Proceedings of GLOGIFT 09
November 12 – 14, 2009
National Institute of Industrial Engineering
Mumbai, India

Environmental indicators for innovation and sustainability

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ABSTRACT

The measurement and reporting of environmental performance of business companies has been the subject of intense research efforts during the last few years. Environmental indicators can provide an important tool for managers, while also providing valuable information to regulators, shareholders and other stakeholders, including researchers. Many companies already provide environmental information through statements to regulators, corporate environmental reports (CERs) and declarations under schemes such as the EU Eco-Management and Auditing Scheme (EMAS). Basic concepts, requirement of environmental indicators, investigation into how these can be put into practice, review of recent trends and developments in the field have been explored in the paper. Presently, there is an obvious lack of standardization among methods and procedures, especially as regards aggregation of environmental information. There is also an increasing need for more general indicators that would allow for assessing the contribution of business companies into the dynamics of sustainable development. The objective of measuring environmental performance of a company is to develop measures for internal assessment and comparison of overall environmental performance of companies.

***KEYWORDS**: Environmental indicators, environment performance evaluation, tools*

INTRODUCTION

During the last decade, there has been an increasingly intensive interest in assessing, measuring and documenting the environmental performance (EP) of industry. Pressure is increasing on companies to report on the environmental impact of their activities. While in the previous two or three decades the behavior of firms in this re-

spect was mainly dictated by government, some companies have begun to recognize the potential benefits of behaving more consciously and proactively in this area. In parallel to this, there is an increasing need for tools that allow for a proper and objective measurement and benchmarking of the performance of firms with respect to the environment. As J. Ladd Greeno and S. Noble Robinson pointed out as far back as 1992: "Demands on companies to measure, document and disclose information about environmental performance will become more invasive i.e., as the result of pressures from employees, neighbors, the general public, environmental groups and regulatory agencies. In the same way that public companies are measured by their financial results, environmental performance will increasingly become a critical factor to scrutinize" (Tyteca, 2002). In all cases, indicators can provide only partial information that may need to be qualified with information from other sources. Indicators are deliberately simple measures that stand as proxies for complex and often diffuse phenomena. Indicators indicate: awareness of their specific limitations and biases is an important aspect of their interpretation.

HISTORY OF INDICATORS

Companies are facing constantly competitive challenges: low cost was the most competitive priority of the 1960s, flexibility became the strategic weapon of 1970s, whilst the implementation of the total quality management (TQM) based programmers represented the most effective perceived managerial solution for achieving good performance in the 1980s (Azzone et. al 1996). At the beginning of the nineties, corporations considered their environmental performance and, in particular, the reduction of their impact on the 'state of the environment' by the implementation of environmental efficiency programmes (Bloom & Morton, 1991).An extensive literature search and evaluation about performance evaluation was done and many different approaches addressing the subject were found such as balanced scorecards (Kaplan and Norton, 1996), the Baldrige Award , intellectual capital , the triple bottom line (Elkington, 1999), executive dashboards (GRI, 2000), systems thinking , GEMI- measuring environmental performance and ISO 14031 were among others. All of them have a component related to performance evaluation, but the ones that address clearly the process of performance evaluation for management systems are the following standards: ISO 14031 and GEMI - measuring environmental performance. These standards focus primarily on environmental performance. Examples of several initiatives on environmental indicators (which represent the interests of a variety of company stakeholders in various combinations) are:

- Association of Chartered Certified Accountants (ACCA) Report on Environment-Related Performance Measurement (Bennett & James, 1998)
- Global Reporting Initiative (CERES, 1996)
- EU Eco-Management and Audit Scheme
- ISO 14031 – Environmental Performance Evaluation
- Guide to Corporate Environmental Indicators by the German Federal Environmental Agency
- WBCSD Report on Eco-efficiency Metrics
- National Round Table on the Environment and the Economy (NRTEE, 1997)
- EEA Working Paper on Eco-efficiency Indicators (Gee & Moll, 1998)
- World Resources Institute (WRI) Report (Ditz & Ranganathan, 1997)

Each approach has its different strengths and weaknesses with regard to several criteria, such as performance measurement or performance management, applicability within an environmental management system or reliability of data collection. Some of these initiatives, such as EMAS, ISO, by the WBCSD or the German Federal Environmental Agency, are more aimed towards internally oriented performance management whereas others are focused on external performance measurement (WRI, NRTEE, EEA, CERES, ACCA). Overall, the current practice of using environmental indicators in business shows little standardization and the use of many different environmental indicators.

