to senior management. At the top of the pyramid is a small set of key

indicators. Some of these rely on a simple aggregation step; others are derived directly from specific indicators (such as annual emissions of carbon dioxide, for example).

2.3.4 Designing Environmental Performance Indicators

In the broad area of procedure and general criteria a degree of consensus had already emerged by the mid-1990s. For example, the seven criteria used by BHP (1995) are a concise statement of the factors to be considered in designing environmental performance indicators, which must be:

1. Meaningful and realistic measure of environmental, health and safety performance
2. Feasible to obtain in cost-effective manner
3. Easily understood and clearly defined
4. Useful to senior management, the company, and line management
5. Able to facilitate comparisons between performance and company policies
6. Scientifically credible
7. Able to provide early warning signals of unfavourable performance

This list of general criteria might be amended to ensure that indicators are developed which are not only scientifically credible, but which also have the support of stakeholder groups. Thus, in designing the indicator set there is a need to conduct a scoping process that consults not only the different levels of management within the company, but also the full range of stakeholders involved. This scoping serves to identify a set of environmental effects and impacts which stakeholders regard as significant. The Sustainable Seattle program is regarded by many as a model of stakeholder consultation in the context of developing a metropolitan set of Sustainability Indicators. The program developed a set of indicators over a two-year period using a specially appointed indicators task team and a civic panel comprising several hundred people (see Table 12 below for analysis of the Sustainable Seattle Program and other indicator initiatives and systems).

The debate over the design of indicators has tended to take the form of a duel over dualisms (aggregate vs. multivariate, generic vs. specific, quantitative vs. qualitative, cause vs. symptom). Table 6 summarises the historical debate, draws comments based on the GRI guidelines, and assesses the weaknesses and strengths of a range of environmental indicator design approaches. Further details can be found in Appendix A.

Table 6. Overview of environmental indicator design parameters

Design parameter	Commentary	Strengths	Weaknesses
Input versus output	Environmental management is conceptualised as a system comprising inputs and outputs, in which inputs refer to the financial, human, and technical resources dedicated to environmental management while outputs refer to either sources or impacts	Input audit could be used as a proxy for environmental performance	The linearity of the relationship between inputs and outputs from the system and the efficiency with which resources are used to achieve outputs is an issue
Single aggregated versus multi-variate indicators	Indicators can be divided into two groups according to whether they are comprised of a single aggregated index in which one figure is reported, or whether a set of indicators are used to convey many different variables	Non-aggregated indicators are useful for a wide range of stakeholder groups	Constructing single indices is typically very data intensive and they are misleading since they necessarily obscure details of performance and provide no indication of where improvements could be made
Ideal type versus peer group	One of the primary applications of environmental performance indicators is to benchmark. There is considerable debate over whether there is an appropriate absolute standard - an ideal type - against which an organisation's performance can be judged, or whether the only relative benchmarking is appropriate, with the benchmark set by current best-practice within the organisation's peer group	May be possible to measure performance relative to thermodynamic constraints (i.e. an absolute measure of performance)	The relative benchmark may not be the most useful if the objective of environmental performance measurement is to identify the opportunities for technological innovation, rather than to benchmark current performance across a number of different plants or firms.
Normalised versus absolute	Normalised indicators are those that have been standardised by reference to some common denominator to assist the process of comparison. Absolute indicators refer to the actual figure for the plant or organisation in question prior to normalising.	Normalised data is essential to conducting meaningful comparisons; absolute figures on resource use or releases to the environment are better gauges of the likely effect on local assimilative capacity.	None – normalised and absolute indicators have equal relevance in specific applications

Static versus dynamic	The debate over the relative merits of static indicators - which record events at a single point in time - compared to dynamic indicators - which represent change over time - is of limited value since the two types of indicator are not mutually exclusive	Dynamic indicators have the advantage of normalised data (since they are normalised by a common time period such as per year, per hour etc.) and can therefore be used to compare improvement in performance across a range of heterogeneous sites. Static indicators may be useful for establishing baseline measurements	Establishing reliable background conditions may be complicated in the context of existing operations or in areas that have been historically disturbed, making the use of static indicators impossible
Generic versus specific	A common goal in the development of environmental performance indicators is the design of indicators that are sufficiently generic to be applied across a range of different sites, but which are also sensitive enough to capture key differences between sites.	Generic indicators are relatively easy to identify when dealing with inputs (or causes as described above) as they share a common structure from site and site and are often recorded in way that facilitates comparison. It is possible in some cases to develop indicators of environmental performance which are highly site-specific, but which nonetheless can be compared against a common standard	The challenge in designing indicators is to situate the indicator somewhere on the continuum between overly detailed site specific indicators which provide no basis for comparison between sites and a very limited, bland set of indicators which record only those few features which are common to all sites.

2.3.5 Specific Environmental Indicator Categories

This section draws together the preceding discussion and subsequently divides environmental performance indicators into four categories, describing environmental conditions at the site, the environmental loadings due to productive activity at the site, the system of environmental management, and environmental achievements.

Indicators Of Environmental Conditions

These indicators provide an assessment of current environmental conditions at the operation. They represent a snapshot of ecosystem health and biological diversity and can be combined in time series to create a dynamic indicator of change at the operation. Indicators may be selected by reference to parameters for which data collection is currently required by environmental regulation, by consultation with stakeholders - and especially those in the vicinity of the operation - and by reference to the objectives of the company's environmental policy. Key indicators of ecosystem health can also be drawn from the conservation, ecology, and biology literatures. These literatures have developed techniques that provide relatively robust indicators of ecosystem health based on measures such as species diversity, carrying capacity, and key species etc. When reported as part of a full indicator set they provide an important means of "ground-truthing" environmental performance achievements related in other indicators.

Indicators should report on rare, threatened, endangered, or vulnerable species at the site and incorporate a description of the size and status of the population. They should also compare measures of species diversity or ecosystem health on rehabilitated land with that of areas adjacent to the operation or on agreed control areas. Other indicators that may be locally significant could include ambient air quality and a comparison between upwind and downwind conditions, and ambient surface and groundwater quality, including a comparison between up gradient and down gradient conditions.

Environmental Output Indicators

These indicators provide an assessment of the linkages between industrial processes and the natural environment at the level of the plant and are equivalent to the "source" indicators described above. They are the most detailed and data-intensive type of performance indicator and correspond closely with the outputs from Life Cycle Analysis or the Eco-Balance indicators as discussed by Tyteca (1996), Azzone et al (1996) and others. Typically they consist of both static and dynamic assessments of raw material flows into and out of a plant, and are often compared between plants by normalising for the amount of product produced. For analytical purposes environmental loadings can be broken down into five sub-groups: Raw Materials, Emissions, Wastes, Energy, and Transportation. The selection of specific indicators within each of these groups would be based on a combination of the type and complexity of plant processes, stakeholder requirements, and a consideration of current and impending regulatory mandates. These source indicators can be effectively represented in an annotated flow diagram illustrating material flows into and out of the operation.

Environmental Management Process Indicators

These are equivalent to the "input", "cause" or "process" indicators and provide an indication of the status of environmental management at an operation. Indicators not only assess the resources devoted to environmental management, but also the level of integration of environmental management within operations, the extent of corporate commitment to environmental improvement, and the integrity of the systems in place to deliver environmental performance.

For each of these parameters, the focus is on whether environmental management plans and objectives - which must meet certain minimum criteria - have been developed or implemented. The idea is to establish progress in implementing critical management processes that will ensure best-practice environmental performance. Once these minimum criteria have been established, they can be ranked according to a schema similar to the following: non-existent (1), under consideration (2), under development (3), implementation in progress (4), implemented as part of the management system (5). It has been noted by some practitioners (e.g. BHP, 1995) that some environmental management process indicators are evolutionary in that at some future point operations will have fully integrated these objectives, and indeed this is one of the principal aims of the GRI methodology and Guidelines.

Environmental Achievement Indicators

These indicators cover specific progress towards targets which can be set by the company in its environmental policy, thrown up by baseline audits, established by treaty obligations, or codes of conduct and guidelines to which the company is a signatory. It also covers compliance with existing environmental regulatory requirements, a record of environmental suits and legal challenges to the company based on environmental performance, and environmental initiatives by the company that extend beyond normal operations. Homestake, for example, currently sets annual numerical targets for its operations and then reports on achievement of those targets: examples include, reclaim 75% of remaining acreage affected at closed operations, quantify waste generated at major units, conduct operations with zero chemical-related wildlife mortalities.

2.4 Development of Social Performance Indicators

2.4.1 Introduction

Statistical information on social topics has been collected from as early as the sixteenth century, when irregular gathering of mortality figures was undertaken. An increasing demand for data covering areas of state interest (such as military, trade, population and finance) led to an increase in the collection of social data during the 17th century including the first tables of life expectancy for different age groups. The trend continued through the 18th and 19th centuries including a work subsequently heralded as the beginning of modern efforts of social quantification: The Statistical Handbook of Belgium produced by Quételet.

In 1790 the USA held its first decennial census and in 1832 the Statistical Department of the Board of Trade was established, institutionalising the collection of social statistics. By the early 20th century publications by the Italian Niceforo covered "the measurement of life" and he began to develop key indicators for his concept of "civilisation".

A.C. Pigou, a British Economist argued in his "Economics of Welfare" (1924) that economics could no longer ignore the concept of social costs and reflected that the market economy was not perfect, there was a role for state intervention in such an economy. These arguments remained largely marginalised until the 1950s when the concept was incorporated into the new "welfare economics" (particularly in cost benefit analysis) and such costs are now known as "externalities".

Around the same time in America, William F. Ogburn of the University of Chicago included in his interests the promotion of the role of social research in government decision-making. One of the important publications in the field of the social indicators movement, for which Ogburn was largely responsible, was "Recent Social Trends" (US President's Committee, 1929). Topics covered included: education; the arts; race and ethnic groups; recreation and leisure; health and environment; rural trends; women; occupations; the family; crime and punishment; and religion.

Macro economic indicators (such as gross national product, GNP) have been used over many decades to illustrate national economic performance and as a policy making tool for governments. Their relative usefulness suggested to some social scientists that an analogous series of social indicators might be as effective for use in social policy. Further, economic indicators were increasingly recognised as being inadequate to evaluate wider social welfare issues. Gross (1966) coined the term "economic philistinism" in referring to the fact that economic indicators were successfully over-emphasising the use of monetary evaluation at the expense of other important social considerations.

The 1960s saw a rapid growth in the "social indicator movement", as a growing dissatisfaction set in with the amount and quality of social information available to governmental decision-makers. After a few years, the term "social indicator" encompassed a diverse variety of attempts to specify socio-economic well-being indicators stretching from broad quality of life measurements to specifics, such as housing quality. In 1972, Wilcox et al produced an annotated bibliography of indicators listing over 1000 entries concerned with social indicators – by the early 1980s this number had grown closer to 10,000 (Carley, 1981). Still, however, there seems to be little consensus over what a social indicator is, or should be, and despite the wealth of literature, the predominance of environmental performance indicators over social performance indicators remains.

By the 1980s, at least 30 countries were producing a "national social report" – a compendium of social measures. Examples include "Social Trends" in the UK and "Social Indicators" in the USA. The aim of such reports is to give a broad narrative on social conditions and trends at national level. Measures include infant mortality rate numbers enrolling in primary school, population per physician, percent population access to safe water supply; daily per capita calorific intake. Arguments abounded that there was no clear link between the reported figures and the underlying causes and thus they are not indicators but merely statistics.

It is estimated that the current state of development of corporate social performance and Sustainability Indicators is running at least a decade behind that of the development of environmental performance and Sustainability Indicators. Many of the organisations working on social performance issues are only just beginning to turn their attention to the development of measures relating to social performance, and those that are doing so are typically working in isolation. As a result, the social performance and Sustainability Indicators that have or are currently being developed are generally company specific.

2.4.2 Prerequisites For the Development of Social Indicators

Involvement of the Diverse Public

Public involvement begins as a means to inform and educate the impacted population as well as the project proponent about the proposed action before and after development decisions have been made. It should continue by assisting in the identification of problems associated with the proposed projects, as well as the needs and values of the impacted community. Finally, given the will, it is possible to involve the community directly in decision-making and action with the project and its assessment.

Social Impact Assessment (SIA)

A public involvement and conflict management program can be integrated closely and beneficially with the development of the social impact assessment process. Public involvement and SIA developed out of the same values - that placed people ahead of economic progress. Demands for public involvement reoriented SIA methodology to focus on the human, living community, not just data, statistics, and projections. Connor (1985) called this the community, or participative approach to SIA. However, such an approach varies dramatically in its depth, some being concerned with simply informing the community, whereas others actually give the community decision-making authority. Four basic levels of intensity of public involvement can be identified:

- Information. Information sharing underpins all other levels of participation. With respect to SIA it is a matter of informing the affected populations of what is planned and how it will affect them. It puts people in the picture and can help them facilitate individual or collective action. This approach does not seek people's reactions, and should such reactions occur, no corrective actions would be forthcoming. An information-only approach is only really acceptable at the start of the assessment, with opportunities for participation later. Methods for information dissemination include leaflets, maps, newsletters, advertising, presentations at meetings, press releases, and press conferences.
- Consultation. This means that people are not just informed but also actively consulted on key issues. In SIA this will involve the affected community providing feedback to the assessment practitioners on anticipated impacts and initial feelings about the project. These views may then be used to contribute minor changes or additions to the project. At an absolute minimum, public involvement should involve this stage with communication flowing between the agency, assessor, and affected group. According to

partridge (1994): 'consultation is the least intensive and in many ways the least participatory…and should be viewed as an initial step'. Methods for consultation include interviewing, consultative meetings, simulations and scenarios, and surveys.

- Decision-making. This occurs when people are involved in decision-making about aspects of a project. In respect to SIA, this will mean giving the community direct influence in the focus and implementation of the assessment from the beginning. People become part of the process, and their knowledge and views receive maximum consideration. This will involve the assessor adopting a facilitating rather than directing stance. Methods for decision-making will include stakeholder analysis, action planning, brainstorming, maps and models.
- Acting together. This can take place when people feel confident enough to go beyond deciding together and propose partnership action. Proposals are community-based, and not assigned exclusively to an outside agency. In this, power is devolved down to the community level. Acting together may involve short-term collaboration or forming more permanent partnerships with other interests. In terms of the SIA, this might mean active collaboration either between the practitioners or the proponents and the community in such activities as collecting data, monitoring the environment, initiating and maintaining schemes (Bisset, 1996b; World Bank, 1995; Paul, 1987).

Analysis of Social Impact Equity

Impacts should be specified for differentially affected groups and not just measured in aggregate. Initial identification of the full range of stakeholders likely to be affected by an agency action is central to the concept of impact equity. Although there will always be winners and losers as the result of a decision to construct a major facility like a mine, no category of person considered more vulnerable because of their age, ethnicity, gender, or other factors should have to bear the brunt of negative social impacts, or be excluded from the benefits of positive social impacts.

There are a number of examples in the literature of groups that could be considered vulnerable or powerless. The elderly have been identified as a category of persons sensitive to involuntary displacement and relocation. Children have suffered learning problems resulting from long-term exposure to various forms of noise and air pollution. Minorities and more specifically the poor have traditionally been politically underrepresented and therefore often the first victims of social impacts in industrial development projects. Occupationally, farmers have often been the worst to suffer the negative impacts of major projects, which are frequently located in rural areas and demand directly or indirectly the use of large tracts of land. The special impacts to those persons must be accounted for and not lost in summary statistics (ICGP, 1995).

Precautionary Principle

Generally, the principle that it is better to be roughly correct on important issues than precisely correct on unimportant issues should be applied. Under circumstances of resource shortages, weighting must be differentiated between impact identification (the types of impacts) and impact evaluation (the significance of the impacts). Connected to this principal, is the principal that the absence of solid proof should not rule out a potential

impact. All E/SIAs are anticipatory in nature, and as such are concerned with the probable impacts in advance of the development event. Questions of the absolute proof of impacts should not prevent their reporting, because it will always be impossible to prove with true confidence in advance the actions in question. Accordingly, if the evidence for a potential type of impact is not definitive in either direction it should be included on the basis that it cannot be ruled out with confidence rather than excluded on the basis that the impact is not proven (ICGP, 1995).

2.4.3 Specific Social Indicator Categories

High profile companies that have developed in-house social performance and Sustainability Indicators include Placer Dome, Co-operative Bank, Shell, BP Amoco, Ben and Jerry, Body Shop, United Utilities and Rio Tinto. Given that social issues and stakeholder interests vary from company to company, and given the relative infancy of the field's development, the social performance and Sustainability Indicators spearheaded by these and other innovative companies tend to relate to specific issues of corporate social responsibility such as employment or trading. Overall, therefore, the development of social performance and Sustainability Indicators is both company and issue focused.

Although the major proportion of recent developments in the area of social performance and Sustainability Indicators can be attributed to individual companies working on specific issues, this should not overshadow more broad based developments in this field by a small number of research and government bodies and multilateral organisations.

Prominent among these is the Global Reporting Initiative (GRI), established in late 1997 with the mission of designing globally applicable guidelines for preparing enterprise-level sustainability reports. It is convened by CERES (Coalition for Environmentally Responsible Economies) and includes the active participation of corporations, NGOs, consultants, business associations, universities and other stakeholders globally.

The GRI seeks to establish a common framework for enterprise-level reporting on the linked aspects of sustainability: environmental, economic and social. It adopted the following hierarchy for organising and presenting information in sustainability reports:

- Category: i.e. general class or grouping of issues of stakeholder concern (e.g. labour practices, local economic impacts).
- Aspect: i.e. specific issue about which information is to be reported (e.g. child labour practices, corporate giving to host communities).
- Indicator: i.e. the most precise measures of performance during a reporting period (e.g. adherence to an international child labour standard, monetary contributions per year to host communities).

The GRI's proposal has been the inspiration behind MERN's presentation of Sustainability Indicators for the Non Ferrous Alliance (see Chapter 3: Case Studies). The GRI has identified a number of generic social categories, issues and indicators: Like the GRI, Elkington et al. (cit. Bennet and James, 1999) suggest there are social issues and indicators that have broad utility across stakeholders, companies and sectors. The social issues and

indicators identified and suggested by the GRI and Elkington et al. are outlined in Tables 7 and 8 respectively.

Table 7. Selected GRI social issues and suggested indicators

Issue	Indicators
Policies, organisation and management systems	Publicly available missions and values statement, and social policy statements; social charters, codes or voluntary initiatives; organisational structure and responsibilities for oversight and implementation of social policies; management systems pertaining to social performance (e.g. ISO 14001, SA 8000); management systems for supplier and supply chain
Stakeholder relationships	Basis for selection, definition and profile of major stakeholders; approaches to consultation with stakeholder (e.g. surveys, focus groups); number of consultations; the use of consultation data; plans for strengthening stakeholder consultation
Management performance	Performance pertaining to internal social policies and standards and voluntary initiatives; major awards received regarding social performance and activities; indicators of occupational health and safety e.g. rates of occupational injuries and illnesses and lost workdays
Corporate, employees, community, suppliers and customers	Ethical standards, bribery/corruption, transparency, human rights
Employee performance	Workforce diversity, freedom of association, child labour, turnover rate, absenteeism, compensation & benefits; community performance / involvement, skills transfer, technology transfer, complaints, community reinvestment, philanthropy, taxes
Supplier performance	Procurement standards, partnership screens; customer performance - product labelling, training in product use

Table 8. Selected Elkington et al. social issues and indicators

Issue	Indicators
Employment practices	Gender and ethnic ratios, pay rates, benefits, holidays, training, job satisfaction, a safe working environment; financial and job security; freedom from discrimination and professional development opportunities
Community relations	Contributions to community development; job creation; taxes paid/ tax breaks received; philanthropy; and employee volunteerism
Supplier and customer relations	Fair trading practices with suppliers, distributors and partners; number of products sourced locally; the length of supplier relationship and payment on time; no use of child or forced labour
Social impact of product	Contribution of products and services to social welfare; equity; and the meeting of basic human needs, such as food, shelter, water and healthcare.