DEFINING AN INDICATOR?

Decision making and management of complex issues requires methods for representing these issues by simple units of measure. These are called indicators, condensed information for decision making. Indicators are "specific measurement of an individual aspect that can be used to track and demonstrate performance. These are usually, but not always quantitative" (GRI 2000). Indicators are used to depict the vast quantity of environmental data of a firm in a comprehensive and concise manner. They are mostly applied to set absolute material and energy data in relation to other variables in order to increase the informational value of quantitative data. Indicators allow one to set targets for business performance and see improvements through careful monitoring. Measuring performance allows a company to determine objectively what is working and what is not. Indicators are important environmental tools for translating and delivering concise, scientifically credible information in a manner that can be readily understood by decision-makers at all levels of society.

Indicators should be:

- objective,
- understandable,
- significant (reflect all relevant aspects)
- responsive to stakeholder expectations
- allow for meaningful comparisons
- workable i.e. data required is readily available in practice
- allow a value judgment, ideally based on explicit value system
- relatively small in number
- sensitive to the conditions they are designed to measure
- predictive such that changes in indicator trends relate to changes in underlying conditions
- readily measurable to minimize the lag time between information gathering and interpretation

USES OF INDICATORS?

Communication is the main function of indicators: they should enable or promote information exchange regarding the issue they address. Communication demands simplicity. Indicators always simplify a complex reality. They focus on certain aspects which are regarded relevant and on which data are available. But their significance goes beyond that obtained directly from the observed properties.

External stakeholders need a set of Environment Performance Indicators (EPIs) on an aggregated scale that allows them to put pressure on the companies, to make sure that improvements are planned and implemented on a continuous basis. Internal stakeholders need more detailed EPIs to describe and control environmental performance of their products and individual activities or processes inside the company. In relation to policy-making, environmental indicators are used for three major purposes:

- to supply information on environmental problems, in order to enable policy-makers to value their seriousness
- to support policy development and priority setting, by identifying key factors that cause pressure on the environment
- to monitor the effects of policy responses

Environmental Key Performance Indicators (KPIs) provide businesses with a tool for measurement. They are quantifiable metrics that reflect the environmental performance of a business in the context of achieving its wider goals and objectives. KPIs help businesses to implement strategies by linking various levels of an organization (business units, departments and individuals) with clearly defined targets and benchmarks. The indicators are also used in reporting, planning, clarifying policy objectives and priorities, budgeting and assessing performance. Federal agencies, private corporations, local communities, and others develop environmental indicator sets to condense complex topics or concepts into a manageable amount of meaningful information. Environmental indicator sets also serve as powerful tools for communicating information on complex environmental issues in a way that makes them more comprehensible and accessible.

OBJECTIVES OF INDICATORS: The key objectives of an indicator are:

- To simplify a complex reality
- To quantify
- To communicate
- To raise awareness and understanding
- To inform decision-making
- To measure progress towards established goals of the company
- To provide information that helps evaluation and decision making within organizations that engage in environmental efforts.
- To provide a common foundation of information for organizations and external interested parties (such as consumers, business partners, residents in local communities, shareholders, and financial institutions)

Environmental indicators offer themselves to top management, environmental managers and other departments as comprehensive and concise key data sets in a vast sea of environmental information. They provide decision makers in firms with an overview of relevant progress, and highlight problem areas. On this basis, environmental targets can be backed up with concrete figures, which make the definition and pursuit of environmental targets controllable and verifiable. Furthermore, their connection to traditional indicators allows for the identification of potential monetary benefits. The strength of environmental indicators lies above all in the numerical

analysis of trends and year-to-year comparisons. Subject to regular evaluation and target control, environmental indicators can highlight adverse trends through environmental controlling, adopting the function of an "early warning system". Furthermore, benchmarking within a branch offers the opportunity to identify weak points and potential improvements.

Table 1 Different users and functions of environmental indicators inside and outside the firm. [Source: Environmental Indicators For Business: A Review of the Literature and Standardization Methods - (Olsthoorn et.al., 2000)]

Users/ decision context	**Function for the user**
Corporate manager	• To monitor a firm's "environmental" development in relation to strategic targets (derived from concern about future impacts of environmental developments). • To identify most harmful wastes and emissions • To communicate corporate environmental performance/ attitude to stakeholders (shareholders, environmental authorities, clients) • Reference performance in preceding periods/ years.
Production plant manager	• To identify opportunities for improvements of efficiency • To convey information on the efforts to limit environmental impact of plant operations
Market manager	• To identify new markets opportunities • To defend market positions. • Reference point competitors.
Purchasing manager	• Accountability. Business- to – business relation
Environmental authorities (compliance situation)	• To test compliance of firm with permits
Authorities (national)	• In voluntary agreements. • Communicating a firm's effort to environmental improvement. • Useful for constructing databases that are helpful in developing and implementing a government's environmental policy.
Investors & shareholders	• Indicator for financial performance; • May indicate environmental liabilities that could affect a firm's financial performance
Consumers	• To meet needs of green consumer

BUILDING ENVIRONMENTAL INDICATORS

Environmental data is often displayed without known standardization or conversion factors, and with limited information as to what the data refers to or includes. This makes comparability for external users difficult and external information users may find it difficult to make sense of such data. To increase transparency of performance and to increase credibility, it is preferable that all environmental data be normalized after which step the data can be standardized or aggregated to suit particular information needs (Figure 1). This sequence should improve comparability of data (through standardization), as well as reduce data complexity and increase the usability and suitability of data (aggregation).

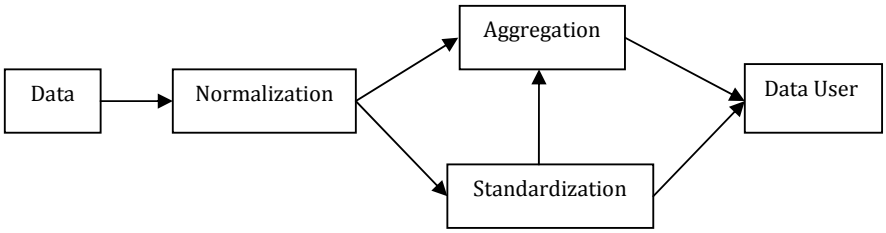

Figure 1 Stepwise approach to development of environmental indicators.
[Source: business organizational response to environmental challenges: performance measurement and reporting (Tyteca, 2001)]

Standardization refers to efforts to increase the comparability of environmental data. Normalization ensures that data is converted to units or to a form which relates it to a chosen standard or baseline or that it has common units. By contrast, aggregation refers to the transformation of data into different forms or formats to allow a better understanding or interpretation of the data. Aggregation of information aims to produce simple, but meaningful indicators that reflect a firm's overall environmental performance.

CLASSIFICATION OF INDICATORS

Selecting meaningful and effective tools for measuring environmental performance is becoming increasingly important due to the increasing costs of environmental operations; market, regulatory and public pressures; voluntary initiatives, such as the International Chamber of Commerce Business Principles for Sustainable Development; and international standards, such as the International Organization for Standardization (ISO) 14001. Many metrics are already in use.

CLASSIFICATION TYPE I

Kolk and Mauser (2002), summarizing the insights from three initiatives, the ISO 14031, the GRI and the eco-efficiency guide of the World Business Council for Sustainable Development (WBCSD), identify the following three distinguished elements of Environmental Performance Evaluation (EPE) (Diakaki 2006):

- *Environmental management indicators (EMIs).* These indicators provide information about the efforts of the management to influence the environmental performance of the organization's operations.

- *Environmental condition indicators (ECIs).* These indicators provide information about the direct impacts of the organization's operations on the environment and are particularly difficult to standardize or operationalize. ECIs describe the direct strain and impact on the environment. For example, they can highlight the effect of air emissions on the regional air quality, or the effect of water emissions on waterways in the vicinity of a production site. Because the effects of many environmental factors, such as eutrophication, reduction in biodiversity, global warming etc. display a high interdependency of causes (e.g. emissions of other production sites, households etc.), condition indicators are usually only applied by public institutions. Together with environmental political target setting, these national indicators can be used by firms to aid the selection of their performance indicators, as well as supporting their setting of priorities and goals. Only when a firm is the main cause of a local impact on a region, such as an airport producing noise pollution, air emission from the electricity sector or the water quality downstream from the pulp and paper sector, are these indicators to be applied by individual firms.