In addition to existing social issues and indicators identified and developed by companies such as Placer Dome or by organisations and researchers such as the GRI and Elkington et

al., there are international, regional and national standards relating to the social dimensions of business. These must be incorporated in the development of any social Sustainability Indicator model. For example, EU companies have to meet the obligations imposed by Directive 85/337/EEC. This directive makes it clear that unless justified to the European Commission, Environmental Impact Assessment should be introduced for private and public projects likely to have a significant effect on the environment. Article three defines the scope of the EIA to include human beings and cultural heritage while article six relates to the issue of public participation (Bond and Wathern cit. Petts, 1999).

2.5 Development of Economic Performance Indicators

2.5.1 Introduction

Figures have been used from the earliest historical times by governments, their use gradually spreading to specific purposes such as taxation and military levies. The earliest date for a collection of figures in the UK is 1199 (Clerk and Frank, 1938), although medieval indifference to numbers and arithmetic meant that widespread use was not common until the 15th century. One of the earliest instances of the collection of economic indicators is noted as Gregory King's 1696 population forecasts and he has been hailed as the pioneer of national income statistics (Barber, 1967). During the 18th and 19th centuries Thomas Malthus produced a series of essays on population growth, suggesting that the potential for population growth vastly exceeded the capacity of the earth to sustain it. He could thus be considered to be a very early thinker on the theory of "carrying capacity" and subsequently "sustainability".

However, it is common to describe the commencement of the discipline of economics as the result of the work of Adam Smith whose great work "The Wealth of Nations" launched the classical traditions of economic thought in the 1770s. Smith analysed value and found that some items (he used air and water as examples) had vast utility but, as they are not exchanged, had little value. Contrarily, some items with little utility (his example was diamonds) could command huge exchange values. He and his contemporaries insisted that price and value could not be readily collapsed into one another: "value" was viewed then as independent of the whims of the market. A market (or nominal) price could vary but intrinsic value remained constant. (It is interesting to note the resonance of Smith's examples when viewed in the context of today's discussions over valuing natural and social capital).

Mitchell (1962) and Mitchell and Jones (1971) provide a thorough coverage of statistical collection, primarily dating from the 1800s. Very many economic indicators of the "state of the nation" are available and they include information on: the labour force, including numbers of unemployed; agriculture, such as the overseas corn trade, yield per acre of main agricultural products; coal industry including coal imported and output of main coal fields; similarly, imports of iron and the outputs of different grades of iron; overseas trade figures; average wage; public finance including public income and expenditure from national to local level and income tax rates and yields; and prices and price indices.

Macroeconomic data presentation has become internationally standardised according to the 'System of National Accounts' (SNA) 1953 with revisions in 1968 and 1993. This has

established a coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis and policy-making. It also serves as a basis for the calculation of key indicators of economic performance including gross national product, gross value added, gross national income and balance of payments.

In recent years developments have taken place in environmental accounting that seek to address the shortcomings of the standard SNA. The SNA framework is seen as having three major drawbacks with respect to the environment: (1) the neglect of the depletion of natural resources; (2) the inadequate treatment of defensive expenditure; and (3) the failure to account for the degradation of environmental quality and its effects on human health and welfare.

No consensus has yet been reached on the appropriate way to adjust the SNA format, however three major approaches are:

1. The adjustment of national accounts to incorporate environmental effects.
2. The development of satellite accounts outside and complementary to the core SNA.
3. Independent natural environmental and resource accounts linked to the national accounts (this concentrates on keeping inventories of physical and monetary flows and stocks of natural resources. (OECD, 1994; Markandya and Pavan, 1999.)

On a world-scale the World Bank has been working on alternative valuation initiatives and in the 1990s, in response to world-wide interest, it established an Indicators and Environmental Valuation Department. This department published a monograph in 1997 entitled "Expanding the Measure of Wealth" which built on its "three capitals model" and presented "portfolio" indicators to provide an alternative measure of the wealth of nations, taking the new paradigm of Sustainable Development as:

a process of managing a portfolio of assets to preserve and enhance the opportunities people face

In this definition, assets are the produced, natural and human resource capital of any country. By extending the measure of wealth to include natural capital and human resources in addition to produced assets (the traditional measure of wealth) it is possible to view not only the total of national wealth, but also the difference between countries.

Conventional financial performance indicators, as a vital means of monitoring competitiveness and commercial viability of companies, are historically better established than indicators in the environmental and social dimensions. Indeed, reporting of standardised financial performance data to stakeholders, principally shareholders and tax authorities are a routine and legally enforced aspect of business practice. Further indicators of economic performance beyond standard accounting measures are also used according to the specific sector, company or site. However, when considering the development of economic performance indicators in the context of sustainable development it is necessary to assess the extent to which orthodox and existing 'off the shelf' indicators are appropriate and

consequently the extent to which new indicators ('tailor made') should be developed. If tailor made indicators for economic sustainability are developed further questions arise concerning the extent to which existing data collected by companies can be used in the construction of these indicators and the extent to which new data is needed. This in turn has cost implications for a company. Against this must be balanced the fact that tailor made approaches developed collaboratively within the company alongside consultants are more likely to promote learning, and to leave in place methodologies capable of being adapted to manage uncertainty and change

This section provides an overview of economic performance indicators illustrating how these can be categorised and how developing indicator frameworks have included standard financial indicators along with other monetary and non-monetary indicators. It also outlines some key issues in the selection of indicators for economic performance.

2.5.2 Categorisation of Economic Performance Indicators

Aspects of economic performance and related indicators can be categorised and sub categorised in a number of ways. This can be, for example, according to the stakeholders that will be primarily interested in the indicator, the financial or non-financial nature of the indicator parameter or whether the results or the determinants of a strategy are being indicated. An overview of the types of categorisation discussed in this section is given in Table 5 (above). A useful point of entry here is to consider the different stakeholder groups that will be interested in certain types of indicator.

Corporate Stakeholders

Economic performance indicators traditionally used by a company, whether based on standard accounting practices or geared to specific circumstances of a company, are aimed towards showing performance towards the economic goals of that company and are therefore a tool for decision-making. Thus, the key stakeholders for these types of indicators are the company itself and those with a vested interest in commercial performance such as shareholders.

In choosing an appropriate range of such company centred performance indicators it is necessary to achieve an appropriate balance reflecting different aspects of economic performance. Aspects of performance and connected indicators can be sub categorised in a number of ways. A common generic division is as follows (Lothian, 1987):

- Financial performance
- Competitive advantage
- Quality of service
- Flexibility
- Resource utilisation
- Innovation

Such generic divisions fall into two conceptually different categories. Measures of the first two reflect the economic success of the chosen strategy, i.e. ends or results. The remaining four are factors that determine competitive success, i.e. means or determinants. Another way of categorising these sets of indicators is to refer to them either as leading or lagging indicators, where, for example, improved innovation leads to better financial performance reflected in financial indicators over subsequent reporting periods.

Clearly the relative importance of these different categories of indicator will vary between sector, company and site. In the mining industry one emphasis is on resource utilisation in terms of productivity and efficiency, however aspects such as quality of service are also relevant since this will include measures of reliability and competence.

A further issue in finding an appropriate balance of indicators for economic sustainability is the split between financial and non-financial indicators. Clearly, economic performance will be ultimately measured in financial terms. Key financial indicators relate mainly to the above sub categories of:

- Financial performance (e.g. profitability, economic value added, share value and net income)
- Competitiveness (e.g. sales growth)
- Innovation (e.g. R&D investment)

However, there is a debate about the extent to which non-financial measures should be included in a set of indicators of economic performance. An over reliance on financial indicators can result in short term decision making at the expense of long-term sustainability. Professor R.S. Kaplan of Harvard Business School in "The Evolution of Management Accounting" (quoted in Shaw, 1999) states:

> ...if senior managers place too much emphasis on managing by the financial numbers, the organisation's long term viability becomes threatened.

In terms of the above sub-categories the key areas where non-financial indicators are relevant are for:

- Competitive advantage (for example, share of the market against competitors or share of new projects in the industry)
- Quality of service (e.g. customer satisfaction analysis, delays in delivering to customers)
- Flexibility (e.g. ability to change the production schedule when the marketing plan changes)
- Resource utilisation (e.g. resource efficiency)
- Innovation (e.g. R&D versus competition)

Other Stakeholders

In the context of sustainable development we are also interested in economic impacts of company activities from the point of view of other stakeholders such as the local community, local business, supply chain business and governments. Although these stakeholders may have an interest in the above company-centred indicators there are other aspects of company economic activities that may not be covered in these indicators and for which additional indicators can be developed. One way of categorising these indicators adapted from the MERN Sustainability Indicators for the non-ferrous metals sector project (see section 3.2) is as follows:

- **Economic impacts of a company or site:** This group includes the direct local and national economic impacts brought about by the business practice of the company or site on actors outside the industry. It includes, for example, supply chain opportunities, local economic impacts, taxes revenues and corporate social investment. The principle stakeholders include the local community, industries related to the company or site and government.
- **Employment impacts of company or site:** This groups focuses on employment impacts brought about by the business practice of a company, for example, numbers in primary employment, secondary employment, wage rates and equity effects. While primary employment and wage rates are an aspect of the sustainable economic performance of a company discussed above, it is included here since its principle stakeholders are the community from which employees are drawn.

It is, of course, possible to break down these categories further into more specific stakeholder groups if deemed appropriate for the purposes of a specific indicator framework. It should be noted that while some of the indicator relevant data in the above categories will be collected and readily available, for example data on tax revenues, other data might be unavailable. There may also be methodological problems in the definition of an indicator to adequately capture a given impact, for example, in the case of supply chain impacts and secondary employment.

2.5.3 Economic Indicators For GRI

The Global Reporting Initiative is an example of the development of economic indicators within a set of sustainability reporting guidelines for companies or other organisations. This is a high profile international project as noted above, which is undertaking on-going consultation among stakeholders on Sustainability Indicators (GRI, 2000).

GRI acknowledges that organisations affect the economies in which they operate in many ways, including through their use of resources and creation of wealth and that these impacts are not fully captured and disclosed by conventional financial accounting and reporting. It therefore aims to expand the boundaries of reporting to include impacts on stakeholders outside the conventional boundaries. In particular, it acknowledges that comprehensive reporting may require addressing in some way the total life-cycle impact of the product or service. Thus it urges reporters to include reference to the more significant supply chain issues.

> The GRI encourages reporting organisations to adopt a life-cycle approach and to report comprehensively on both the upstream and downstream (indirect) effects of operations and activities. At the same time, the GRI asks reporting organisations to be cautious when reporting on effects that occur once the product or service has been delivered (i.e., effects "outside the factory gates"). Reporters are asked to present a balanced picture, containing both positive and negative effects of their activities.

(GRI, 2000)

The proposed economic performance indicator framework uses the following categories:

- Profit
- Investments
- Tangible assets
- Wages and benefits
- Labour productivity
- Taxes
- Community development (includes employment and philanthropy)
- Suppliers
- Products and services

This framework therefore includes the conventional measures of economic performance (profits, investments, tangible assets, labour productivity) while also embracing impacts on stakeholders outside the conventional boundaries (taxes paid to taxing authorities, community development, and economic issues and impacts associated with the use of principal products and services). It should be noted however that at present indicators associated with products and services are not well developed and the issue of secondary employment impacts is not explicitly covered.

2.5.4 Environmental Accounting

Linked to the development of environmental accounting at the national level discussed above are efforts to develop methodologies for environmental accounting at the company level. The objective is to attach monetary values to the direct and indirect environmental impacts of a company's activities using a diversity of valuation methods (see for example ENDS, 2000). One approach is to calculate 'environmentally sustainable profit' in which the costs of environment impacts are deducted from the operating profit. This type of approach is at an early stage of development with many methodological issues such as choice of valuation method and impact boundaries to be resolved. Therefore, it is unlikely that such approaches can be successfully operationalised in the current phase of corporate Sustainability Indicator development. However, with future consensus on methodology and successful piloting such measures may have a role to play as crosscutting environmental/economic indicators.

2.5.5 Issues of Indicator Selection and Operationalisation

Trade-Offs Between Indicators

There is the potential for 'trade-offs' between indicators within a framework where a positive movement in one indicator may result in a negative movement in another. This is of particular relevance to economic Sustainability Indicators and may result from different goals held by different stakeholder groups. A pertinent example is that of indicators for resource efficiency and primary employment. An increase in efficiency may result from, for

example, the introduction of new technology that has the additional impact of reducing the workforce needed to produce a given level of output.

Commercial Confidentiality

A key issue for operationalising economic Sustainability Indicators is that while companies may collect indicator relevant data this will not be made publicly available in view of the need to protect commercial confidentiality. This is particularly the case for certain financial or market share data. One proposed solution to this problem where data is being collected for industry/sector level indicators is for agreement to be sought across an industry/sector that data supplied will only be used for aggregation and no company specific data will be generally available.

Cross-Cutting Indicators

In developing Sustainability Indicators decisions need to be taken as to whether specific issues and their associated indicators should be defined as social, environmental or economic. Clearly, some issues cross over between two or more dimensions, for example, in the case of corporate social investment and employment equity issues that are relevant to both economic and social dimensions. This can be approached either by assigning a crossover issue to one dimensions but clearly signposting its relevance to another or by developing a separate group of integrated indicators as is intended in the GRI framework.

2.6 Examples of Integrated Indicator Systems[15]

2.6.1 World Bank World Development Indicators

The Development Assistance Committee (DAC) of the OECD chose, in 1996, 7 international development goals from resolutions of UN conferences. In 1998 a joint meeting was held between the UN, OECD and World Bank that led to a proposal of 21 indicators to track progress towards the goals. Subsequently annual reports have been produced, the latest being "World Development Indicators 2000" (World Bank, 2000). World Development Indicators 2000 includes 800 indicators in 85 tables, organised in six sections: worldview, people, environment, economy, states and markets, and global links. The tables cover 148 economies and 15 country groups with basic indicators for a further 58 economies.

The international goals focus on reducing poverty; achieving universal primary education, gender equality in enrolments in primary and secondary education and drastic cuts in infant and child mortality rates. They are also taking steps to reverse environmental degradation. In practical terms, all of these are aspects of the wider aims of sustainability and sustainable development.

[15] The Global Reporting Initiative is reviewed elsewhere in this chapter.

2.6.2 UN Sustainability Indicators

Following the 1992 Rio conference, the UN Environment Programme (UNEP) developed a series of indicators designed to determine governmental progress towards sustainable development goals. The selection of Sustainability Indicators is based broadly on the sections of the Agenda 21 document (UNCED, 1992) and falls into four categories with a total of 132 indicators given in 16 subdivisions (see Table 9).

Table 9. ***United Nations working list of indicators of sustainable development***

Social aspects of sustainable development		**Environmental aspects of sustainable development (subdivided into water, land, atmosphere & waste)**		**Economic aspects of sustainable development**	**Institutional aspects of sustainable development**
Access to safe drinking water	Unemployment rate	Groundwater reserves	Agricultural education	GDP per capita	Sustainable development strategies
Life expectancy at birth	Head count index of poverty	Wastewater treatment coverage	Wood harvesting intensity	Net investment share in GDP	Mandated Environmental Impact Assessment
Adequate birth weight	Poverty gap index	Annual withdrawals of water	Forest area change	Sum of exports and imports as % GDP	Prog. integrated environmental & economic accounting
Infant mortality rate	Squared poverty gap index	Density of hydrological networks	Managed forest area ratio	Annual energy consumption	National councils for sustainable development
Maternal mortality rate	Gini index of income inequality	Biochemical oxygen demand in water bodies	Protected forest area as a percent of total forest area	Share of manufactured goods in total merchandise exports	Potential scientists and engineers per million population
Nutritional status of children	Ratio of average female wage to male wage	Domestic consumption of water per capita	Threatened species as a percent of total native species	Environmentally adjusted Net Domestic Product	Scientists and engineers engaged in R & D per million population
Immunisation against infectious childhood diseases	Population growth rate	Concentration of faecal coliform in freshwater	Protected area as a percent of total area	Share of natural resource intensive industries in manufacturing value-added	Representatives of ethnic minorities and indigenous people in national councils for sustainable development
Contraceptive prevalence	Net migration rate	Population growth in coastal areas	R & D expenditure for biotechnology	Proven mineral reserves	Expenditure on R & D as a percent of GDP
Proportion of potentially hazardous chemicals monitored in food	Total fertility rate	Discharges of oil into coastal waters	National bio-safety regulations or guidelines	Proven fossil fuel energy reserves	Ratification of global agreements
National health expenditure devoted to local health care	Population density	Releases of nitrogen and phosphorus to coastal waters	Emissions of greenhouse gases	Lifetime of proven energy reserves	Implementation of ratified global agreements
Total national health expenditure related to GNP	Rate of change of school-age population	Maximum sustained yield for fisheries	Emissions of sulphur oxides	Intensity of material use	Main telephone lines per 100 inhabitants
Rate of growth of urban population	Primary school enrolment ratio	Algae index	Emissions on nitrogen oxides	Share manufacturing value-added (GDP)	Access to information
Per capita consumption of fossil fuel by motor vehicle transport	Secondary school enrolment ratio (gross and net)	Land use change	Consumption of ozone depleting substances	Share of consumption of renewable energy resources	Programmes for national environmental statistics
Human and economic loss due to natural disasters	Basic sanitation: % population with adequate excreta disposal facilities	Changes in land condition	Ambient concentrations of pollutants in urban areas	Net resources transfer / GNP	Representation of major groups in national councils for sustainable development
Percent of population in urban areas	Children reaching grade 5 of primary education	Decentralised local-level natural resource management	Expenditure on air pollution abatement	Total ODA given or received as a percentage of GNP	
Area and population of urban formal and informal settlements	School life expectancy	Population living below poverty line in dry-land areas	Generation of industrial and municipal solid waste	Debt / GNP	Contribution of NGOs to sustainable development
Floor area per person	Difference between male and female school enrolment ratios	National monthly rainfall index	Household waste disposed per capita	Amount of new or additional funding for sustainable development	
Infrastructure expenditure per capita	Women per hundred men in the labour force	Sustainable use of natural resources in mountain areas	Area of land contaminated by hazardous wastes	Environmental protection expenditures as % of GDP	

Table 7: Contd.

Social aspects of sustainable development		Environmental aspects of sustainable development (subdivided into water, land, atmosphere & waste)		Economic aspects of sustainable development	Institutional aspects of sustainable development
House price to income ratio	GDP spent on education	Population change in mountain areas	Waste recycling and reuse	Debt service / export	
	Adult literacy rate	Land affected by desertification	Municipal waste disposal	Capital goods imports	
		Satellite derived vegetation index	Chemically induced acute poisonings	Foreign direct investments	
		Welfare of mountain populations	No. chemicals banned or severely restricted	Share of environmentally sound capital goods imports	
		Use of agricultural pesticides	Generation of hazardous wastes	Technical co-operation grants	
		Use of fertilisers	Imports and exports of hazardous wastes		
		Irrigation percent of arable land	Expenditure on waste management		
		Energy use in agriculture	Expenditure on hazardous waste treatment		
		Arable land per capita	Generation of radioactive wastes		
		Area affected by salinisation and water-logging			

2.6.3 US Interagency Working Party on Sustainability

An Interagency working group was one initiative established in the US following the Rio Summit in 1992. The group developed a framework for organising indicators and proposed 40 indicators relating to various aspects of sustainability. The indicators proposed are tools for simplifying, quantifying and communicating vast amounts of information more meaningfully. They consider that useful feedback will be generated relating to the efforts of the nation towards sustainability – i.e. improved economic, environmental and social well-being. The 40 indicators (see Table 10) can be categorised differently within the framework (see Table 11) which organises them into long-term endowments and liabilities; processes and current results (each has a subcategory of society, environment and economy). The framework emphasises the links between inherited assets, actions taken and what is passed on to future generations. It also aims to encourage thinking in the three dimensions of environment, society and economy as a whole, rather than each in isolation.

Table 10. US Interagency Working Party Sustainability Indicators (US Interagency Working Party, 1998)

Economic	Environmental	Social
Capital assets	Surface water quality	US population
Labour productivity	Acres of major terrestrial ecosystems	Children living in families with only one parent present
Federal debt to GDP ratio	Contaminants of biota	Teacher training level and application of qualifications
Energy consumption per capita and per $ GDP	Quantity of spent nuclear fuel	Contributing time and money to charities
Materials consumption per capita and per $ GDP	Status of stratospheric ozone	Education attainment by level
Inflation	Greenhouse climate response index	Participation in the Arts and recreation
Investment in R&D as a % of GDP	Ratio of renewable water supply to withdrawals	People in census tracts with 40% or greater poverty
Domestic product	Fisheries utilisation	Life expectancy at birth
Income distribution	Invasive alien species	Educational achievement rates
Consumption expenditures per capita	Conversion of cropland to other uses	
Unemployment	Soil erosion rates	
% Households in problem housing	Timber growth to removal balance	
Home ownership rates	Greenhouse gas emissions	
	Identification and management of Superfund sites	
	Metropolitan air quality non-attainment	
	Outdoor recreational activities	

Table 11. US Interagency Working Party framework for Sustainability Indicators (after US Interagency Working Party, 1998)

Long-Term Endowments & Liabilities	Processes	Current Results
This category provides insights into possible future challenges by measuring the status of resources, capacities and liabilities that are passed onto future generations. They are the key to understanding the evolving and inter-generational nature of sustainable development. Example: capital assets or endangered species.	This category includes processes and driving forces affecting the "long term" or "current" categories. Often this is what must be changed to assist movement on the path towards sustainability. Example: investment in R&D; greenhouse gas emissions or births to single mothers.	This category illustrates the US progress (or otherwise) in improvements to current conditions or experiences. These are often high in the media. Example: gross domestic product; air quality or educational achievement.

2.7 The Role of Indicators Relative to other Management Tools

In general terms, there are two main problems in the implementation stage of environmental, social and economic strategies. First, some companies see the implementation of management systems and auditing procedures as sufficient action to protect the natural and social environment. They do not see (or consider) the need to develop a strategy per se. For example, in the context of environmental protection, with the achievement of an Environmental Management System (EMS) standard accreditation the company takes the risk of becoming complacent, and ignoring the need to control the impact of its activities on the environment. Furthermore, to its disadvantage, they might miss the opportunity to gain some of the aforementioned advantages.

Second, in the process of developing an environmental strategy, some companies ignore the need to consider and incorporate the internal and external opportunities and threats present in their environments. In order to set realistic goals and objectives companies need to assess the context within which the organisation is operating - externally and internally - and set objectives that will allow the organisation to survive and succeed within that context. The main aim of analysing the context is to set a direction where companies develop a strategy that creates a fit between the external situation (opportunities and threats) and internal capabilities of the company (strengths and weaknesses). These aspects have been extensively considered in the management literature, but seem to have been ignored in the environmental management field.

The following sections explore the relative role of indicators against a background of other management tools – it uses environmental performance indicators and environmental management tools as an example, as it is in these dimensions that the concepts are most advanced.

2.7.1 Use of Environmental Management Tools

One of the major problems of the growing "environmental challenge" is the lack of experience that companies have had in managing the environment. The need to minimise the impact of a company's activities in the environment in a systematic manner is a relatively recent phenomenon. Previously, environmental by-products arising from a company's production processes such as pollution or waste were treated as externalities, thereby remaining outside the companies' management responsibilities. Two arguments have developed since then. First, pollution and waste can be considered as an economic inefficiency that the company should manage in order to improve its business operations. Second, there has been an increasing demand that the socially and physically polluting behaviour of the firm be brought under control. In this new light, government, international organisations, and industries have had to develop tools that would enable them to manage their 'externalities'.

EMS standards and auditing procedures are two of these tools. There is a general consensus on the reasons why EMS standards have been developed, principally the need for a standardised approach to environmental management. Environmental auditing and subsequent environmental management systems were tools used in the US to cope with increasingly stringent legislation. The use of EMS standards attempted to rectify some of the shortcomings of previous environmental management procedures, which can be outlined as follows:

- The environment was disconnected from key business processes, and inadequate training was provided.
- Environmental management was used to manage problems rather than opportunities and was considered a cost rather than a resource.
- There was no accountability of managers responsible for environmental performance.[16]

In order to promote the use of EMS, the standards had to be promoted as means of achieving a number of tangible benefits. They were first seen as a quality approach to the environment. Industries in the 1980s experienced the rise of quality management standards, such as BS5750, which were well accepted and widely adopted. It has been said that the shift from quality assurance to total quality management can be compared with the environmental management trend from end-of-pipe pollution control to systems of integrated pollution control and environmental management.[17] Although the usefulness and role of these standards have been seen in different lights in the literature, there are a number of tangible benefits that companies would hope to achieve by implementing an EMS, the majority of which are financial benefits arising from cost savings due to more efficient resource consumption, reduced waste and compliance with legislation.

However, the implementation of an EMS has been regarded as a superficial move, in the same way as green advertising claims were in the 1980s. Companies that implement an environmental management system in isolation, tend to ignore the corporate strategy,

[16] Street P. and Barker B. 1995. Promoting good environmental management: lessons from BS5750. *Journal of Environmental Planning and Management,* v38, n4.

[17] Street P. and Barker B. Refer to footnote 12.

culture and structure of the company as a whole. Consequently the company treats environmental management as an add-on activity rather than an integrated aspect of their business activities. Companies that respond to the "environmental challenge" by solely implementing an EMS can be considered to be responding in a compliance only manner. In order to go beyond–compliance there is a need to develop an integrated environmental strategy that may incorporate an EMS as one of its management tools.

Academic and empirical literature coincides in noting the advantages of having an integrated environmental strategy. The main problem arising from the literature is the need to encourage companies to engage in such activities. The immediate effect was compliance strategy to cater for stricter regulatory standards. The implementation of an EMS as a more comprehensive responsive is the second effect. The main problem with this practice is that does not guarantee an improvement in a company's environmental performance, as there is a greater emphasis on the existence of a management system, than on the achievement of challenging environmental targets. Thus, the shortcomings that EMS standards tried to rectify still exist.

Whilst the development and prescription of EMS as a tool to improve environmental performance has been relatively successful, as witnessed by the growing numbers of certifications and environmental reports, (BATE, 1998), less progress has been made in the area of environmental responsibility, (Welford, 1997). Although environmental standards have checklists of organisation-oriented factors, little attention has been paid to how these less tangible elements of developing good environmental management should be operationalised, (Meima & Welford, 1997). Authors argue that unless companies work towards these additional goals, that include notions of cultural and value shifts, improved environmental performance will not be sustained in the long term, (Halme, 1997; Dodge, 1997).

Evidently, the challenge for EMS development is ongoing and it is suggested that true implementation only occurs when employees are adequately trained and involved in the decision making process. In their study of eight engineering companies in the Netherlands, Klinkers and Neilssen (1996) showed that corporate environmental care programmes30 were maximised by involving employees in environmental decision making. In particular, this practice served to raise environmental awareness, which brought positive gains in terms of improving measured environmental performance. At the Rover Group the development of an environmental policy and EMS was facilitated by engaging in strategic human resource management, (Pollack, 1996). This process recognised the importance both of human resource issues and of understanding the beliefs and assumptions channelling behaviour in the organisation, (Storey, 1995). In practice, this involved training environmental associates and facilitators at all levels of the organisation.

Developing environmental awareness demands training at appropriate levels and a prior assessment of training needs which should aim to identify the knowledge and skills gaps, (Emerson et al, 1997). Crosbie and Knight (1996) suggest that environmental training should be targeted according to the knowledge requirements of decision makers, ranging from board level and senior managers to general workers and those with specific environmental responsibilities. This theme is acknowledged by Bird (1996), who in addition

recommends seven key points in the successful delivery of training and awareness raising, based on a study of environmental training experiences at five UK organisations.

These studies suggest that awareness raising through training can improve EMS delivery and by association improve the environmental performance of companies. As environmental training remains in its infancy additional research is required to assess which mechanisms are most effective and to what extent organisations are building the necessary competency to deliver improving environmental performance in the long term.

Management tools, such as Sustainability Performance Indicators, have a role to play in assisting both companies and their stakeholders to assess the extent to which their production activities are contributing to, and not detracting from, sustainable development goals. However, Sustainability Performance Indicators are only one tool of several that can be used by companies within a social or Sustainability Performance Management System to support strategy aimed at ensuring their mining operations contribute to sustainable development over time. The other tools that require research and further refinement and integration include: Impact assessment - integrated (not just environmental and social) and inter-generational (not just at one point in time); partnerships; stakeholder dialogue; corporate social investment; capacity building, closure planning and professional development; social/environmental/economic accounting; sustainability reporting; and, auditing & verification.

2.7.2 Analysing Internal and External Environments

The problem with the need to develop and implement an environmental strategy is the need to create a set of policies and objectives that create a fit between the external and internal environments of the firm. The external environment of a firm constitutes all the external influences that impinge upon the firm's decisions and performance. For a company taking a stakeholder approach to managing the environment, these external influences would be its external stakeholders, such as industry competitors, contractors and suppliers, customers, regulators and local communities. The internal environment refers to the company's resources and capabilities. Analysing the internal environment involves seeking self-knowledge in terms of a thorough and profound understanding of the company's resources and capabilities.

The rationale behind analysing the internal environment is that the external environment is often a volatile and dynamic one. It therefore makes more sense to define a firm in terms of what it is capable of doing rather than the goals it needs to satisfy. In general the greater the rate of change in a company's external environment, the more it must seek to base its long term strategy upon its internal resources and capabilities than upon an external market focus. This is specifically relevant when it comes to planning an environmental strategy. The environmental literature and empirical research shows a volatile environment, where the concept of what companies are expected to do keeps on changing and expanding.

The general lack of insight into the need to incorporate the above factors into an environmental strategy has a significant effect on environmental performance as a whole. A company may try to implement a challenging and comprehensive environmental strategy

that meets the needs of the external stakeholders, but lack the internal resources to implement it. In a survey by the Institute of Directors, 37% of their members had never discussed environmental issues at board level.[18] This lack of commitment to environmental issues is a major constraint in achieving an improvement in environmental performance. A survey undertaken by Gibbon and Holland on the environmental practices of small and medium sized enterprises (SMEs) showed that out of those that had developed environmental policies, only 61% had undertaken any form of audit or evaluation.[19] The effectiveness and credibility of those policies not being monitored could be seriously questioned.

2.7.3 The Environmental Challenge for Management Theory

Traditional management theory has tended to ignore or underestimate the importance for businesses of managing the physical and social environment. Organisational studies, as a field, has not adequately addressed environmental discourses because of the limited ideas of 'organisational environment' that emphasises economic, social, political and technological environments.

Traditional Management Theories

There are three streams of literature that address the organisational environment as a theoretical construct:

- Organisational theory: the firm is regarded as an open system, but its influences are mostly economic and social. The business environment is divided into: the task environment, which influences narrowly defined tasks such as purchasing, sales and production; and the general environment, which refers to the broad social and economic range of organisations. Managers in these organisations enact their environments through their perceptions, personal biases and interpretation of environmental constraints, opportunities and threats.
- Strategic Management: this theory is based on the premise of firm competitiveness in free market economies. The environment is a multidimensional concept that consists of economic, social, political and cultural forces. The natural environment is outside the domain of their concerns. Environmental degradation is considered an externality.
- Corporate Social Responsibility: this theory provides a more liberal definition of the firm's environment. Organisational stakeholders provide one way of understanding the environmental influences of the firm. The public and its interest in the environment are therefore legitimate forces in strategy making. Many researchers in this field acknowledge that corporations have significant environmental side effects, so they seek to reform corporations and their production systems, products and waste management processes. They advocate regulations and voluntary corporate actions to achieve corporate reformation.[20]

[18] Welford R. (ed) 1996. *Corporate Environmental Management*. Earthscan Publications Ltd.
[19] Welford R. 1995. Environmental Strategy and Sustainable Development. Routledge. London.
[20] The summary of these definitions is taken from: Shrivastava P. 1994. Castrated environment: greening organisational studies. *Organisation Studies,* v15, n5, Winter.

The above definitions denote a marginalisation of the natural environment in the business context. It is therefore not surprising that present business practices and recent environmental literature fail to provide an integrated approach to the development of environmental strategies. It has been argued that in order to move towards an efficient approach that would bring significant and continuous improvement in companies' environmental performance industry needs to move away from the current management paradigms.

Criticisms of Traditional Management Theories

There is a strong argument advocating the fact that current management theory does not address ecological issues seriously. There is an increasing call for a paradigm shift away from a commercial attitude to a restoration of eco-systems, where the ultimate goal of business should not be to make money but to increase the general well being of human kind through service, creative invention and ethical philosophy.[21] Shrivastava (1995) clearly outlines the following limitations of traditional management theory to manage the environment.

- Denatured view of the environment: both strategic and organisational studies define the environment in terms of economic, political, social, and technological dimensions. There is no attempt at understanding how organisations have an impact on the natural environment, as it all focuses on how environments influence the organisation.
- Production/consumption bias: traditional management theory focuses on the productive activities of businesses that benefit stakeholders. This approach ignores the environmental destruction and harm caused by the production processes, such as environmental pollution, toxic products and wastes. Traditional management also emphasises the consumerist society ideal of the Western society, ignoring the danger of promoting unsustainable consumption patterns.
- Financial risk bias: traditional management practices are burdened with the definition of risk as related to economic returns and financial and product markets. They ignore the technological, ecological and health risks arising from industrial activities.
- Anthropocentrism: this is the most constraining limitation of traditional management theories. The emphasis is on the human being who, in the more radical anthropocentric form, has no moral obligation to minimise their impact on nature. The organisational exploitation of natural resources is legitimate, even desirable.

These limitations reflect the main criticisms of management theory. The present literature expresses the need to move away from this paradigm and develop a different way of looking at businesses, society and the environment. This implies a trade off between traditional management attitudes to more ecologically conscientious management. Such a trade off would be an important step in order to solve the present corporate environmental strategy issues, where the environment is not yet considered a priority in business. In order to integrate environmental strategies into the business activities, and make them work there is a need to reassess how businesses operate.

[21] Hawken P. 1995. A teasing irony. In Welford, R. and Starkey R. 1995. *The Earthscan Reader in Business and the Environment*. Earthscan, London.

2.7.4 Environmental Management Theory

There are several suggestions as to what types of changes business and management researchers should be considering when developing strategies to improve environmental performance. There is a need to refocus the organisational centre of gravity to address ecological degradation. The least radical form of change is a move towards corporate social responsibility in management. There are industry examples where companies have engaged in active participation with one or more of their stakeholder groups (working community, local, regional and global). Some mining companies, such as Rio Tinto, work closely with regional and local government, and community groups in order to understand their needs and concerns and be able to adapt and contribute to their culture in order to promote and encourage development. In a similar way, environmental pressure groups are now more active in engaging in talks and negotiations with companies in order to help them understand the environmental and social problems they face and help them manage them.

These are, however, examples of proactive companies. Corporate social responsibility activities are not widespread through industry and in some cases are used as a façade. Some of the literature calls for a greater trade off: that of giving priority to ecological/biological, ethical/moral, and social and political justice concerns.[22] Such a trade off requires the following:

- Moving away from measuring returns in terms of profits and economic returns and including at least environmental performance criteria
- Shifting the focus from the current economic orientation to an ethical one that includes the concerns and responsibilities of all stakeholders
- Viewing nature as an independent force rather than regarding it as a resource
- Create a more holistic understudying of economic and organisational development by finding environmentally sustainable economic-development strategies and lifestyles

This trade off has already begun to take place in the international arena. The notion of sustainable development suggests a shift away from traditional management theory. Advocates of the sustainability paradigm demand a complete notion of the external environment, an acknowledgement of the full range of the material, ecological and non-market exchanges with the physical, biological and broader sociological spheres.[23] There is a need to develop systems and ways in which this paradigm change takes place in a wider context, and not in isolated organisations.

2.7.5 Competencies

The development of competencies and competency-based strategies has grown in popularity in the early 1990s. These developments have been fuelled by a recognition that strategic change, (e.g. as required and driven by the new environmental agenda), involves a learning

[22] Shrivastava P. 1994. Refer to footnote 16.

[23] Gladwin, T.N., Kennedy, J.J. and Krause, T. 1995. Shifting paradigms for sustainable development: implications for management theory and research. *Academy of Management Review*, **20**(4), October.

process and the ability to reconstruct and adapt the knowledge base of an organisation faster than competitors in order to sustain a competitive advantage, (Sparrow & Bognanno, 1994).

The popularity of competency-based strategies in the management literature can, in part, be attributed to the work of Prahalad and Hamel (1990). They argue that in the 1990s, successful growth and competitive advantage will reflect the ability of companies to, "identify, cultivate and exploit core competencies", as opposed to improvements brought about through the restructuring and delayering exercises characteristic of the 1980s, (Prahalad and Hamel, 1990, p 79). In particular they suggest that the popular framework of the strategic business unit can actually stifle creative growth and that companies need to rethink their strategies, building on a basis of competency portfolios. Although the majority of authors agree with this synopsis, there is less unanimity on how competencies should be defined or characterised within an organisation, (Harvey and Lusch, 1997; Clarke and Pitt, 1996; Leonard-Barton, 1992).

Teece et al (1992, p 18, op cit) describe competencies as, "firm specific assets ... assembled into integrative clusters spanning individuals and groups ... that enable distinctive activities to be performed". More specifically, competencies consist of the expertise and knowledge accumulated by a firm over time, (Clarke & Pitt, 1996). In adopting knowledge-based view of the firm Leonard-Barton (1992) distinguishes competencies on four dimensions. She suggests firstly that competencies are "embodied in (1) employee knowledge and skills and embedded (2) in technical systems. These processes are guided and controlled by (3) managerial systems, (1992, p 113, (original emphasis)). The fourth component comprises values and norms that run throughout the first three dimensions.

Emerging from the literature is an understanding that competencies are difficult to define, (and as a consequence to protect), due to their intangible nature. Frequently, skills, resources and to large extent technologies, are comprised of tacit knowledge possessed by, and shared amongst, individuals within an organisation, (Clarke and Pitt, 1996). Further this experiential knowledge often remains uncodified or does not lend itself readily to documentation. Yet in spite of their elusiveness, authors appear confident that competency issues will,

> become central to the determination of effective management ... as the importance of intangible assets increases,

(Harvey and Lusch, 1997). Of specific importance has been the recognition that competencies are composed both of,

> technological expertise (products and processes) and the organisational capacity to deploy that expertise effectively,

(Coombs, 1996, emphasis added). This skills composite, comprising a number of key competencies has been referred to by Prahalad and Hamel (1990), as an organisation's 'core competence'.