- *Environmental performance indicators (EPIs). These* indicators may be further subdivided into operational and impact indicators. The operational performance indicators (OPIs) provide information about the environmental performance of specific organization's operations, while the impact performance indicators (IPSs) provide information about the outputs of the organizations' operations.

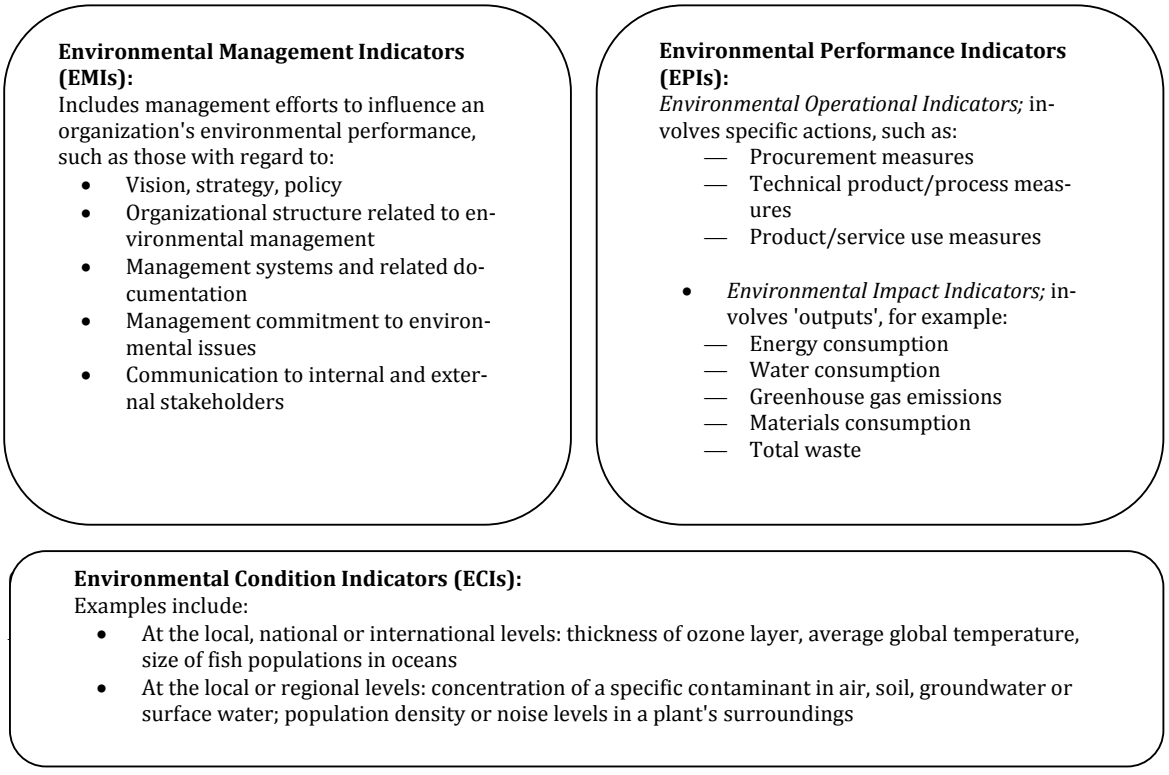

Figure 2 Components for environmental performance evaluation [Source: Kolk and Mauser (2002)]

Table 2 Summarizes the main aspects of both kinds of indicators. [Source: GEMI 1998,Measuring environmental performance: a primer and survey of metrics in use]

	Lagging Indicators	**Leading Indicators**
Type of measure	End-of-process or output indicators	In-process or management indicators
Approach	Quantitative	Qualitative and quantitative
Example	Pounds of toxic chemicals released to air, water, and land	Percent of facilities conducting self audits
Strength	Easy to quantify and understand; generally preferred by the public and regulators	Reflect current or future, rather than past performance
Weakness	Time lag in feedback loop; root causes not identified	May not address all stakeholder concerns; can be difficult to quantify and evaluate; hard to build support for use

CLASSIFICATION TYPE III

The European Environment Agency (EEA) has classified indicators into 4 simple groups which address the following questions (Environment indicators: Typology & overview Tech. report 25, 1999):

- 'What is happening to the environment and to humans?' (Type A or Descriptive Indicators)
- 'Does it matter?' (Type B or Performance indicators)
- 'Are we improving?' (Type C or Efficiency indicators)
- 'Are we on the whole better off?' (Type D or Total Welfare indicators)

CLASSIFICATION TYPE IV

There are three main types of environmental performance indicators, all of which can be used to track environmental performance (Envirowise, 2007):

- management (MPI)
- financial (FPI)
- operational (OPI)

MPIs are not designed to help improve resource efficiency directly, but they are important, for example, in terms of meeting company objectives and in the context of environmental management systems. MPIs are "a type of EPI that provides information about management efforts to influence the environmental performance of the organization's operations. MPIs relate to the policy, people, practices, procedures, decisions and actions at all levels of the organization" (Jasch C. 2000).