Core Competencies

Core competencies are distinct in that over time, particular combinations can confer specific advantages to an organisation. Prahalad and Hamel (1990, p 84-85) suggest that core competencies may be identified by three tests:

- A core competence provides potential access to a wide variety of markets
- A core competence should make a significant contribution to the perceived customer benefits of the end product
- A core competence should be difficult for competitors to imitate

In other words when in-built, core competencies should be capable of differentiating a firm from its competitors and, if nurtured and protected, provide competitive advantages into the future. As an example, the authors cite Honda's engine expertise which has been developed into world beating products despite having a smaller R&D budget than its competitors who frequently lose their long term competitive edge by outsourcing products, (and by definition competencies), as a shortcut to a more immediate competitive product. Even where particular products derived from competencies are unsuccessful, the intrinsic value of developing a new skills base can be justified. For example, Sony lost the battle over video recording equipment in the 1980s but by retaining video-related competencies the company is now able to challenge competitors in the camcorder market. One of the strengths of these companies has been their ability to redeploy and adapt their core competencies to a changing product market. However, the recognition that past practices, skills, managerial systems and values may not be appropriate for new projects presents a challenge to many companies. Leonard-Barton, (1992) has identified this property of core competencies, which can inhibit development, as core rigidities.

Whilst rigidities can affect all projects Leonard-Barton (1992) showed that these issues were more problematic for new projects that, from the outset had been designed to extend existing competencies, or introduce new ones. For example, changing a technical system may primarily require upgrading existing computer facilities whereas altering the values associated with a previous way of working impinges on cultural issues which are less amenable to change, particularly in the short-term. The greater the number of dimensions misaligned with the new project goals the more difficult it becomes to execute the project successfully. Leonard-Barton (1992) observed that when faced with this paradox projects were often abandoned or managers returned to the familiarity of existing competencies.

It is clear, therefore, that competencies can represent both strength and weakness and that the ability of a company to identify and use these resources successfully depends largely on a combination of managerial and organisational capacity. In particular, delivering successful environmental management programmes and innovations requires managers to cultivate and actively develop new skills and knowledge in tandem with new technological capabilities.

Environmental Competencies

It appears that the development of appropriate competencies will become an important factor in the success of organisational environmental initiatives and, as noted in relation to EMS, this factor has been acknowledged in the blueprint of management standards. However, although management theorists would argue that organisations are increasingly competence intensive, (Teece et al, 1990), most organisations lack environmental competence since it is a new field of knowledge and action, (Dobers and Wolff, 1996).

We have observed above, that appropriate and targeted training will become increasingly important if environmental management systems and programmes are to deliver results over time. Further, it was suggested that additional research is required to establish which training mechanisms are most effective in raising and maintaining awareness. In working towards these goals Dobers and Wolff (1996), posit that firms should aim for four elements of environmental competence.

First, managers should be capable of using an inter-disciplinary knowledge base. This element recognises the need for an understanding of the legislative, political, social and economic facets of environmental issues. Second, managers must be confident in their ability to facilitate inter-organisational relationships. We have observed that the environmental effects created by mining activities generate a series of issues on contact with different stakeholder groups. Engaging and communicating with a broader spread of stakeholder groups requires a social competence beyond traditional management boundaries. Third, companies should work towards the integration of environmental technology into multi-technology operations. Although legislative changes may be the primary driving force in technological improvements, evidence from the mining industry suggests that companies working with, and actively implementing environmentally progressive technologies are more successful and proficient in their overall environmental management programmes, (Warhurst & Bridge, 1997). Finally, managers should strive to create a value-driven discourse. This supports the argument that only through significant cultural and strategic change will organisations be capable of fulfilling sustainable development driven objectives, (Halme, 1997; Dodge, 1997). This is especially important if, as authors suggest, the environmental (and increasingly, the social) agenda continues to initiate a reengineering of industrial life.

2.8 Further Examples of Sustainability Indicator Systems and Reporting Initiatives and their Relevance to the Mining Sector

2.8.1 Introduction

Table 12 reviews an extended selection of Corporate Sustainability Indicator/Reporting initiatives based on a survey by Ranganathan (1999) with amendments by the MERN team. These are given under the headings of Environmental Performance Measurement, Social Performance Measurement and Integrated Measures of Business Sustainability. Economic performance is accounted for in a number of these initiatives.

Table 12. Overview of reporting and indicator initiatives, and relevance to the mining sector

INITIATIVE/COMPANY	WEB/EMAIL ADDRESS	OVERVIEW	RELEVANCE TO MINING SECTOR
Integrated Measurement			
The Columbian Business Council for Sustainable Development (CECODES)	cecodes@colomsat.net.co	Includes 37 large firms and two business associations covering: mining, oil, construction, manufacturing, agro-industry, commerce, insurance, and banking. Environmental indicators are standard, but 'social responsibility' measurement includes investment per direct employee above legal requirements of salaries and compensations	High (particularly environmental indicators), but mainly within the Columbian/South American context.
McDonough Braungart Design Chemistry - Product Sustainability Index	http://www.mbdc.com/	Index uses three interdependent categories (ecology, social equity and economy) to assess existing products and approach redesign	Low – product orientated, but may become significant if mining sector begins to analyse and integrate downstream (product) use of its outputs
Oko-Institut Product Sustainability Assessment Tool	http://www.oeko.de/deutsch/chemie/hoechste.htm	Product sustainability assessment tool (PROSA) for rating the sustainability of new product design and business development efforts	Low – product orientated, but may become significant if mining sector begins to analyse and integrate downstream (product) use of its outputs
The Sustainability Product Wheel	100760.1270@compuserve.com	The wheel is structured into four rings: customer value, physical environmental impacts, product attributes, and social impacts and provides a simplistic assessment even in the absence of complete data and highlights key problems	Low – product orientated, but may become significant if mining sector begins to analyse and integrate downstream (product) use of its outputs. May be subsumed by Dow's Eco Compass

Table 12. Contd. Overview of reporting and indicator initiatives, and relevance to the mining sector

Integrated Measurement			
Wuppertal Sustainability Indicators	http://www.wupperinst.org	Propose both macro (country) and micro (business) indicator, as well as interlinkage indicators for macro-level policy analysis. Environmental indicators include: resource intensity (produced goods or services per material input, land input, or energy input) and transport intensity. For business social sustainability, the authors have adapted the UNDP human development index to form a Corporate Human Development Index (three main components of which are quality of industrial relations and labour conditions; education; and income level and distribution)	Low for environmental indicators – product orientated, but may become significant if mining sector begins to analyse and integrate downstream (product) use of its outputs. Corporate Human Development Index may be useful in the formal mining sector
Environmental Performance Measurement			
American Institute of Chemical Engineers	http://www.aiche.org/docs/cwrt	Center for Waste Reduction Technologies is undertaking a collaborative project to develop sustainability metrics. The project aims to develop a group of core and optional metrics for each of the seven areas of eco-efficiency promulgated by the World Business Council on Sustainable Development	High
Canadian National Round Table on the Environment and the Economy	http://www.nrtee-trnee.ca	Eco-efficiency Task Force, in collaboration with the WBCSD, is developing eco-efficiency indicators: materials intensity, energy intensity, and pollutant dispersion.	High – Noranda Mining and Exploration Inc have piloted materials intensity and energy intensity indicators

Table 12. Contd. Overview of reporting and indicator initiatives, and relevance to the mining sector

Dow Eco-Compass	http://www.dow.com/cgi-bin/frameup.cgi?/environment/ehs.html	Dow Chemical has developed an Eco-Compass to provide a simple, visual summary of the life-cycle data analysis – the eco-compass has six 'poles' -- energy intensity; mass intensity; environmental and health risk potential; sustainability of resource usage; extent of reuse, remanufacturing, and recycling) and service intensity	Low – product orientated, but may become significant if mining sector begins to analyse and integrate downstream (product) use of its outputs
ECO-Efficiency Assessment Per Unit of Service	N.vanNes@IO.TUDelft.nl	The metric focuses on the utility of a product in relation to the burden it imposes on the environment.	Low
The European Chemical Industry Council	http://www.cefic.be/	The guidelines on environmental reporting, developed in 1993 as an extension of Responsible Care's public disclosure requirements, cover four areas of disclosure: corporate environmental reports, site environmental reports, standard emissions inventory, and a "do's and don'ts" of reporting	High, but subsumed by GRI
GEMI Primer on Measuring Environmental Performance	gemi@worldweb.net	The US Global Environmental Management Initiative (GEMI), a partnership of 21 leading companies committed to environmental excellence released a publication entitled 'Measuring Environmental Performance: A Primer and Survey of Metrics in Use'	Medium – the primer examines the design of an EMS through the use of performance indicators

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

International Standards	http://www.iso.ch	The International Standards Organisation's draft	High – fundamental to the

Organisation – ISO 14000 series		guidance on environmental performance evaluation, (ISO 14031), categorises indicators into three basic types: environmental condition indicators, operating performance indicators, and management performance indicators.	development of indicators
Investor Responsibility Research Center	http://www.irrc.org/profile/index.html	IRRC collects information on more than 1500 companies and calculates three indices of environmental performance: an emissions efficiency index, a spill index, and a compliance index. Each company specific index is plotted over time against an industry wide index, to facilitate comparison with industry wide performance.	High
National Academy of Engineering		Established a committee on Industrial Environmental Performance Metrics to examine the current state of art in measuring industrial environmental performance in four industrial categories: automotive, chemical, electronics, and pulp and paper.	
Management Consultants	tfitch@kpmg.com	Environmental Management practice of KPMG Peat Marwick, for example, has developed a balanced scorecard approach to environmental performance measurement. This proprietary tool creates a system for generating key performance	Medium – at corporate rather than site level

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

		indicators for environmental management systems. Metrics are developed in four areas – financial, customer/stakeholder satisfaction, business	

		process, and organisational learning and innovation	
NPI Global Warming Indicator	http://www.npi.co.uk/globalcare/	The UK based NPI Global Care Investments, an environmental and social investment fund, has developed a draft corporate global warming indicator. The indicator calculates an aggregate and normalised measure of a firm's carbon dioxide equivalent emissions. The index sums emissions from transport use, energy use, and process related emissions and then normalises by unit turnover	High
Verein fuer Umweltmanagement in Banken, Sparkassen und Versicherungen	101330.3112@compuserve.com	VfU, the Association for Environmental Management in Banks, Savings Banks, and Insurance Companies, is a German based organisation set up in 1994 to develop and help implement industry specific strategies and tools for environmental management in the banking and insurance industries. VfU has published a guidance document for environmental reporting that defines eleven metrics: two for energy consumption, one for water consumption, three for paper consumption, three for waste generation, two for business traffic (in km/yr/employee) and one for C02 emissions	Potentially high

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

WBCSD Eco-efficiency Metrics and Reporting Project		The World Business Council for Sustainable Development (WBCSD), an association of leading companies from around the world, has launched	High

		on eco-efficiency metrics project. The project intends to define a standardised set of metrics for eco-efficiency for use by member companies and has produced "Measuring Eco-Efficiency: a guide to Reporting Company Performance" (WBCSD 2000). This report only includes indicators for quantity and value of company products and does not consider indicators of product use downstream in the supply chain.	
World Resources Institute (WRI)	http://www.wri.org/meb/	In a recent report, Measuring Up: Toward a Common Framework for Tracking Corporate Environmental Performance, WRI calls for, and proposes, a universal framework for tracking corporate environmental performance. This framework embraces four key categories of environmental performance indicators that were chosen to focus business on preventing pollution and boosting resource efficiency. The four categories of indicators are: materials use, energy consumption, non-product output (a measure of waste generation), and pollutant releases.	Medium – may not take due account of the limits to minimising waste generation in the mining sector

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

Social Performance Measurement

Ben & Jerry's	http://www.benjerry.com	Since 1988, Ben & Jerry's, a Vermont based ice cream company, has published an independently	High

		audited social report as part of its annual financial report. The social report, like the Body Shop's, is constructed around Ben & Jerry's key stakeholders and includes the results of an employee work life survey that addresses such issues as satisfaction with pay, working conditions, job security, etc.	
The Body Shop International	http://wesley.stanford.edu/faculty bios/fhansonk.html	In 1995 Kirk Hanson, at Stanford Business School, conducted an independent evaluation of the social performance and impact of The Body Shop. The company was rated on 39 dimensions of social performance, organised primarily by the stakeholder that is affected by the performance. For each criterion the company was given a rating between one (much worse than comparable companies) and five (much better)	Medium – retail context does not translate directly to extractive context
Center for Economics Priorities Accreditation Agency - Social Accountability Standard	http://www.cepaa.org	The Center for Economics Priorities Accreditation Agency (CEPAA), an arm of the New York based Council for Economic Priorities (CEP) rates companies against social and environmental criteria and has published a social accountability standard focusing on ethical sourcing (SA 8000). Specific requirements are set	High

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

		out on child & forced labour, health & safety, union matters, discrimination, compensation,	

		working hours, and management systems. The standard was developed by a coalition led by CEP and CEPAA and is based on conventions of ILO, Universal Declaration of Human Rights, UN Convention on Rights of the Child.	
International Labor Organisation Human Development Enterprise Index	http://www.ilo.org	The International Labour Office has developed an index to measure the orientation of enterprises toward human development. The index, an amalgam of three individual indexes, covers enterprise skill formation; work security and social equity (non discriminatory Labour practices); and economic equity or earning differentials between employees.	High
New Economics Foundation	neweconomics@gn.apc.org	New Economics Foundation has an indicators programme that focuses on developing indicators of quality of life and sustainable development. The programme spans all levels at which decisions are made – local, organisational, national, and international. At the business level work on environmental and social performance indicators is focused via social audits	Medium – primarily product orientated

Table 12 (cont'd). Overview of reporting and indicator initiatives, and relevance to the mining sector

WBCSD Corporate Social Responsibility Project	http://www.wbcsd.ch/	WBCSD is a coalition of 125 international companies that aims to develop closer co-operation between business, government and all other organisations concerned with the	High

		environment and sustainable development. WBCSD has formed a Corporate Social Responsibility working group to develop a common understanding of what this means for companies in the different contexts and conditions in which they operate. The working group is approaching this task on three tiers: scoping/mapping the boundaries; practice; and, measuring, assessing, reporting.	

2.9 Conclusions

The original terms of reference for this report included a number of questions as noted below: these are answered based on the analysis presented in this chapter:

- What are the characteristics of and similarities and differences between the various systems currently in use to measure or rate environmental and social performance in the mining and minerals sector?
  It is clear from the analysis that the most highly developed indicators and indicators systems are those relating to the most tangible of the three dimensions – that is, the environmental dimension. This is reflected in Tables 2 and 3, where environmental 'applications' of the indicators predominate. This is in fact the principal similarity between the systems summarised in Table 3 – although they incorporate social and economic aspects there is clearly a focus at the present time on the environment. The differences relate to the perspective taken in the derivation of the indicator types (Table 2). Perspectives can be technical vs. non-technical, internal vs. external, qualitative vs. quantitative and so on. The chosen perspective relates to the requirement to communicate with specific stakeholders – therefore in part the differences are stakeholder-driven (in those cases where companies are responding to stakeholder pressure or requests). This is not necessarily a negative point, but it does serve to demonstrate that there is no single set of Sustainability Indicators that is relevant to all (or perhaps even many) stakeholder groups and there is a reliance instead on the use of specific sub-sets to meet the requirements of stakeholders.

- What are the drivers, rationale and assumptions, explicit or implicit, behind the current systems?
  The global and site level drivers behind the development of indicators and indicator systems were reviewed in section 1.3. Although these are many and varied, all carry within them the central theme of reporting to external stakeholders, irrespective of the nature of the information that is to be transferred or the nature of the stakeholders. The refinement of appropriate methods to ensure the relevance of performance indicators and their reflection of different stakeholder perspectives, including vulnerable stakeholder groups remains the principal driver at the present time – many of the other drivers have already played their part in the development of indicators and indicator systems and can now be considered secondary drivers in many cases.

- Who developed them, why and how?
  Table 3 includes information on the developers of the reported indicator systems, while Table 4 reviews major reporting initiatives. In broad terms generic or 'off the shelf' indicator systems have been developed by institutional reporting initiatives while 'tailor made' indicator initiatives have generally been developed to address key sustainable development challenges perhaps in the area of human rights or following an environmental incident. The latter are more specific and tied to either individual sites, regions, activities and incidents, and consequently the developers are nearly as numerous as these four aspects. This underlines the problems of standardisation, and explains in part the significance of, and requirement for, standardised, off the shelf approaches – what these lose in their specificity they gain in the transparency and ease with which a range of sites may be compared.

- What processes if any were put in place for dealing with uncertainty, for learning and for revision?
  There is only limited literature available that relates to the development processes and the incorporation of capacity to deal with uncertainty. More information is available that relates to learning and revision, but again this is primarily in the environmental dimension and often linked to a formal Environmental Management System methodology. Given the present predominance of off the shelf type approaches, the degree of responsiveness to uncertainty is likely to be limited by the need to address situations at a large number of varying sites – these are 'broad brush stroke' indicators, and uncertainty may occur at too fine a level to be readily detected or accounted for in generic systems. Alternatively, tailor made approaches developed collaboratively within the company alongside consultants are more likely to promote learning, and to leave in place methodologies capable of being adapted to manage uncertainty and change.

- What are the advantages and disadvantages of the various systems from different stakeholder perspectives and what are their most contentious aspects?
  Table 6 reviews the strengths and weaknesses of various systems. Generally, most are developed from the company perspective or from a broad public interest perspective. There exist few systems capable of commenting from multi-stakeholder perspectives least of all from a community or ethnic minority perspective, and this is one of the greatest disadvantages and contentious aspects.

- What needs to be done either to strengthen existing systems or develop an alternative system?
  There is a need to develop a combined off the shelf 'top-down' and tailor made 'bottom-up' approach and to develop business practice indicators that can assure investors that a proficient sustainability performance management team and system is in place. This concept is explored in greater depth in Chapter 3, below.

- What information needs to be in the public domain to facilitate measurement and evaluation of sustainability performance?
  A great deal of information exists in the public domain, so the question should perhaps relate more to how to facilitate knowledge of its existence and access to it. Economic data is essential to the development of economic performance indicators, however, this may be sensitive and confidential, and special provision must be made for access without transfer to the public domain. There is a need for more transparency with respect to resource rent agreements and the type of tax frameworks negotiated for each project, its time horizons and the nature and extent of adjustments made to ensure that economic benefits are transferred back to benefit the host communities of mining operations especially where there are fragile ecosystems and vulnerable communities.

- What lessons can be learned cross-sectorally about the measurement of sustainability performance?
  The oil and metals sectors can provide useful lessons with respect to disseminating information about their approaches to Sustainability Indicators and the management of sustainability performance. These lessons are explored in the following chapter.

3 Case Studies of Sustainability Indicators and the MERN Sustainability Performance Management System

3.1 Introduction

This chapter reviews MERN research in developing tailor made approaches to the development of Sustainability Performance Indicators and sustainable development management systems for the non-ferrous metals, oil & gas, power plants and mining sectors. These are detailed below.

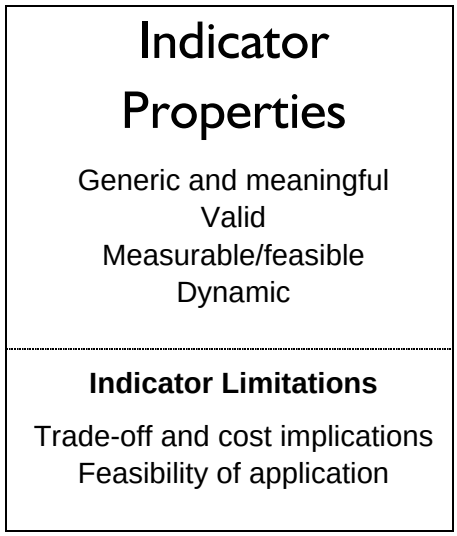
3.2 Sustainability Indicators for The Non-Ferrous Metals Sector

The UK non-ferrous metals sector comprises 332 firms producing zinc, lead, nickel, copper and aluminium. It employs over 36,000 people and has an annual turnover of £4.5 billion. The sector through its association the Non-ferrous Alliance (NFA) decided that it would work with MERN to develop a framework of Sustainability Indicators to be able to track and report on progress of member companies towards UK and global sustainable development goals. The MERN team consisted of a project co-ordinator and specialists in the environmental, social and economic dimensions of sustainable development with a strong team approach to methodological development, the scoping of issues and indicator testing. There was also close contact with the project sponsors – the NFA and DTI, during the course of the project with regular (typically monthly) meetings held between NFA directors, DTI representatives and the MERN team.

3.2.1 MERN & Sustainability Indicators

Within MERN, the research took as a starting point the concept of sustainable development as a sustained improvement in human health and well being, quality of life, and ecosystem health. As a consequence, Sustainability Indicators for MERN are about communicating meaningfully to different stakeholders the extent to which an operation, project or initiative (in this case the UK non-ferrous metals sector, and its member companies) is contributing to, or detracting from, the health and well-being and quality of life of individuals and communities and also to ecosystem health. From a management system perspective, MERN considered that there was a need to develop indicators that are meaningful at a company level (in the first instance) to help business understand the actions that need to be taken to ensure its activities contribute towards sustainable development.

Box 3-1 Properties of MERN indicators



Box 3-1 captures the properties of indicators in terms of both the characteristics of a "good" indicator and their limitations. Research also suggests that the indicators chosen must be generic and therefore transferable, and meaningful to different stakeholders and potential users across business, government and civil society. Some indicators that can be suggested will be more relevant or acceptable than others for different groups of stakeholders. However, all must ultimately be comprehensible and capable of communicating meaningful progress, or otherwise, towards sustainable development goals. Suggested indicators must also be scientifically valid, cost-effective, measurable and feasible to collate. They must be capable of indicating progress over time and therefore must have a dynamic quality and be capable of capturing both positive and negative qualities.

In constructing the indicators framework there was an awareness of limitations such as the trade-offs that may be implicit in selecting one indicator over another – e.g. a contribution to local employment may be a useful indicator for government while efficiency and an optimally 'down-sized' work force may represent a key constituent of economic competitiveness and therefore a useful Sustainability Indicator for business. Also some indicators may be more costly to employ and report on than others. The process of developing and reporting against indicators should not detract from the business goal of economic efficiency.

The social sustainability issues and indicators developed by MERN for the NFA represents an amalgamation of existing company, research and governmental social issues and indicators and existing standards and regulations. These are complimented by sector specific issues and indicators derived from the researchers own expertise and experience and from stakeholder input through field research. The issues and indicators have been selected to be generic enough to be applicable and comparable to different indicator models in different companies, industries and sectors, both in their content and their presentation, while being tailored to the specific operating environment of the non-ferrous metals sector in the UK. As such, the indicators developed by MERN have a generic and a more sector specific component.

The social sustainability issues and indicators developed by MERN for the NFA were selected to encompass all significant areas of corporate social responsibility. As such, they are designed to be comprehensive and manageable rather than exhaustive and inoperable. Nevertheless, many smaller companies adopting the social indicator model, may, for financial or logistical purposes, require a more restricted collection of core social indicators, on which they can draw and utilise. Given that the indicator model has evolved holistically, highlighting core issues and indicators is potentially problematic. In particular it is complicated by the fact that stakeholder interests and concerns will vary from site to site, depending on the size and type of business unit and its social operating environment and an a priori indicator focus cannot account for this.

3.2.2 Indicator And Issue Categories

The MERN approach to developing indicators is 'issues-based'. Issues are derived from a combined process of top-down expert driven categories – that is, through reference to expert knowledge and existing 'off the shelf' indicator categories and 'bottom-up' stakeholder scoping exercises where information is gleaned from interviews and observations through site visits and public consultation. Research has suggested that the issues and indicators that are identified need to be categorised and be of a manageable number. During this research, indicators and issues were arranged according to three generic MERN categories:

- Level I: relates to the contribution that the UK non-ferrous metals sector makes to the aims and objectives of global sustainability.
- Level II: relates to the UK non-ferrous metals sector, or in a limited number of cases within that sector, to large business units.
- Level III: relates to the individual companies that make up the UK non-ferrous metals sector.

To assist in understanding the interrelated nature of issues and indicators, the following points should be considered:

- While indicators are derived from consideration of issues, issues cannot be generated from indicators. Therefore, in any process to define suitable indicators, a comprehensive review of issues must be undertaken first.
- By definition, Level I issues are 'Environmental Sustainability', 'Social Sustainability' and 'Economic Sustainability'. These are the "three pillars" of sustainable development and represent the end goal for the UK non-ferrous metals sector in contributing to global sustainable development.
- Level II issues can be defined by a 'top-down' approach where each Level I issue is split into two or more issues that are relevant to the sector. Alternatively Level II issues can be defined by a 'bottom-up' approach where Level III issues relevant to individual companies are aggregated to form the Level II issues, informed by the 'top-down' approach.
- Level III issues are defined at company-level, and can be aggregated to generate sectoral Level II issues. While it is theoretically possible to split Level II issues to produce Level III issues, this approach was not considered practical in the context of this project.

- Unlike issues, the relationship between Level I, II and III indicators is one that is linear and one-way only. Level III indicators can only be derived from Level III issues. Similarly, Level II indicators can normally only be generated by aggregation of Level III indicators, not by splitting Level I indicators. There are a few rare exceptions to this rule where indicators that are not relevant at the company level are significant at the sectoral level (e.g. recycling of metals). In these cases, a Level III issue leads directly to a sectoral Level II indicator. Level I indicators are produced only be aggregation of Level II indicators.
- Finally, it should be noted that aggregation works only vertically within each of the three dimensions of sustainability, and not across them.

Box 3-2 Sustainable Development goals

Social Sustainability

- Enhanced health & wellbeing; social equity and human rights protection and promotion.

Environmental Sustainability

- Environmental management and clean technology diffusion.

Economic Sustainability

- Sustainable economic performance and enhanced intra- and inter-generational equity with respect to economic welfare.

3.2.3 Methodological Background

Beginning with the provisional working Global Sustainable Development Goals (Box 3-2) based upon Agenda 21 (UNCED, 1992) and the Universal Declaration of Human Rights, as noted above a combined 'bottom-up' and 'top-down' approach was adopted. This lead to the development of the Sustainability Indicators Frameworks. Three individual frameworks were developed: one for each of the environmental, social and economic dimensions.

In summary, the methodology was implemented in seven key stages:

1. An initial assessment of the industry and review of the issues associated with its potential environmental, social and economic impacts. In addition, the impacts of the environment, communities and the economy on the non-ferrous industry were also considered. This generated a large number of issues, of varying levels of relevance and significance.
2. During the assessment of potential issues, work was also undertaken to identify stakeholders that had a significant interest in the UK non-ferrous metals sector. The most important stakeholders included employees, customers, suppliers, local communities, regulatory bodies, and environmental/public interest pressure groups. Some of these were consulted throughout the project in order that they could have an input into the work from outset to completion (although not all participated in each

stage of the project). A survey was sent to a number of stakeholders to assist in this process.

3. Preliminary visits were made to a representative group of industrial operations in order to consult formally and informally with employees and managers. All sites had been sent in advance a standard information sheet outlining the aims of the project, the purpose of site visits and asking a set of key questions about the operation of the site. The findings were then used to revise MERN's initial assessment of potential issues and assist in the preliminary development of issue-specific performance indicators.

4. Based on the revised assessment of potential environmental, social and economic issues, plus consultation with the industry, the NFA and other interested groups, MERN drew up three provisional lists of indicators, for environmental issues, for social issues and for economic issues, respectively. These lists then formed the basis of further work.

5. A further round of more formal industry employee consultation was then undertaken – an employee survey was presented to all companies taking part in the second round of site visits (see 6, below). The researchers used interviews and also enabled some respondents to complete and return the survey independently. All of those interviewed took part enthusiastically, entering into the discussion with the researchers and contributing their opinions, which were then used to ensure that the coverage of issues was still valid.

6. Having developed the three provisional lists of indicators, and following detailed feedback from NFA directors and DTI representatives, a second set of site visits was undertaken in order to validate the indicators with the site representative and so to assist in the process of selecting those that are the most significant and useful indicators. In particular, each manager was asked to assess every proposed indicator relevant to his/her site based on availability of information, confidentiality and ease of use. Ideas for modified or alternative indicators were also requested where managers perceived problems might emerge with the management of those developed by MERN. A useful overall finding from this part of the consultation exercise was the high degree of consensus on which proposed indictors were most readily implementable and which needed to be refined, removed or reserved for possible future use.

7. A final stage in validating the lists of indicators was undertaken using a survey of NFA member companies. This was co-ordinated by the NFA in order to maximise the response rate, and respondents were simply asked to indicate the feasibility of use of each proposed indicator at their site by simply indicating "yes" or "no" in the appropriate column. Again an important finding was the high degree of consensus on the most workable and least workable proposed indicators.

The grouping of issues and the selection of indicators was guided by a 'top-down', expert-driven working framework, complemented by a parallel 'bottom-up' approach that involved interviewing or surveying internal and external stakeholders, in order to define the issues of concern that selected stakeholders of the industry wished to see addressed. It also defined what for them would constitute progress, so as to guarantee positive contributions to the three sustainable development goals noted in Box 3-2. The sustainable development goals in part define the types of outcome that the non-ferrous industry will need to generate in order to contribute to, and not detract from, the sustainable development process.

3.2.4 Project Consultative Process

A central part of the project approach alongside desktop research ('top-down' approach) was consultation with industry and other stakeholders ('bottom-up' approach). This was undertaken during issues scoping and assessment prior to the development of a working framework of business practice Level III indicators and the piloting of the proposed indicator framework.

Stakeholders may be individual persons, groups who share a common issue, or coalitions mobilised around a specific objective or issue. Alternatively, a stakeholder is a person or organisation who impacts upon, or is impacted by, the company. MERN's proposed stakeholder consultation programme was designed to obtain comments on:

1. The extent to which the Sustainability Indicators concept developed by MERN for NFA was perceived by stakeholder groups to be appropriate
2. Alternative categories, issues, indicators and parameters identified or developed by other stakeholder groups during the consultation process

Stakeholder identification involved:

- Desktop research to identify stakeholder categories. This identified two principal stakeholder categorisation frameworks. The first was derived from the International Finance Corporation (1998). The second is outlined below, and is derived from Wheeler and Sillanpaa (1997):

  (a) Primary stakeholders (social) e.g. shareholders, partners, employers, employees, customers, suppliers, local community

  (b) Primary stakeholders (non-social) e.g. future generations, non-human species

  (c) Secondary stakeholders (social) e.g. regulatory bodies, social pressure groups and competitors

  (d) Secondary stakeholders (non-social) e.g. environmental pressure groups and animal welfare organisations

- Desk research and consultation with the NFA and their business associates to identify stakeholder groups and issues falling within Wheeler and Sillanpaa's (1998) stakeholder categorisation framework. A number of key primary stakeholder groups were identified and consulted through the "issues scoping" site visits. Twenty-nine key secondary stakeholder groups were identified.

- Consultation with stakeholder groups identified through desk research and by the NFA and their business associates to identify further stakeholder groups and issues. Although a very small number of such stakeholder groups were identified, limited project resources and time prevented their inclusion in the consultation process.

3.2.5 Stakeholder Consultation

The two principal methods of enquiry that were employed to consult stakeholders were semi-structured interviewing and surveying. Semi-structured interviewing is defined as being 'based on a checklist of general questions which can be revised at any time, leaving a degree of flexibility, so that other issues raised during the interview can be explored' (Mikkelsen, 1995). This was the principal method of enquiry used to consult primary stakeholders during site visits undertaken by the MERN team to outline the key issues relevant to the non-ferrous metals industry. In addition to the scoping of key issues, semi-structured interviewing was also the principle method of enquiry to consult primary stakeholders on the indicators generated by MERN.

Surveying is a well-established method in social science, aiming to give systematic, representative and reliable information from, or about, a defined population (Easterby-Smith et al., 1991). Under this research programme, surveying refers to questionnaires administered to specific stakeholder groups; in this instance to key representatives of secondary stakeholder groups.

3.2.6 Consultations for issues scoping and assessment

Issues Scoping Site Visits

A key activity undertaken by the MERN team concerning scoping of issues was a series of visits to non-ferrous metal industry sites. The purpose of this first set of visits was:

- To improve understanding of and gain feedback on the economic, environmental, technical and social issues pertaining to the industry at company level.

- To explain the aims and relevance of the project to company managers and establish a rapport which would benefit the project during the development and piloting of the business practice indicator framework.

- To provide a key input alongside other stakeholder consultation and desk research to the development of the business practice indicator framework. Site managers were also asked for their comments on metals use in society as an input to the development of product use indicators.

Industry Employee Consultation

One approach used by the research team to obtain stakeholder opinions from those within the industry was the use of a "Pilot Employee Survey". This is a management tool originally developed by MERN team members in conjunction with a research partner company in the oil industry. The survey was deployed in that company with extremely high response rates and became an important tool in providing measurement targets and indicators for the oil

company[24]. It became one of the research objectives of the NFA project to assess whether the survey would be appropriate for use by the UK non-ferrous sector.

The employee survey was presented to all companies taking part in the second round of site visits (Piloting visits - see below) during which consultations on the business practice indicators framework were undertaken. The survey was used to gather responses from employees across all grades of employment.

Some of the companies at this stage, whilst happy to assist in the refinement of the business practice indicators framework, were not willing for employee feedback to be collected in this way. Problematic industrial relations situations were cited as a reason. In itself, this shows that social issues in the industrial relations arena may be sensitive in some parts of the industry.

The survey was utilised at several of the MERN site visits but, due to a limited number of interviews and returns, it has not been possible to make any useful statistical analysis of the responses. In some cases the language on the questionnaire was challenging and, should the industry choose to use this tool in any future stakeholder consultation exercises, it is recommended that the language be simplified.

The research aimed to use both an interview situation and also for some respondents to complete and return the survey independently of the researchers. All of those interviewed took part enthusiastically, entering the discussion with the researchers and contributing their opinions, which are reproduced below. In general the attempt to obtain responses without using an interview proved disappointing with only one response received. It was thus not possible to establish whether there was any difference in response that could be attributed to the interview situation or anonymous completion.

The four open questions included at the end of the survey proved rather difficult in practice. These had not been included as part of the original survey devised with the oil company but were included with the NFA project in order to prompt discussion and awareness of the wider issues of sustainable development. These were very similar to the questions circulated to NGO organisations. Introducing these questions into a situation where there was little or no background awareness of sustainable development issues, it proved challenging for both the interviewers and interviewees to articulate the issues in a common language. These questions were not given to those filling in the form outside of the interview situation.

NGO Consultation

Of the twenty-nine identified secondary stakeholder groups referred to above four responses were received; this was a rather disappointing result. Some of the other consultees responded by advising us that they had insufficient knowledge in the area and felt they had little, if anything, to contribute to the project. Others responded that they were subject to "consultation overload" and had insufficient resources to address the questionnaire. Many

[24] See Premier Oil "Social Performance Report 2001" and at www.premier-oil.com, and section 3.3 below.

of the consultees did not respond despite follow-up calls and correspondence; it might be assumed that they had similar reasons for not responding. Environmental organisations were the positive respondents and consequently environmental issues are prominent in the responses. This may reflect the general situation that the environmental domain is still commonly held as the most important, or at least the most developed, in the concept of sustainability. The issues raised informed the project but also illustrated that there remains only a poor distinction between the metals and mining industries.

During the project (July 2000) although not directly arranged because of it, an NGO engagement seminar was hosted by the DTI, which provided further opportunities for consultation.

3.2.7 Piloting of Working Framework of Business Practice Indicators

Indicator Piloting Site Visits

Having developed a working framework of business practice indicators and received detailed feedback from NFA Directors, a second set of site visits (referred to as the "indicator piloting" site visits) were undertaken. The purpose of these visits was to discuss the working framework with site managers to help us arrive at a more concise and workable framework. In particular, managers were asked to assess each proposed indicator for its feasibility of implementation at their site in terms of availability of data, confidentiality and ease of implementation. Ideas on amended or alternative indicators where there were perceived to be problems with the proposed

During the visits site managers provided helpful feedback to the MERN team on each of the proposed indicators in terms of their feasibility of operation at the site. Additionally, suggestions were received on how to improve or clarify those indicators that were considered to be problematic in terms of scope, implementation or cost as proposed. The feedback given has been a key input in the process of refining the working framework of indicators into the business practice indicator framework and informed the rationale/commentary of the environmental, social and economic indicator frameworks. A useful overall finding from this consultation exercise was the high degree of consensus on which proposed indictors were most readily implementable and on those which needed to be refined, removed or held for possible future use.

NFA Member Piloting Survey

A further stage in testing the working framework of business practice indicators was an NFA member piloting survey. This was co-ordinated by NFA Directors as it was considered that this would help to maximise the response rate. The simplified framework of proposed site level business practice Sustainability Indicators and explanatory notes used in the indicator piloting site visits (above) were sent to all NFA member sites. The respondents were asked to indicate the feasibility of use of each proposed indicator at their site by simply indicating "yes" or "no" in the appropriate column. Further comments on individual indicators were invited if the respondent considered it appropriate. In total 5 full responses were received and these were reported along with the indicator piloting site visit findings. Again,

respondents are not identified in order to preserve confidentiality. However, even from this small sample showed there was consensus on the most workable and least workable proposed indicators. This consensus exists both within the survey and when compared to the indicator piloting site visit findings. However, it should be pointed out that sites responding to the survey and the sites most willing to take part in the indicator piloting visits may be those more interested in sustainable development issues and willing to implement Sustainability Indicators. If this is the case the findings of the survey and piloting visits may give a somewhat skewed picture of the workability across the whole industry of some site level indicators in the framework.

3.2.8 Final Note On Methodology

This section has reviewed the approach adopted by the research team to develop Sustainability Indicators for the non-ferrous metals sector. The aim of providing this detail is two fold. First to demonstrate the research rigour underlying the development and validation of the indicators: they were not 'bought off the shelf'. Second to enable the same methods to be followed in future work to identify new indicators as conditions change. To reiterate, the methodology of the project is an output in itself.

Finally, our unsuccessful efforts in the time scale within which we were working to develop product use/metals use discussion underlines the challenge of doing research. Sometimes we ran up against "cul-de-sacs", but nonetheless there is value in demonstrating that methodological process for future work, since product use indicators represent an important need.

3.2.9 Further Work Required

A great deal of more work is required in order to integrate the indicators MERN has developed in this project with a workable Sustainability Performance Management System, not least with respect to ensuring its applicability to SMEs as well as larger business Units and the types of training programmes that would contribute to the dissemination of the SPMS. It should be noted that this framework would be adapted differently as we see below to address the needs of other types of businesses. Size does matter in respect of the nature of issues that are articulated at Level 1, and therefore the type of issues that cascade down. We have considered situations in which Level 0 and Level 4 might be required. Nonetheless, the logic of the framework architecture is sound and in the next section we explore the applicability of the MERN Sustainability Performance Management System to an oil company's operations.