FPIs Because they combine resource efficiency and unit costs, FPIs can give misleading results, e.g. a fall in the value of an FPI may just reflect a drop in material costs.

OPIs Operational performance indicators (OPIs) are "a type of EPI that provides information about environmental performance of the operations of the organization, and OPIs relate to:

- the design, operation, and maintenance of the organization's physical facilities and equipment;
- the materials, energy, products, services, wastes, and emissions related to the organization's physical facilities and equipment; and
- the supply of materials, energy and services to, and the delivery of products, services and wastes from the organization's physical facilities and equipment". ECIs provide information about the condition of the environment which may be useful for the implementation of environmental performance evaluation within an organization.

Operational performance indicators evaluate the actual environmental aspects of firms. They are sub-divided into mass and energy indicators as taken from the input–output analysis, and infrastructure and traffic indicators. Examples include electricity consumption per production unit, total waste, average petrol consumption of the transport fleet. OPIs are the basis of internal and external communication of environmental data, such as for the EU-EMAS Regulation or for the education of the workforce. Extending their application to cost analysis also allows for their use in environmental cost management. The organization's operations include physical facilities and equipment, as well as the supply to and delivery from them.

CLASSIFICATION TYPE V

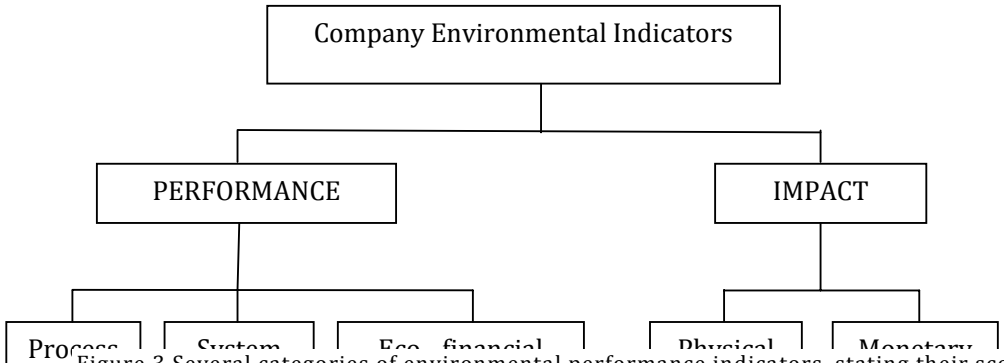

Figure 3 Several categories of environmental performance indicators, stating their scope & goals [Source: Business organizational response to environmental challenges: performance measurement and reporting (Tyteca, 2001)]

ORGANISATIONS INVOLVED IN DEVELOPMENT OF INDICATORS

There are several organizations which take the initiative to develop indicators or their frame works to facilitate the business. Some of the important organizations are given below.

Global Reporting Initiative (GRI) - The GRI is a unique, multi-stakeholder organization founded on the conviction of consistent, regular and comparable reporting provides transparency and can be a powerful catalyst to improve business performance. The GRI's vision is that reporting on economic, environmental, and social performance by all organizations becomes as routine and comparable as financial reporting. (TABLE 3)

International Organization for Standardization (ISO) is the world's largest developer and publisher of International Standards. ISO is the International Organization for Standardization. It is made up of national standards institutes from countries large and small, industrialized and developing, in all regions of the world. ISO develops voluntary technical standards which add value to all types of business operations. They contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. ISO standards also serve to safeguard consumers and users in general of products and services and to make their lives simpler. (TABLE 3)

ISO 14031 Environmental performance evaluation (EPE) is “an internal process and management tool designed to provide management with reliable and verifiable information on an ongoing basis to determine whether an organization's environmental performance is meeting the criteria set by the management of the organization”.

Table 3 Organizations and their environmental indicators

GRI INDICATORS	**DEFRA**	**ISO**	**CII-ITC**
Materials- used other than water wastes used Energy- consumption & their sources Water- Total water use Biodiversity- land , location & biodiversity Impact on biodiversity Emissions, Effluents & wastes- Green house gas, climate change ODS Emissions Waste handling Effluent management Significant spills Suppliers- Products & Services- Significant environmental impacts of principle products & services Recycling & reuse of products Compliance- Environmental compliance status Transport- Overall-	GHG emissions- Green house gas Emissions CO2 gas emission Electricity generation- Renewable energy Resource use- Domestic material consumption Energy consumption Waste abstraction Waste-- Natural resources-- Bird populations Agricultural inputs Protected areas Fish landings Emissions of air pollutants Environment equality Air quality & health Local environment quality	Environmental measurement and improvement Prevention of pollution and resource conservation Hazardous material management/substitution Environmental communications Waste management Water management (e.g., waste, storm, ground) Environmental incident response and preparedness Air quality management Environmental awareness and training Energy management; and Transportation	Resourse use efficiency Stakeholders perception Status of complaince to regulations Use of Innovative environment tools Greening of supply chain Policy , management systems and governance Transparency & reporting Multilateral environment agreements Awards , recognition & certifications Training
	KPMG	**WBCSD**	**ACCA**
	Direct & indirect CO2 emissions SO2 emissions Total energy use Water consumption	Environmental audits Quarry rehabilitation Emissions reduction Energy consumption Waste production & recycling Waste recovery Alternative / renewable fuels Water consumption	Ecological footprint analysis Approaches to assess environmental Impact- LCA- life cycle assessment MAB-mass balance analysis EMFA- energy & material flow analysis MIPS- Material intensity per unit service

GRI: Global Reporting Initiative
DEFRA: Department for Environment, Food and Rural Affairs
ISO: International Organization for Standardization
CII – ITC: Confederation of Indian Industry and Indian Tobacco Company
ACCA: Association of Chartered Certified Accountants

Triple-Bottom Line Reporting (TBL): TBL accounts routinely cover social, economic and environmental indicators and enable decision-makers to quantify trade-offs between different facets of sustainability. Corporations are beginning to apply the concept of sustainability at a practical level in terms of corporate citizenship or Corporate Social Responsibility (CSR). CSR is currently dominated by the notion of the Triple Bottom Line.TBL was a term originally coined by John Elkington to describe corporations moving beyond reporting only on their financial "bottom line" to assessing and reporting on the three spheres of sustainability: economic, social and environmental. Triple Bottom Line can be viewed as a reporting device (e.g. information presented in annual reports) and/or an approach to improving decision-making and the fundamental functions of organizations (e.g. the provision of tools and frameworks for considering the economic, environmental and social implications of decisions, products, operations or future plans). It can reduce risk, assist in delivering better outcomes for employees, shareholders, customers and clients, and enhance reputation.

Triple-Bottom Line Accounting of Social, Economic and Environmental Indicators - A New Life-Cycle Software Tool- A new TBL software tool, developed at the University of Sydney, has been adapted to the UK economy (www.bottomline3.co.uk). An organization's financial accounts, together with onsite impact data, act as input. Software outputs include aggregate figures, detailed breakdowns and rankings of economic, social and environmental indicators. Sector benchmarking, structural path analysis (upstream supply chain analysis), production layer decomposition and quantification of 'shared responsibility' are available for all indicators. TBL Accounting has been formulated as a quantitative framework using an input-output-based LCA method.

As a result, a software tool was developed in collaboration with the using organizations, enabling users to create a comprehensive sustainability report solely by importing their existing financial accounts. This software tool is called Bottom Line 3, or short BL3 ("BL-cubed").

The World Business Council for Sustainable Development (WBCSD) is a CEO-led, global association of some 200 companies dealing exclusively with business and sustainable development. The Council provides a platform for companies to explore sustainable development, share knowledge, experiences and best practices, and to advocate business positions on these issues in a variety of forums, working with governments, non-governmental and intergovernmental organizations. Its mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues. The Council's objectives are to:

- Be a leading business advocate on sustainable development;
- Participate in policy development to create the right framework conditions for business to make an effective contribution to sustainable human progress;
- Develop and promote the business case for sustainable development;
- Demonstrate the business contribution to sustainable development solutions and share leading edge practices among members;
- Contribute to a sustainable future for developing nations and nations in transition

Eco-efficiency is one of the tools from WBCSD of sustainable development. "Eco-efficiency harnesses the business concept of creating value and links it with environmental concerns. The goal is to create value for society and for company, by doing more with less over a life cycle." The purpose of Eco-efficiency indicators is to help companies evaluate their performance over time with respect to material and energy productivity and pollutant dispersion.