3.3 Premier Oil Case Study

Premier Oil is a medium sized UK oil and gas company with 750 employees located in three operations overseas – Pakistan, Indonesia and Myanmar. All of these operations pose significant and specific human rights, environmental and social performance challenges.

MERN contributed to the development of a Social Performance Management Workbook that describes a framework for developing and running the MERN Social Performance

Management System. It is not a manual with all the answers. The idea is that the Premier management team work together to make it a useful guide for operating a social performance management system that meets the following three goals:

- Improves social performance within Premier, and demonstrates what Premier is doing for audit and verification purposes.

- Provides a framework for managing social performance and a set of management tools with instructions for use in subsequent social audits.

- Defines: responsibilities for implementing targets, monitoring criteria and reporting lines and schedules.

The workbook is designed to be used in conjunction with the Social Performance Report (SPR) 2001 and to contribute to the development of the Social Performance Report (SPR) 2002. The latter should be considered an internal as well as external report on last year's social performance. It also explains the origin of this year's social performance targets and provides the baseline from which future performance can be measured and evaluated. The SPR is also a template for subsequent years' audits.

3.3.1 Drivers and Context

As foreign direct investment increases and the extractive sector in particular expands its operations world-wide, Premier has found itself in a very different operating environment. This new operating environment is characterised by growing demand for:

1. Improved environmental and social performance in corporate practice – that is enhanced Corporate Social Responsibility (CSR) and the application of social Key Performance Indicators (KPIs) to measure progress; and, Social Performance Reporting to communicate those performance achievements both internally within the company and externally to stakeholders and other interested groups.

2. Increased accountability to a broader group of stakeholders, stretching beyond employees and shareholders to encompass communities located in the areas of our operations. This primarily means Corporate Social Investment – CSI on the one hand, that is, contributing to social development; and Social Auditing, on the other.

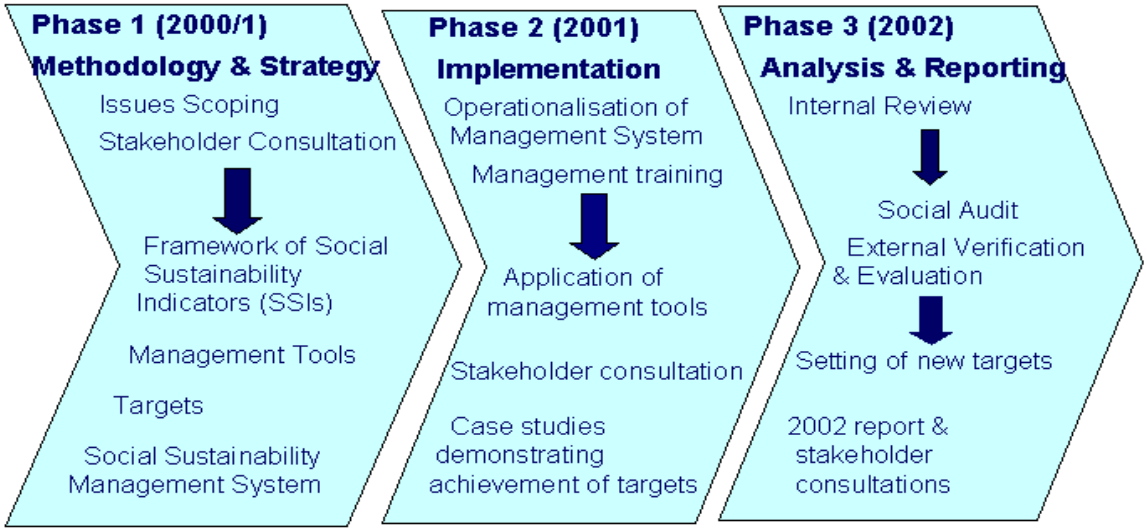
Social Auditing is a systematic approach to dialogue with internal and external stakeholders and to the appraisal of social performance from the perspective of these stakeholders.

The audit process is a systematic approach to dialogue with internal and external stakeholders and appraisal of social performance from the perspective of these stakeholders. It follows a standard called AA 1000, to be upgraded shortly to AA 2000, which is a standard developed by the Institute of Social and Ethical Accountability to demonstrate the steps that a company has followed to measure and report on its social and ethical performance. Surveys, interviews and focus group discussions contribute to building a picture each year of both stakeholders' perspectives on performance as well as the effectiveness of management

systems, strategies and policies. A set of key performance indicators (KPIs) help to categorise, evaluate and describe performance across a consistent set of social sustainability issues.

This process is then subject to outside verification and evaluation involving site visits and desk research. It is the understanding of MERN that no other extractive sector company of this size has undertaken such a thorough investigation of its status in relation to corporate social responsibility.

Figure 1 Social Sustainability Performance Evaluation



3.3.2 Choice Of Indicators/Kpis

In order to measure progress over time and to define targets and strategies for achieving them, we developed a framework of performance indicators. The detailed method is documented in the Social Performance Report 2001 and is based on the MERN Sustainability Indicator Framework (which in the case of Premier Oil was developed in collaboration with EQ Management – see acknowledgements section). In summary, the indicators are both stakeholder-derived and expert-derived, as in the case of the NFA project, identified through the following process:

- First, defining social sustainability issues of concern, through stakeholder dialogue.
- Second, defining what would constitute a progressive response to those concerns on the part of the company.
- Third, identifying a set of indicators capable of rating over time the company's corporate social performance with respect to addressing those areas of concern.

This same approach is adopted to review and revise the indicators to address additional issues. The indicators are also:

- A mix of qualitative and quantitative measures.

- Manageable in number.

- Fairly easily measurable and not too burdensome for managers in business units to be able to collect.

- Capable of showing a meaningful pattern or evolution of progress over time and of predicting progress.

3.3.3 A Balanced Mix Of Process And Outcome Indicators/Indicator Hierarchies

Indicators are organised in a system of logical hierarchies, which group together global, business unit and site level indicators (Levels 1, 2 & 3 respectively).

Three key areas of social sustainability are addressed at Level 1. This is different to the case of the non-ferrous sector where the Level 1 indicators are the three dimensions of Sustainable Development themselves.

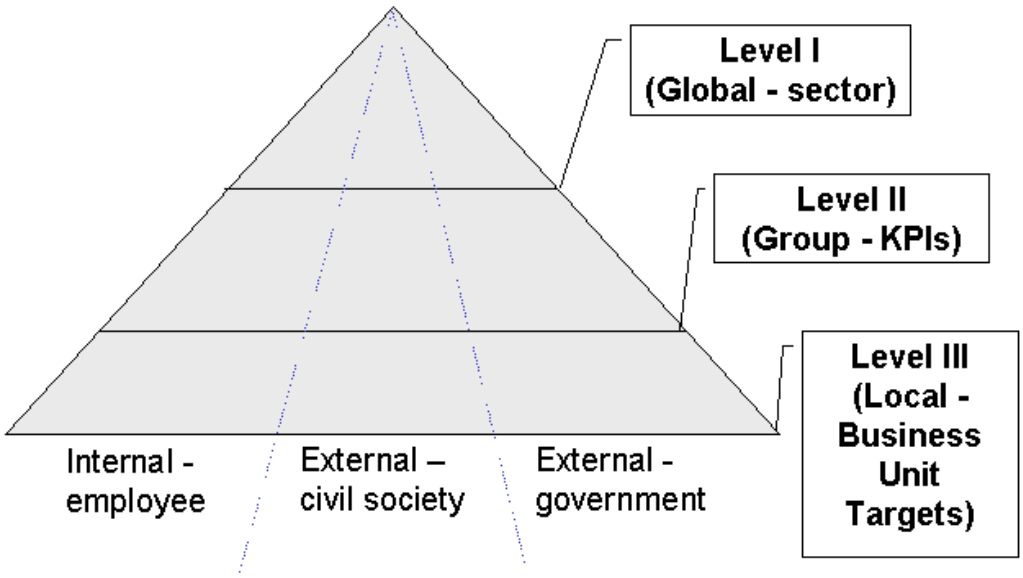
They are, first, A) internal CSR; secondly, B) external CSR with respect to local community, NGO and shareholder relations and thirdly, C) external CSR with respect to government relations. The Level 1 global corporate indicators describe how Premier as a company is contributing to addressing global social sustainability concerns.

Each of these is linked to a set of **key performance indicators (KPIs),** (Level 2 indicators), which are principally business unit derived.

The site level indicators – Level 3 - are derived from addressing issues of concern principally identified in stakeholder consultation exercises and through applying different management tools, such as surveys. These tools form part of the **Sustainability Performance Management System**. Other experts in the field and from within the company, including the overseas business units, are involved in verifying their appropriateness through a process of peer review. In the case of Premier, then Level 3 indicators are presented as a set of management tools (questionnaires, survey forms, guidelines for consultation etc.) all of which give rise to their own detailed sets of case-specific indicators. These are all pilot and can be adjusted or varied to address evolving stakeholder concerns on an annual basis. There are of course any number of management tools that can be developed to provide indicators of performance at site level on any number of issues. The selection process adopted here is based on priority concerns of both Premier Oil and its stakeholders, as communicated to us during the 2000/2001 social performance audit.

Figure 2 describes indicator dimensions and the table of indicators summarises the KPIs. In the case of Premier it is the Level 2 KPIs that are the critical dimension of the Social Performance Management System.

Figure 2 Social Sustainability Indicator Dimensions



LEVEL 1 Internal CSR: Effective development & implementation of policy & practice, which assures social justice ir the workplace
LEVEL 2 KPIs
Socially responsible employment and working conditions
Socially responsible management policies and systems
Socially responsible approach to personal development
Socially responsible communication strategy and employee involvement

LEVEL 1 External CSR for Local Communities, NGOs and Shareholders: Effective development & implementation of corporate governance structures, policies & reporting mechanisms which contribute to more socially responsible external stakeholder relations
LEVEL 2 KPIs
Group policies with reference to internal & external CSR benchmarks & human rights issues
Sustained commitment to social performance evaluation & reporting at local & corporate level
Ongoing Group social audit and verification processes conforming to AA 1000
Demonstrable use of SIA tools throughout project life, including closure
Sustained commitment to corporate social investment

LEVEL 1 External CSR regarding Government Relations: Effective development & implementation of policy & practice, which assures socially responsible engagement with government stakeholders pertaining to regulation, human rights & corporate citizenship
LEVEL 2 KPIs
Corporate compliance and accountability with respect to international, national and regional regulations, restrictive measures and laws
Commitment to strategy of corporate citizenship irrespective of laws in place and government approach to enforcement
Identification of human rights issues and commitment to their protection
Proven commitment to government stakeholder dialogue and engagement as a systematic principle of corporate policy from the outset to the end of a project/investment
Investigate more equitable 'rent-sharing' agreements
Proven commitment to CSI as a mechanism for contributing to local and regional development plans in countries of operation

In order to measure performance at business unit and Group level in a consistent manner across Premier's world-wide operations, we developed a series of management tools that will be revised, applied and added to on an annual basis. The detailed results of the application of these tools provides a picture of our performance for use internally in target and strategy formulation as well as for external reporting.

Some of the management tools are listed below alongside brief explanations of their purpose.

- Employee Survey
- Human Resource Managers Surveys at Group and Business School level
- Corporate Social Responsibility managers at Group and Business School level
- Audit and Verification/Evaluation Performance Criteria
- Guidelines for Ethical Supply Chain Management
- Guidelines for Managing Social Risk
- Guidelines for Community Compensation
- Considerations for Consultation with Local Communities
- Shareholder Questionnaire
- Guidelines on Community Investment

3.4 IDRC Case Study

The project entitled 'Environmental & Social Performance Indicators and Sustainability Markers in Minerals Development: Reporting Progress Towards Improved Ecosystem Health & Human Wellbeing Phase II', funded by the International Development Research Centre (IDRC), Ottawa, Canada, the Tata Energy Research Institute (TERI), Indian Western Regional Centre, Goa, and the Institute of Regional Studies (INER), University of Antioquia, in collaboration with the Mining and Energy Research Network (MERN), Corporate Citizenship Unit, Warwick Business, School, University of Warwick, have been researching, in part, some of the complex interactions between metals and mining projects, social and ecological changes, and community health and wellbeing. The collaboration has involved a three-year research exercise developing methodological tools to track changes in community health and wellbeing of those populations – primarily in a less developed country and rural context – who reside within mining regions or those affected by specific mining projects. Specifically, one of the research objectives has been to develop health and well being – or 'quality of life' – indicators. The research is underpinned by the belief that such indicators will assist in improving community conditions by drawing attention to, and systematically tracking, changes in community health and wellbeing.

This research is being conducted through TERI's extensive studies of an iron ore mining region in Goa, India and INER's longitudinal research work with the Wayuu indigenous peoples affected by coal mining in Colombia. The work is supported with additional research exploring theories and practices of health of rural Malagasy in Southwest Madagascar. All empirical studies undertaken are integrated within MERN's environmental and social performance and sustainability markers indicator framework.

A key component of the research has been to develop the conceptual definitions that underpin and frame community health and wellbeing indicators through a collaborative, multidisciplinary and multicultural process. The concepts of wellbeing or quality of life have been incorporated into the indicator framework to reflect research findings that for many cultures 'health' is a multi-faceted and collective, as well as individual, construct.

We believe that this conceptualisation of indicator development is in contrast to many of the current indicators used to measure community health. Much of the mortality and morbidity indicators currently used to measure health are underpinned by a biomedical model and focus on the absence or presence of disease and injury. As such, they are more indicators of disease rather than indicators of health.

Additionally, whereas, there has been a historical tendency to define health indicators as measures of 'objective' health status, this ecosystem health and human well being approach incorporates both subjective and objective measures. Subjective health and well being indicators incorporate, but go beyond, an individual's physical and/or psychological state or status to include the collective social, ecological and spiritual aspects or dimensions of health. We argue that such an approach is necessary to better understand the full range of impact and influence of metals and mining projects on communities' health and wellbeing. Moreover, this research approach to community health indicator construction aims to be more integrative, with the indicators developed in a process that engages all stakeholders and which are tailored to community-specific needs and concerns. For example, in Goa, TERI is

working with a range of stakeholders from government, companies and communities in developing and implementing health and well being indicators.

TERI is also working towards adjusting income accounts from mining by costing the environmental and social impacts from mining. This will be an additional regional level indicator, as it will indicate over time the net contributions to the region from mining activity. (For more details see Noronha, L. Natural Resource Forum. 25:2001, pp 53-65).

Furthermore, The INER team is also working on developing a cultural matrix articulated on the basis of five key determinants of health and well-being for indigenous peoples: identity, territory, autonomy, participation and self-determination. The matrix is being used to adapt both the indicator framework, and the QOL tool, for their application in the context of the Wayuu peoples of Northern Colombia, in whose territory the Cerrejon coal deposit is developed.

Research findings and the methodological tools developed will be available by April 2002.

3.5 Case Study – The Development Of Biodiversity Indicators

The literature pertaining to biodiversity indicators is both diverse and extensive. Its roots lie in disciplines including mathematical biology (Pielou 1977; Rotenberry 1978), conservation biology (Wilson 1989; IUCN 2000), ecology (Soule 1990; Revilla, Palomares et al. 2001), and more recently the social (Reid, McNeely et al. 1993; Costanza, d'Arge et al. 1997) and environmental sciences (OECD, 1993). Bringing together these perspectives means bringing together different conceptions and priorities about what biodiversity is. Arguably the single mechanism most responsible for achieving this has been the Convention on Biological Diversity (Rio de Janiero, 1992). Article 2 of the Convention defines 'biological diversity' (of which 'biodiversity' is the contraction) as "the variability among living organisms form all sources including, inter alia, terrestrial, marine and other aquatic systems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (UNEP 1994).

This definition widens the field of biodiversity, from what was traditionally a species-oriented domain, to one that includes at least two other tiers of the biological hierarchy: genes and ecosystems. Measures of biodiversity need to reflect the 'diversity' within each of these levels. It is partly for this reason that there can be no single indicator of biodiversity. This discussion presents an overview of developments in biodiversity indicators, culminating in the presentation of a core set of 'state' and 'pressure' indicators described by the Convention on Biological Diversity. Central to these indicators however, are the concepts of species richness and abundance.

Despite the earlier proclamation that there can be no single measure of biodiversity, it is species richness (i.e. the number of different species present in an area) however, that is perhaps the single measure most associated with the term (Bell and Morse, 1999). In spite of its intrinsic appeal as a simple quantitative indicator however, species richness measures prevent one from observing changes occurring within the system until a species has disappeared. It is partly for this reason that the species abundance measure (i.e. the relative

numbers of individual species) was introduced. The alliance of these two measures saw the development of a host of technical diversity or 'evenness indices' that reduced biodiversity to a single number (Molinari, 1989; Bulla, 1994). Whilst attractive to mathematical biologists, ecologists and even some decision-makers, these indices were not only flawed in their design, but were also anathema to those who sought more qualitative measures of diversity (Franklin, 1996). Whilst such indicators are intrinsically reflective of broader level ecosystem attributes, they continue to be measured in terms of species numbers and abundance. It is the selection of what types of species to measure, however, that makes them qualitative. This is discussed below.

3.5.1 Quality Or 'State' Measures

It is through the use of more qualitative indicators, that measures of genetic and ecosystem diversity are brought to the fore. As the functional unit of heredity (UNEP, 1995), it is genes that are essentially responsible for 'determining' species. They hold the 'code' for morphology, virulence, activity, and confer on their host organism a wide range of distinct characteristics. It is genetic diversity that makes individuals within a species resistant or susceptible to diseases, makes them fast growers, or the producers of unique chemical substances. These are traits of great interest to humanity in terms of crop plants and livestock, or as a source of medicines e.g. taxol as a 'cure' for cancer. But, how can such diversity be measured? There are various mechanisms. The first and certainly most reliable measure is through biochemical and molecular isolation, and even genome sequencing (Bisby, 1995; Gray, 1996). The current monetary and temporal expense of such techniques however makes it impractical at a large scale. Hence the second measure: taxonomy. Traditionally used as a means of classifying biological diversity, taxonomy informs us how different species (and hence genes) are from one another i.e. 'uniqueness.' The idea, albeit contentious, is that by examining the phylogenetic tree, one may be able to identify 'indicator taxa' (i.e. species) that are both reflective of other poorly studied groups (Pendergast, 1997) and sufficiently 'unique' (i.e. different to other species) that they warrant both measurement and conservation.

It is this sentiment of selecting species-level indicators reflective of broader level genetic, species or ecosystem properties, that is echoed in the 'indicator species' concept (Begon, Harper et al, 1990) and the idea of 'high impact' species (Mooney, Lubchenco et al., 1995). Whilst the former category includes species that may act as 'early-warning' pollution indicators (e.g. lichens), the latter includes 'keystone species' and 'exotic' invasives (or 'aliens') such as Eucalyptus, or the water lettuce (Eichornia crassipes, Pistia spp.). The presence of such species is suggestive of some wider ecological impacts. The presence of alien invasives for example, suggests that other species will be out-competed for resources, and gradually reduced in numbers possibly leading to local or permanent extinction. All such species exemplify the primary tenet of indicators to provide information about a phenomenon, and to simplify and clarify potentially large amounts of data. This makes them useful to both biologists and decision-makers for their ability to 'point out' potential environmental trends.