Elements of Eco-efficiency include:

- Reducing the material requirement for goods and services
- Reducing the energy intensity of goods and services
- Reducing toxic dispersion
- Enhancing material recyclability
- Maximizing sustainable use of renewable resources
- Extending product durability

- Increasing the service intensity of goods and services
- Eco-efficiency tool - This tool was developed to assist small and medium-sized manufacturers.

Confederation of Indian Industry and Indian Tobacco Company (CII-ITC) Centre of Excellence for Sustainable Development is an institution that creates a conducive, enabling climate for Indian businesses to pursue sustainability goals. It creates awareness, promotes thought leadership, and builds capacity to achieve sustainability across a broad spectrum of issues. It enables Indian businesses become sustainable, and channels the potential of Indian industry to power India's agenda for inclusive growth and sustainable development. It enables businesses transform themselves by embedding the concerns of sustainable development into their own strategies and processes. (Table 4)

The Centre of Excellence:-

- Conducts advocacy and initiates awareness generation activities to the industry in all parts of India on triple bottom line issues.
- Conducts professional training for capacity building on sustainable development not only for the large companies but also the medium and small companies.
- Recognizes and reward companies that contribute to sustainable development and promote role models in different sectors of the Indian Industry.
- Encourages sustainability thought leadership

DEFRA – Department for Environment Food and Rural Affairs. It's aim is to protect and improve the environment, and to integrate the environment with other policies across Government and in international fora. DEFRA has given 22 environmental KPIs which act as indicators for businesses. Sustainable Development Action Plan (SDAP) commits DEFRA to take specific action to achieve progress towards each of the four priorities in DEFRA , (2008).

- Sustainable consumption and production
- Climate change and energy
- Natural resource protection and environmental enhancement
- Creating sustainable communities and a fairer world

KPMG- KPMG is the global network of professional services firms whose aim is to turn understanding of information, industries, and business trends into value. KPMG was established in India in September 1993, and has rapidly built a significant competitive presence in the country. The firm offers its clients a full range of services, including financial and business advisory, tax and regulatory, and risk advisory services. In India, KPMG has a client base of over 2000 companies. The firm serves leading information technology companies and has a strong presence in the financial services sector in India while serving a number of market leaders in other industry segments. (KPMG, 2008)

ACCA (the Association of Chartered Certified Accountants) is the global body for professional accountants. They aim to offer business-relevant, first-choice qualifica-

tions to people of application, ability and ambition around the world who seek a rewarding career in accountancy, finance and management. Many approaches have been proposed by ACCA which can be used by companies to monitor their house keeping practices . (ACCA, 2008)

CONCLUSIONS

An indicator is user specific. Different indicators are used by different companies as per their requirement and special indicators are also built to measure some specific processes in a firm. For proper evaluation of a firm's environmental performance it should have a combination of some specific as well as some general indicators. Indicators reduce the number of measurements and parameters that normally would be required to give an exact presentation of a situation. Indicators also simplify the communication process by which the results of measurement are provided to the user. Due to this simplification and adaptation to user needs, indicators may not always meet strict scientific demands to demonstrate causal chains. Indicators should therefore be regarded as an expression of "the best knowledge available". An important aspect of any kind of indicator is the necessity to take account of as many relevant characteristics as possible. Not only could they be exploited to compare firms of a given industrial (sub-) sector in a national context, but perhaps more importantly in a sustainability perspective, they could serve to compare firms or sectors that can significantly differ in the way they take social and environmental goals into account. This can result in the formulation of adequate corrective actions since the causes of un - sustainability can be detected from the indicators. And here we return to the ultimate objective of using indicators, namely, providing the stakeholders with adequate tools to adopt regulations and incentives that will ensure overall sustainability. Although there has been significant progress in building, implementing and exploiting environmental performance indicators over the last few years, we are still far from complete standardization and universal use by private companies and public decision makers.

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