A similar measure is that of habitat size or area. The validity of this measures stems from 'island-biogeography-theory' (Wilson, 1989), which suggests a larger habitat area will

contain greater species richness. This relationship stems from the fact that certain species, especially larger primates and 'climax species,' require an area of a certain size to obtain sufficient resources for their survival. Should the area be fragmented or reduced in size, it is not longer able to sustain such species, and they either migrate or become regionally extinct. In a world where mega-diversity habitats, such as tropical rainforests and coral reefs, are increasingly being encroached on by human development, this is an especially significant indicator. Utilising it effectively however, involves regional ecological studies on species habitat requirements and possibly even migration patterns. Such measures can also give ecologists and policy-makers an indication of different ecosystems and biome types, and their relative area within a given region or nation.

3.5.2 Pressure Or Use Measures

If used efficiently many of the above indicators can provide an 'early-warning' of ecosystem impact. Such measures are especially valuable because of the time is may take for biodiversity impacts to lead to recognisable ecosystem effects e.g. species extinction. It is due to this 'temporal lag' that policy-makers increasingly suggest the identification of 'pressure' and 'use' indicators (OECD, 1993; UNEP, 2000). Among the primary pressure indicators are those relating to habitat loss (and fragmentation), pollution, exotic invasives, and vital ecosystem 'use' measures. As the above sections deal at least partly with the first three categories, this section will briefly discuss to the last: ecosystem use.

The use of ecosystems by humans is a field explored by anthropologists, biologists, ecologist, sociologists, and even economists. It is these groups who have been responsible for popularising a term that has since been accepted by both the Convention and other international organisations: namely, ecosystem 'goods and services' (Costanza, 1992; UNEP, 1995). Ecosystem goods refer largely to those species-oriented 'outputs' of ecosystems that are utilised or 'harvested' by humans These include: crop plants; forest products as a source of fuel, construction wood, or medicinal plants; and sea products for food, or as a source economic revenue. Ecosystem services refer to the emergent ability of ecosystems to perform more abstract function such as, air and water purification, weather amelioration, and control of the hydrological cycle. The maintenance of these ecosystem 'goods' and 'services' provided by biodiversity is fundamental to human survival. It is for this reason that indicators relevant to these outputs and functions provide a crucial part of any biodiversity indicator set.

3.5.3 A Core Set Of Indicators Of Biological Diversity

This section presents a universal list of indicators (shown in Box 3-3) adapted from those presented by the Subsidiary Body to the Convention on Biological Diversity (UNEP, 1997).

Although other international organisations, such as the OECD, the World Resources Institute (WRI) and the United Nations Council on Sustainable Development (UNCSD), have all completed work on biodiversity indicators. In addition to the identification of species-oriented measures of diversity, the list includes ecosystem-oriented habitat measures and allows for the identification of the aforementioned qualitative indicators.

Box 3-3 Preliminary list of first track indicators

Universal State Indicators

Ecosystem quantity

1. Self-regenerating and man-made area as percentage of total area

2. Ecosystem quality (Species abundance related to the postulated baseline (evenness))

3. Distribution or abundance of a few selected species[25] as the percentage of the postulated baseline per country (region, global)

4. Number of indigenous species of one or more selected groups as the percentage of the postulated baseline per country (region, global)

5. Various quality variables as the percentage of postulated baseline[26]

6. Threatened and extinct species and habitat types

7. Number of threatened and extinct species as the percentage of particular considered group per country (region or global); Number of threatened habitats as the percentage of the total per country (region or global)

Universal Pressure (and Use) Indicators

Habitat loss

8. Annual conversion of self-generating area and by habitat type as the percentage of the remaining area per country (region and global)

9. Annual land use change from self-regenerating area into agriculture, permanent pasture and built-up land in hectares per country (region and global)

10. Share of riversheds dammed or channelised as the percent of the whole river per country (region and global)

11. Percent of coastal zone with a population density exceeding 100 inhabitants/km^2

12. Percent of coastal zone within 30 km of a town or city > 100.000 inhabitants

Harvest

13. Total amount harvested per unit effort (tons per unit effort, over time)

Species introductions ('aliens')

14. Total number of non-indigenous species as a percentage of a particular group per country (region, global)

Pollution

[25] The range of species that could be selected here is extensive. May include those qualitative species measures mentioned above *e.g.* indicator taxa, indicator species, keystone species, alien invasives *etc*. May also include the identification of species reflective of ecosystem 'goods' and 'services.'

[26] To include measures relevant to the delivery of ecosystem 'services' *e.g.* the percentage area of intact canopy cover, or the ratio between dead and living wood.

15. Average exceedance of soil, water and air standards of a particular group of substances

Climate change

16. Change in mean temperature per grid cell of 50 km by 50 km, averaged per country (region, global) within a 20-year period

Ecosystem goods

17. Total amount harvested per species and grand total over time (in tons, m^3, US$, percentage GNP, numbers), especially fish and timber products

18. Total recreational revenues derived ecotourism per country (region, global) in US$, % GNP and % employment

Ecosystem services

19. Total and per km^2 carbon stored within forests per country (region, global) referenced to baseline year

3.5.4 How To Identify Site-Level Biodiversity Indicators

This section attempts to answer our previous question of how relevant site-level indicators can be identified. In answering this question, we draw once again on a framework advocated by the Convention on Biological Diversity (CBD), namely the Ecosystem Approach (EA) [UNEP, 1999 #19]. Despite its recent sanction by the CBD[27], the EA has a long history in the conservation sciences. Unlike many previous approaches to ecosystem management however, the EA views humans and society as being integral components of dynamic and inherently unpredictable ecosystems. Indeed, it is often implemented in areas, and contexts, that may be ecologically, socially and economically diverse, and that interact in a complex manner. The multi-disciplinary nature of this strategy makes it a suitable platform from which to identify site-specific indicators that can distil and simplify such complexity. Such indicators are largely derived from the universal indicator set noted previously (see _ refer to other work).

[27] The EA represents "a holistic integrated approach to conserving biodiversity and using biological resources in a sustainable way" [Kakakhel, 1999]. It is a strategy for the implementation of the CBD objectives: the conservation; sustainable use; and fair and equitable sharing of benefits arising from biodiversity.

Box 5 Principles of the Ecosystem Approach (UNEP, 1999)

1. The objectives of management of land water and living resources are a matter of societal choice.

2. Management should be decentralised to the lowest possible level.

3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

4. Recognising potential gains from management, there is the need to understand the ecosystem in an economic context.

5. A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning.

6. Ecosystems must be managed within the limits of their functioning.

7. The ecosystem approach should be undertaken at the appropriate scales.

8. Recognising the various temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.

9. Management must recognise that change is inevitable.

10. The ecosystem approach should seek the appropriate balance between conservation and sustainable use of biological diversity.

11. The ecosystem approach should consider all forms of relevant information including scientific and indigenous and local knowledge, innovations and practices.

12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

The EA views the objectives of resource management as a matter of societal choice. This is especially appropriate considering the high correlation between mega-diversity countries (or regions) and the presence of indigenous or traditional peoples. Many such peoples maintain a unique cultural identity, intricately bound to their relationships with ecosystems, both in terms of their knowledge and use of biodiversity. This has significant implications for the processes of indicator identification and management. Such activities now need to involve the establishment of partnerships (in decision-making, implementation, benefit distribution and evaluation) with identified stakeholder groups (Lele, 1991). Whereas previously indicator frameworks may have been largely developed and managed by company scientists, consultants, NGOs or academics, they now need to include governments and local peoples in a participatory identification and management process. Neither too, can this process be static nor anticipatory. The recognition of changing human needs, and objectives, as well as

the dynamic and uncertain nature of ecosystems, implies that indicators and management systems need to be holistic and adaptive.

The use of an adaptive management system is especially useful when decisions need to be taken in the absence of data or where uncertainty is high. It is essentially a continuous process of action-based planning, monitoring, researching and adjusting, much of which needs to take place in conjunction with identified stakeholder groups. Adaptive ecosystem management depends on a continually evolving understanding of cause-and-effect relationships in both social and biological systems (Szaro, 1996). The ability to adapt indicator targets and thresholds (or even the indicators themselves) in response to the accumulation of new information is a vital aspect of biodiversity conservation and use.

The identification of biodiversity indicators is clearly not a simple linear activity. Managers however, must recognise that change is inevitable, and should allow indicator systems to evolve and develop in response to changing human objectives, pressures and ecological states. Good management seeks to work with rather than ignore this complexity.

4 Conclusions

This paper is about the development and use of Sustainability Performance Indicators (also referred to as Sustainability Indicators) to communicate to the internal and external stakeholders of mining companies the extent to which their mining activities are contributing to, or detracting from, sustainable development goals. In particular, it highlights the potential of such indicators to promote, evaluate or guide sustainable sound investment decisions. The paper also places Sustainability Performance Indicators in the wider context of Sustainability Performance Management Systems, and briefly reviews the other tools available for the development of these systems. It emphasises that indicators can assist in the actual assessment, management and monitoring of impacts of mining on sustainable development goals, as well as the reporting of performance, if they are developed within an overall Sustainability Performance Management System. For this reason, the paper argues that tailor made approaches to developing indicators, that address specific stakeholder concerns and that inform mainstream corporate strategy and support companies' future approaches to managing sustainable development issues, are more likely to contribute to sound investment decision processes than approaches which prioritise reporting against generic 'off the shelf' indicators. Notwithstanding, it is suggested that the latter can inform the former; and, that there are merits to developing combined 'top-down' - 'expert derived' and 'bottom up' - 'stakeholder scoped' approaches to sustainability performance management.

It is argued that those indicator systems that have been developed to date have been mostly about the impact of operations, principally environmental impacts and to a lesser extent about social impacts and rarely economic impacts. Some claim to be Sustainability Indicators but are often little more than combined sets of environmental, economic and social performance indicators, not indicators that are capable of truly describing the extent to which a mining project is contributing or detracting from sustainable development goals over time from an inter-generational equity perspective. Furthermore, few indicator systems have been developed that are capable of describing performance from different stakeholder perspectives, especially the perspectives of local communities that are affected by a project and less still from the perspective of indigenous communities. There are also few indicators systems that are capable of demonstrating changes in performance with respect to two other key areas of sustainable development. First, product use and the extent to which a product is contributing to quality of life, health and well being over time, and second, business practice and the extent to which a project is being managed according to practices that will contribute to sustainable development goals. It is argued, that business practice indicators would be one of the most effective systems for financial investors to use to assist in the evaluation of whether an operation is likely to represent a sound investment from the perspective of sustainability. A business practice indicator system could be quite simple and easy to use. It might involve simply indicators of a proficient Sustainability Performance Management System and indicators pertaining to its verification.

Over the past 5 years, MERN has undertaken research on the development of Sustainability Performance Indicators and management systems for the mining, metals and energy sectors, working in partnership with major mining and oil companies, and a wide range of NGOs,

government departments and leading academic institutions. The paper draws on this research and the results of its application, to give case study examples that illustrate the limitations of different approaches to indicators development and different approaches to both sustainability performance management and reporting. It also draws some conclusions and recommendations for further research.

Chapter 1 argues that there is a growing literature relating to sustainable development on the one hand and corporate social, economic and environmental performance, on the other. Few links are made between these two important areas of work. Chapter 1 does not review these individual areas of literature. Rather it suggests a conceptual and practical approach to creating a bridge between them, using the management tool of Sustainability Performance Indicators within an overall Sustainability Performance Management System. Specifically, Chapter 1 explores the drivers behind the development of indicators at the macro and micro level. Some of the principal global drivers promoting indicator development initiatives include managing the social or broader sustainable development consequences of globalisation; implementing voluntary codes of conduct on corporate social responsibility; meeting regulations and conditions of finance relating to social and environmental issues, and responding to industry peers, shareholders and staff. Project-specific drivers include: improved frameworks for the management of stakeholder expectations; improving the effectiveness of social investments in both developmental and business terms; the need to demonstrate that corporate policy on sustainability is being implemented; responding to local special-interest groups; enhancing local reputation and competitiveness; and aligning social programmes with host government Development Plans.

Chapter 1 also categorises the origins of different methodological approaches to indicators and indicator sets themselves as being either 'off the shelf' or tailor-made, as they relate to company or sector specific initiatives. An important element of MERN's work to date has been the generation of a number of subsets of indicators that have greater relevance to specific stakeholder groups and that are informed by those specific stakeholder perspectives. These subsets supplement generic, core or key performance indicators designed to meet the requirements of a broader range of stakeholders. One such subset might relate to financial indicators, or investment-related business practice or managerial performance indicators (as above), developed in collaboration with the financial sector and industry.

The vast indicator literature is reviewed in Chapter 2 and information is collated in tabular form to generate fresh perspectives as well as to capture succinctly and analyse different methodological approaches, indicator types and characteristics as well as to describe different indicator 'use' possibilities. Based on research to date, Chapter 2 overviews methodologies and different indicator sets, with an assessment of their application and limitations as well as suggestions as to the further work required. Chapter 2 reviews how some approaches can be used to balance the often-disparate requirements of different stakeholder groups. Chapter 2 also attempts to answer the following specific questions, identified within the terms of reference for this study:

- What are the characteristics of and similarities and differences between the various systems currently in use to measure or rate environmental and social performance in the mining and minerals sector? The paper argues that most indicator systems are principally about the environmental impacts of projects. What are the drivers, rationale

and assumptions, explicit or implicit, behind the current systems? Reporting to external stakeholders is considered to be one of the key drivers.

- Who developed them, why and how? Generic off the shelf indicator systems have generally been developed by institutional reporting initiatives while tailor-made indicator initiatives have generally been developed to address key sustainable development challenges perhaps in the area of human rights or following an environmental incident.

- What processes if any were put in place for dealing with uncertainty, for learning and for revision? Tailor made approaches developed collaboratively within the company alongside consultants are more likely to promote learning, and to leave in place methodologies capable of being adapted to manage uncertainty and change.

- What are the advantages and disadvantages of the various systems from different stakeholder perspectives and what are their most contentious aspects? Most systems are developed from the company perspective or from a broad public interest perspective. There exist few systems capable of commenting from multi-stakeholder perspectives least of all from a community or ethnic minority perspective.

- What needs to be done either to strengthen existing systems or develop an alternative system? There is a need to develop a top-down and bottom up approach as described above and also a need to develop business practice indicators that can assure investors that a proficient sustainability performance management team and system is in place.

- What information needs to be in the public domain to facilitate measurement and evaluation of sustainability performance? There exists a great deal of information in the public domain it is more a question of knowing it is available and access. However, there is a need for more transparency with respect to resource rent agreements and the type of tax frameworks negotiated for each project, its time horizons and the nature and extent of adjustments made to ensure that economic benefits are transferred back to benefit the host communities of mining operations within time scales that are relevant to them, especially where there are fragile ecosystems and vulnerable communities.

- What lessons can be learned cross-sectorally about the measurement of sustainability performance? The oil and metals sectors can provide useful lessons with respect to disseminating information about their approaches to Sustainability Indicators and the management of sustainability performance. This paper does precisely that.

Chapter 3 draws on case studies from MERN research in the mining, metals and energy sectors regarding the development and application of indicators and highlights those findings that have more generic relevance and those that could be used by financial institutions in their assessment of investments and associated social, environmental and political risks. Chapter 3 reviews the methodological processes adopted in this work, and explores how the MERN approach, which focuses on sustainability performance management can be used to balance the often-disparate requirements of different

stakeholder groups, as well as provides an overview of the core and supplementary indicators developed by MERN to date.

Chapter 4 provides conclusions, and outlines future research and practical work that is necessary to further develop and implement Sustainability Performance Indicators in the context of mining. The principal conclusions include:

- Management tools, such as Sustainability Performance Indicators, have a role to play in assisting both companies and their stakeholders, particularly financial institutions, to assess the extent to which their production activities are contributing to, and not detracting from, sustainable development goals. The paper addresses the significant new roles and responsibilities of business within a developing paradigm that has shifted from a 'do no harm' approach to operating towards a 'demonstrate positive development benefit' imperative. However, the paper strongly argues that Sustainability Performance Indicators are only one tool of several that can be used by companies within a social or Sustainability Performance Management System to support strategy aimed at ensuring their mining operations contribute to sustainable development over time. The other tools that require research and further refinement and integration include: Impact assessment - integrated (not just environmental and social) and inter-generational (not just at one point in time); partnerships; stakeholder dialogue; corporate social investment; planning for closure, capacity building and professional development; social/environmental/economic accounting; sustainability reporting; and, auditing & verification.

- The distinction between indicators and data (accounts) should not be overlooked. The apparently simple statement that indicators are derived via processing and abstracting from raw data, underscores the methodological challenge of indicator design and highlights the fact there can be multiple sets of indicators for conveying information to different user groups. The key to designing performance indicators for multiple user groups is first, to ensure that sufficient, high quality data on performance is collected, and second, to design robust and scientifically credible methodologies for processing data into indicators that can be used as tools for environmental, social and economic management (i.e. not only reporting).

- Generally, indicators are drawn from significant issues. It is our consideration that the more accurately those issues are prior-researched and scoped the more relevant and justifiable the choice of indicators. As such, sets of indicators are normally designed to be comprehensive and manageable rather than exhaustive and inoperable. Although companies may require a more restricted collection of headline indicators on which they can draw, highlighting 'core' issues and indicators is potentially problematic. In particular it is complicated by the fact that stakeholder interests and concerns will vary from site to site, depending on the size and type of business unit and its operating environment. An a priori indicator focus cannot account for this. Notwithstanding, there is the potential for a core set of indicators to be developed that is meaningful for all of the main stakeholder groups but it could be that there are peripheral and distinct indicators that are more relevant for each stakeholder group. For example, let us consider metal contaminated acid rock drainage (a major environmental issue in the base and precious metal and coal mining industries) – Table 13 summarises potential

indicators based on the perspective of different stakeholders and the issues that those different perspectives raise. It serves to demonstrate that a single issue can be subdivided into sub-issues (grouped by stakeholders), from which numerous potential indicators can be drawn, each of which may be meaningful to the relevant stakeholder.

Table 13. Acid rock drainage – the perspectives of different stakeholders

Stakeholder	Example of sub-issue	Potential indicator
Company	Extent of bonding required (economic)	Investment in pollution prevention
Regulatory authorities	Potential for water pollution (environmental)	Degree of compliance
Local community	Potential impacts on drinking water (environmental/social)	Independent monitoring of water quality
Government	Long-term liability to tax payers (economic)	Planning for closure process
Financial institutions	Long-term economic liability (economic)	Provision of suitable bonds
Environmental pressure groups	Ecosystem health (environmental)	Total release of pollutants

The most appropriate methodological approach from the MERN perspective is one that is sufficiently generic to be applicable to different 'indicator' models used by different stakeholder groups (e.g. mining companies, regulators, financial institutions, local communities, other sectors) both in their content and their presentation, while being tailored to the specific operating environment of the mining sector. As such, sets of "ideal" indicators should have a generic and systemic component and a more sector specific component; and this is the approach used by MERN.

- The definition of sets of 'core' indicators that address principally business practice is possible within the mining sector, although further work is required on the standardisation of methodological approaches. Quantitative and qualitative indicators must be used together if the wide-ranging concerns of a diverse group of stakeholders are to be effectively addressed. In practical terms a core set of Sustainability Indicators for the mining sector that addresses the concerns of all stakeholders is likely to be large and unwieldy without the implementation of common methodological standards and indicator architecture, and the development of appropriate mechanisms for the incorporation of existing indicators and methodologies into a possible 'universal' framework. Moreover, this paper has argued that indicators are only one tool in an overall Sustainability Performance Management System. The mining sector must consider how it might integrate its continuing development of indicators with such universal standards as the latter themselves continue to develop. Moreover, further challenges arise from the need to aggregate environmental, social and economic performance indicators that have been derived using different methodological approaches.

- Irrespective of the nature of the indicators used, 'trade-offs' may occur where a positive change in one indicator may lead to a negative change in another. It is essential that

mechanisms be found to communicate clearly and transparently to stakeholders from the outset these implications.

- The balance between standardisation (i.e. the production of generic indicators) and the tailoring of indicator sets to the specific needs of a site, company, group or metal has not yet been considered in detail, and further work is required in this area in order to derive benefits from both 'top-down' and 'bottom up' approaches.

- Standardisation for reporting purposes offers several benefits, including enhanced transparency, comparability between site and companies, and the opportunity to continue to develop self-regulation, but may reduce differentiation between companies (and hence effect competitiveness); and, for the purpose of contributing to the management of sustainable development issues, may lead to important site-specific issues being ignored. This is where second party verification may have a role to play; that is, where the verifier engages with the company on an ongoing basis to provide constructive criticism as well as a verification assessment. Berkout and Hertin (2001) recently assessed the standardisation of methodological approaches and the development of standard indicators. Taking this approach offers the mining sector the possibility of enhancing the comparison of companies within the sector, and potentially between the mining sector and other sectors. It would effectively contribute towards a 'level playing field', leading to improved efficiency and transparency in the acquisition and reporting of information. This in turn would increase the credibility of the information, which at present is a significant issue for the industry. Credible, transparent and comparable reporting methodologies would contribute to the development of a robust and effective framework within which the industry would self-regulate (based on performance). However, there is a risk that the development of industry-wide standards might have impacts on innovation and competitive advantage within the industry, and implement by default a 'command-and-control' approach despite the ability to self-regulate according to performance. Further work is required to assess the impact of an industry-wide standard approach to indicators. For example, whether such an approach would be implementable, and how to optimise the integration of standard approaches with tailor-made refinements at the level of specific sites, companies or metal. This will require an assessment of both process (methodology) and outcomes (indicators).

- In some areas there is little or no consensus, in particular on the weighting and aggregation of indicators, both within individual dimensions, and across the three dimensions or between generations. Further work is essential to develop the continuing implementation of indicators by consideration of such factors.

- This paper argues that business approaches to sustainable development warrant consideration with respect to three aspects: equity (inter-generational as well as intra-generational), business practice and product use. There is a tendency to presume that indicators are Sustainability Indicators if they address the three dimensions of economic, environmental and social performance of mining operations. Few indicator sets address intergenerational equity; product use indicators are most immature while the majority of indicators are about operational performance and reputational

management within the current period of historic time, and not about managerial performance with respect to managing equitably, ethically and responsibly sustainable development issues.

- There are several examples of 'off the shelf' indicator systems. A tailor made system, such as the MERN approach, has two key advantages. First, it is sector and company specific, and therefore can provide more relevant and user friendly approaches to performance measurement and communication; and second, the indicator development process itself can be an internal learning process for companies and can contribute to dynamic strategy formulation and cultural change within the company, which this paper considers to be an essential part of the embedding of sustainable development within a business. Again, this reinforces our suggestion that sustainability indictors are one management tool within a broader Sustainability Performance Management System. It is the architecture of that performance system that provides both the analytical structure for the qualitative evaluation of performance as well as the logic for combining that evaluation with quantitative measurement so as to be able to track the extent to which a business activity, at whatever unit size one wishes to measure, is contributing to or detracting from sustainable development goals. A 'good' set of indicators (that is a robust, accurate, meaningful and relevant) should meet these criteria. Many fail to do so, which is why the 'take up' of indicators is so patchy and why there are so many versions 'on the market'. The aim of the MERN indicators programme is primarily to develop a methodology that meet these criteria and that is capable of generating for different user groups across different sectors, a useful, meaningful and relevant set of indicators. It may also be the case that there are certain groups of indicators – for MERN this would be Level 2 indicators that are indicators at Group or sector level that are core – and could be termed Key Performance Indicators.

Recommendations For Future Research And Practical Work Include:

- The refinement of appropriate methods to ensure the relevance of performance indicators and their reflection of different stakeholder perspectives, including vulnerable stakeholder groups.

- An investment of resources on the part of the financial sector to ensure that indicators are developed that are relevant to their needs and the needs of their company clients and that address actual sustainability performance and not simply 'cosmetic' sustainability reporting. It is recommended that priority indicators here would be business practice indicators, that describe and verify the proficiency and ethical effectiveness of Sustainability Performance Management Systems and indicators that describe accurately and transparently economic impacts at national, regional and local levels. In mining, investment costs are high (most projects have one-third equity: two-thirds debt financing). Often the equity investment or credit has attached to it environmental or social conditions to reduce any future liabilities. In recent research, MERN found that more than 90 international banks undertake environmental financial risk assessment of borrowers, and 50 of these incorporated environmental liability into loan terms. Having in place an indicators framework that addresses liability-related concerns and that helps

to predict future performance could conceivably boost the risk-related credit rating of a country, company or project.

- The linking of work in the area of Sustainability Indicators with performance management systems more generally, so as to contribute to social accounting, audit and verification processes on the one hand and the appropriate addressing of sustainability issues of concern on the other.

- The need for a set of comprehensive methods and tools to be developed – e.g. a 'logical framework' for sustainability performance evaluation and communication.

- That framework needs an inherent coherence so as to be able to link site level indicators with company and group level and sector level indicators and these in turn with global Sustainability Indicators. Above all, indicators need to be relevant to their frame of analysis.

- Acceptance that indicators cannot simply be pulled "off the shelf", but may need to be developed through research; and that the development process takes time and resources, as well as a commitment on the part of user groups to participate in the development and piloting processes. It is important that companies consider such social science research to be as important and relevant as scientific, geological and engineering research and that it is considered to be an important learning process and not something to be contracted out and managed at arm's length.

- The application of such indicators over periods of time and the extent to they provide possibilities for stakeholders to track performance within and between generations.

- The consideration of Sustainability Indicators as a tool that can be used to promote cultural change within business, as well as to promote the mainstream, not tangential, consideration of sustainable development issues within the investment decision process, to bring about learning and real progress towards sustainable development.

- It is recommended that a key aspect of any future development of the economic dimension within the mining sector should be the inclusion of downstream supply chain impact indicators – the downstream societal benefits of mined materials need to be analysed and discussed alongside the more direct analysis of the mining sector itself. Certain issues that may potentially impact sustainability are largely outside the control of the industry – this is particularly true in the economic dimension - exchange rates, input prices and trade restrictions are examples on the one hand and pre-existing socio-economic vulnerability of local communities are examples on the other. Therefore an area for future research is the extent to which such factors should be the focus of indicators demonstrating a mining company or the sector's progress towards sustainable development goals.

- Notwithstanding, it is in the area of financial indicators that most work exists and in the area of economic impact indicators at community and local and regional levels, from a current and inter-generational perspective, that most work needs to be done.

- Finally, Sustainability Indicators could be considered as a tool that can promote cultural change within business, as well as to promote the mainstream, not tangential, consideration of sustainable development issues within the investment decision process, to bring about learning within organisations and real progress towards sustainable development.

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APPENDIX A: Environmental Indicator Design Parameters

Input Versus Output

Environmental management is conceptualised as a system comprising inputs and outputs, in which inputs refer to the financial, human, and technical resources dedicated to environmental management while outputs refer (in the literature) to either sources or impacts - although sources is to be preferred. Since environmental management is viewed as a system in which specific inputs - in terms of resources - generate specific outputs - in terms of environmental performance - some practitioners have suggested the use of an input audit as a proxy for environmental performance. There are several pragmatic reasons to support this position, not least that data on resource inputs is often readily available, more easily quantified, easily comparable, and less resource-intensive to collect and process. The extent, however, to which an input audit is a scientifically defensible proxy for environmental performance needs to be questioned. At issue is the linearity of the relationship between inputs and outputs from the system and the efficiency with which resources are used to achieve outputs. Can it be assumed that a doubling of expenditure on environmental monitoring yields twice the level of protection as before? Even if the relationship is not linear, is the assumption that spending more on environmental management will produce better performance a reasonable one?

A review of current approaches to environmental performance measurement leads one to the conclusion that input audits are not a suitable proxy for an evaluation of environmental performance. An input audit is, however, a valuable component within a broader set of indicators that include assessments of system outputs. BHP has adopted this position and is developing a set of indicators that include both management system inputs - "Process Indicators" – defined as progress made in implementing management processes considered integral to achieving good environmental, health and safety performance - and system outputs – "Outcome Indicators" – defined as the results or physical outcomes produced through the implementation of the management system.

Single Aggregated Versus Multi-Variate Indicators

Indicators can be divided into two groups according to whether they are comprised of a single aggregated index in which one figure is reported, or whether a set of indicators are used to convey many different variables (Mitchell, 1996). There have been several methodologies developed to combine on a single, aggregated score the relative performance of a plant or company. Many of these require a weighting of relative impacts (e.g. Rice 1993), the challenges of which have been well rehearsed in the literature on Life Cycle Analysis. Recently much of this work on single aggregated indices has come from environmental economics and has focused on the design of an indicator of environmental performance to be applied at the level of the national economy, the city, and the corporation.

Constructing single indices is typically very data intensive and is usually undertaken either as part of a major research effort to green national and corporate accounting techniques (see, for example, the Index of Sustainable Economic Welfare developed by Daly and Cobb 1989, see also Pearce et al. 1988, Pearce and Turner 1990), or to reduce a wealth of data down to a single index as a necessary precursor to a statistical tests of the relationship between pollution/environmental performance and other, selected parameters (see, for example, Tyteca 1996). Typically the objectives and user groups of this research are significantly different to those of the business and management literatures that have focused instead on the design of tools to improve corporate environmental management. There may be target audiences or occasions when such simple indices are appropriate to the objectives of corporate environmental management, but as a general comment they can be said to be misleading since they necessarily obscure details of performance and provide no indication of where improvements could be made. Mitchell (1996:3), for example, concludes,

> aggregated single indices are contentious in construction, are often poorly supported by the required data, and are difficult to understand, doing little to communicate sustainability issues to most people

Ideal Type Versus Peer Group

One of the primary applications of environmental performance indicators is to benchmark. There is considerable debate over whether there is an appropriate absolute standard - an ideal type - against which an organisation's performance can be judged, or whether the only relative benchmarking is appropriate, with the benchmark set by current best-practice within the organisation's peer group. Since one of the more common objectives of corporate environmental policy is to achieve the status of leader in environmental management within the industry, the relative peer-group benchmark may be most practical and receive widest support.

The relative benchmark may not be the most useful if the objective of environmental performance measurement is to identify the opportunities for technological innovation, rather than to benchmark current performance across a number of different plants or firms. In some circumstances, therefore, it may be meaningful to evaluate current best-practice performance against possible future performance without being constrained by currently available techniques. Tyteca (1996) takes up this challenge and suggests that it may be appropriate in some circumstances to define a definitive, ideal standard. He distinguishes between a best-practice standard based on the current technological frontier – in which performance is defined relative to that possible using the limited set of actually existing, commercially available technologies for the process under consideration – and a second frontier based on an evaluation of the thermodynamic constraints underlying the process in question. Recognising the limited utility of this second frontier for most applications of performance indicators, Tyteca also suggests that there may be a third possible frontier - the target frontier - that can be applied in the measurement of environmental performance. Significantly this target frontier is based not on the technological conditions of production, but on the required quality standards of the receiving environment. The target frontier is specified for each polluting substance or environmental impact, and is tailored to meet the specific quality standards and requirements of the local receiving environment.

Normalised Versus Absolute

Normalised indicators are those that have been standardised by reference to some common denominator to assist the process of comparison. Common normalisation procedures include expressing an organisation's environmental performance in terms of, for example, releases per unit of product produced, material use per employee, hazardous waste generated per unit of wealth created, or atmospheric emissions per day. Absolute indicators refer to the actual figure for the plant or organisation in question prior to normalising. The discussion of absolute vs. normalised in the literature is less a debate than a courteous reminder to practitioners that both measures have their place, but that normalised data is essential to conducting meaningful comparisons. Absolute data should not be regarded as a second-best option. In some circumstances - an assessment of the impact of an organisation on the receiving environment over a given time period, for example - absolute figures on resource use or releases to the environment are a better gauges of the likely effect on local assimilative capacity.

Static Versus Dynamic

The debate over the relative merits of static indicators - which record events at a single point in time - compared to dynamic indicators - which represent change over time - is of limited value since the two types of indicator are not mutually exclusive. Dynamic indicators have the advantage of normalised data (since they are normalised by a common time period such as per year, per hour etc.) and can therefore be used to compare improvement in performance across a range of heterogeneous sites. To be meaningful indicators of environmental improvement, however, they need to be constructed by reference to reliable base-line data. In some cases, the appropriate baseline may simply be represented by data sets from previous years. In others, however, the function of the indicators will require that the base-line be constructed based on an assessment of natural background environmental conditions - such as groundwater quality, species diversity, or soil quality - in the vicinity of the operation. This is clearly possible if background conditions are assessed at the outset as part of the EIS process at greenfield projects, but establishing reliable background conditions becomes more complicated in the context of existing operations or in areas that have been historically disturbed. There are number of techniques such as back-casting or spatial comparisons with areas in the vicinity that have not been disturbed to assess potentially exiting conditions prior to disturbance (see, for example, OSM 1996) but the need for these relatively elaborate measures will be determined by the objectives guiding the development of indicators.

Generic Versus Specific

A common goal in the development of environmental performance indicators is the design of indicators that are sufficiently generic to be applied across a range of different sites, but which are also sensitive enough to capture key differences between sites. The challenge in designing indicators is to situate the indicator somewhere on the continuum between overly detailed site specific indicators which provide no basis for comparison between sites and a very limited, bland set of indicators which record only those few features which are common to all sites. Generic indicators are relatively easy to identify when dealing with

inputs (or causes as described above) because they share a common structure from site and site and are often already recorded in way that facilitates comparison (e.g. expenditure at each operation on meeting environmental compliance). They are more difficult to design for sources and environmental impacts since the expression of these can vary dramatically from site to site. Even here, however, the problem of site-specificity - the need to normalise for locally contingent conditions such as different production processes, mineralogical and climatological conditions, and environmental assimilative capacity - can be easily overstated.

It is possible in some cases to develop indicators of environmental performance which are highly site-specific, but which nonetheless can be compared against a common standard. This is true of those pollution sources whose environmental impacts are primarily global in scope rather than local and for which; therefore, local environmental assimilative capacity is not an issue. An example would be the release of carbon dioxide, methane, and other greenhouse gases, for which it is possible to compare the relative impacts of different operations in terms of their contribution to global increases in greenhouse gases. A number of different methodological techniques are also available for dealing with local specificity, one of the most common of which is to use dynamic indicators to express the extent of change compared to previous conditions at the site (see above). Another way is to express local releases as a percentage of existing pollution standards that are tailored to localised conditions. Tyteca (1996) for example, reports on a measure of performance developed by Cormier et al (1993) as part of a more general attempt to investigate the impact of environmental performance on a firm's market valuation. They developed a pollution performance index in which actual levels of pollution for a given plant (as registered by Environmental Ministries) were represented as a percentage of the pollution standard (as set by the Ministries for a given plant). The actual quantity taken as a measure of pollution varied between industrial sectors and for metal industries and mines it was taken as TSS (concentration of suspended solids). This approach is similar to that adopted by Wehrmeyer (1993) which assessed environmental performance by compiling the ratio of ambient concentration of a substance to that of the legal limit for that substance.

As a practical issue, the process of scoping stakeholder concerns at the project level can introduce a number of localised issues that may be highly specific to the site in question. This degree of site-specificity creates two possible options when constructing a list of possible indicators: a minimum core list of only those indicators which are common to all sites; and a maximum list of indicators from all sites but some of which will not be relevant to individual sites. There is no clear consensus from the literature on which is better or more widely applied, although there are some clear tradeoffs to be made between the two in terms of the resources dedicated to data collection and the quality of the information generated. There are good arguments to be made for constructing a maximum list covering all eventualities that could then be used at all sites. The maximum set could be evolved over time from the process of conducting stakeholder consultation at multiple sites throughout the company's operations. In conducting an environmental audit, a positive determination and justification would have to be made for excluding indicators if they are not appropriate for whatever reason. In some cases exclusion may be based on technical criteria - there is no source of sulphur dioxide emissions, for example - in other cases it may be based on social criteria - noise pollution is not regarded by local residents or the regulatory authority as a relevant issue.

Company approaches to indicators

The following table briefly reviews recent information available on the websites of some of the principal global mining companies. The absence of example indicators does not imply that indicators are not used, but rather that they are not reported on the website. The basis for indicators is developed, and with a few exceptions rather intangible, normally containing some elements from both 'off the shelf' and site-specific approaches, within a wider framework of regulations, industry standards and guidelines or other voluntary initiatives.

Table B1. Company approaches to indicators

		Example Indicators			
Company	Basis for Indicators	Environmental	Social	Economic	Reference
Alcan (British Columbia)	EMS and ISO 14001 accreditation	Compliance level	Community investment (>1% of pre-tax income)	Local supplier benefits (number of companies supplying to Alcan)	www.alcaninbc.com/performance1999
Alcoa	In-house Environmental, Health and Safety Value, Policy and Principles	Fluoride emissions (kg per tonne of Al)	None specified	None specified	www.alcoa.com/site/community/ehs/ehs.asp
Anglo-American	In-house, based on group-wide Internet based data acquisition system	Carbon dioxide emissions	Community diseases	Provision of local employment	www.angloamerican.co.uk

BHP Billiton	Integrated health, safety, environment and community policy and management standards, consistent with ISO 14001 and Australian Minerals Industry Code for Environmental Management	Release of greenhouse gases	Time lost due to illness and/or injury	Direct project employment	www.bhpbilliton.com/bb/sustainableDevelopment/home.jsp
Codelco	EMS	Consumption of water	Transparent terms of contracts negotiated with unions	Use of local employment	www.codelcochile.com/ingles/index2.html
Freeport-McMoRan	In-house, continuous improvement through auditing	None specified	None specified	None specified	www.fcx.com
MIM	Australian Minerals Industry Code for Environmental Management	Greenhouse gas emissions	Disabling injury frequency rate	None specified	www.mim.com.au
Noranda	Site-specific development of policies and programmes	Discharge of contaminants (tonnes)	None specified	None specified	www.noranda.com

Table B1 (cont'd). Company approaches to indicators

Norsk Hydro	In-house environmental principles and corporate directive "Management Guidelines for Social Aspects of Participation in Industrial Activities"	Waste generation	Total recordable injuries	Ratio of operating revenues to energy consumption	www.hydro.com
Phelps Dodge	Emphasis is on regulatory requirements and compliance	Report on 27 substances managed or moved at mining operations	Charitable giving	Not specified	http://www.phelpsdodge.com/
Placer Dome	Internal Sustainability Policy	Soil erosion	Social Impact Assessments	Increase in public revenues	www.placerdome.com/sustainability/index.asp
Rio Tinto	In-house, but integrated with all major 'mining and sustainable development' initiatives	Waste generation	Training of local community members for employment	Increase in public revenues	www.riotinto.com/library/microsites/socEnv2000/index_f.html
Teck Cominco	Policy adopted from the Mining Association of Canada	Reduction in greenhouse gas emissions	Not specified	Not specified	www.teckcominco.com/enviro/enviro.html

WMC	In-house, measured against UNEP criteria, and Environment Australia guidelines and integrated with financial reporting	Regulatory compliance – emissions to air	Community training programmes	Use of local employment	www.wmc.com.au/sustain/index.htm