NEW TRENDS IN ENVIRONMENTAL AND SOCIALLY RESPONSIBLE MANAGEMENT IN THE CEMENT MANUFACTURING

By

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ABSTRACT

New Trends in Environmental and Socially Responsible Management in the Cement Manufacturing

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Keywords: Benchmarking; Corporate Social Responsibility; Global Warming; Sustainability; Air Pollution; Triple Bottom Line; Cement Manufacturing.

This thesis explores the environmental and social responsibilities being increasingly shouldered by cement manufacturing sector and outlines a new approach for these companies to accept their responsibilities and to utilise professional approaches to address the economic, environmental and social dimensions of sustainable business. Managing these three dimensions in business translates corporate responsibility into an integrated responsibility for doing business profitably, ethically and in sustainable manner. This three-pronged approach is sometimes called the Triple Bottom Line. It helps companies to fulfil their more holistic Corporate Social Responsibility. A critical review of the literature led the thesis author to develop the theoretical framework for environmental and social reporting to proceed on TBL/CSR journey within the cement industry. Data were collected from TBL/CSR reports from cement companies on key environmental and social performances. Based upon those data, a questionnaire was developed to obtain more information from the leading worldwide cement companies. The combined results of the responses to the questionnaire and the quantitative data derived from the TBL/CSR reports were used to establish best practice benchmarks to serve as performance targets for the author's case study company, Oman Cement Company (OCC).

The contribution to knowledge of this research is the summarisation and prioritisation of the cement industry's implementation of TBL/CSR management systems, which

integrate the elements of TBL/CSR into their strategic plans and daily operational procedures. Guidelines were derived from the Global Reporting Initiative, the United Nations Global Compact and the new ISO 26000 standard, which promotes a new way of working towards innovation, value creation and incremental actions for transforming businesses to become more responsible.

The contributions to practice of this research are the practical and procedural insights, gained by quantitative analysis of environmental and social indicators, into how cement companies are making improvements in their processes and products in response to climate change, economic, governmental regulations and social pressures for improvement. Based upon the findings, recommendations and timetables were developed and are being implemented within the OCC as it progresses on its TBL/CSR journey.

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Glossary of Terms

Absolute gross emissions

The total amount of CO_2 emitted from cement production activities.

Aggregates

Quarried materials (crushed limestone, gravel and sand) are the main components by volume of concrete. Aggregates are mainly used in the following construction sectors: manufacture of ready mix concrete, concrete goods and asphalt as well as for roadbeds and railway foundations.

Alternative fuels and raw materials (AFR)

Energy and/ or material inputs to clinker production derived from waste streams or by-products from other industries.

Allowance

A GHG allowance is a commodity giving its holder the right to emit a certain quantity of GHG.

Annex 1

Annex 1 to the UNFCCC lists the developed country parties that have special responsibilities in meeting the objectives of the convention. They include the OECD countries (excluding Mexico and Korea, the countries of eastern Europe, Russia and the European Union)

Biodiversity

Biodiversity or biological diversity is the genetic diversity within species, diversity between species and diversity of ecosystems.

Cap and Trade

A system that sets an overall emissions limit, allocates emission allowances to participants, and allows them to trade allowances and emission credits with each other.

Cement

Cement is a building material made by inter-grinding gypsum and calcined limestone and clay to a fine powder. It acts as the binding agent when mixed with sand, gravel or crushed stone and water to make concrete.

Cementitious material or product

A substance which when mixed with water forms a paste that subsequently hardens.

CKD

Discarded dust from kiln system de-dusting units, consisting of partly calcined kiln feed material. CKD is some- times used to denote all dust form cement kilns inclusive of bypass dust. Extraction and discarding of bypass dust and CKD serve to control excessive circulating documents elements (alkali, sulphur, and chlorine)

Clinker

An intermediate product in cement manufacturing, produced by de-carbonisation of ground limestone and additives, which is sintered, and fast cooled.

Clinker factor

The percentage of clinker in cement (according to the WBCSD Carbon Dioxide Protocol)

Concrete

A material produced by mixing cement, water and aggregates. The cement acts as a binder, and the average cement content in concrete is about 15%.

Composite cement

Cement with fixed percentage of secondary cementitious material, such as slag and fly ash, replacing the clinker portion of the cement.

Co-processing

Using the cement manufacturing process to recycle, re-use or treat waste while simultaneously manufacturing cement in a single combined operation.

Corporate social responsibility (CSR)

The commitment of business to contribute to sustainable development, working with employees, their families, the local community, and society at large to improve their quality of life.

Eco-Cement

This type of cement has relatively high proportion of Magnesia. It re-absorbs chemical releases, permitting carbon dioxide sequestration.

Eco-efficiency

Reduction in the material and energy resource intensity of production compared with the output thereby doing more with less.

Fossil fuels

Non-renewable carbon-based fuels traditionally used by the cement industry, including coal, oil and natural gas.

Industrial ecology

Framework for improvement in the efficiency of industrial systems by imitating aspects of natural ecosystem, including the transformation of wastes from one process or company to be used as input materials and/or energy for other processes or companies.

Kiln

Large industrial, cylindrical-oven for producing cement-clinker. In this thesis, “kiln” always refers to rotary kiln.

Lost time injury (LTI)

A work related injury after which the injured person cannot work for at least one full shift/ full working day.

LTIF

Number of Lost time incidences per million man-hours.

Mineral components

Cement constituents, which are not derived from clinker production. They include blast furnace slag, fly ash, natural pozzolana and limestone.

Occupational health and safety (OH&S)

Polices and activities to promote and secure the health and safety of all employees, subcontractors, third parties and visitors.

Ordinary Portland cement

Most commonly used cement that consists of approximately 95% ground clinker and 5% gypsum.

Pyro-processing

Processing of kiln feed at high temperature in a furnace to undergo a series of chemical reactions to form cement clinker.

Ready mix concrete

Concrete is a well-dosed mix of cement, aggregates, water and admixtures. It is one of the most widely used building materials in the world.

Secondary cementitious materials

Industrial by-products such as, blast furnace slag and fly ash that have cementitious properties, which are used to substitute clinker in cement.

Severity Rate

Number of lost working days per million man-hours.

Shotcrete

It is a concrete (or sometimes mortar) conveyed through a hose and pneumatically projected at high velocity onto a surface, as a construction technique. Shotcrete undergoes placement and compaction at the same time due to the force with which it is projected from the nozzle. It can be impacted onto any type or shape of surface, including vertical or overhead area.

Specific gross emission

The gross amount of CO_2 emitted per tonne of cement produced.

Specific net emissions

The net CO_2 emitted per tonne of cement is the total CO_2 emissions minus credit for alternative and biomass fuel consumed per tonne of cement produced.

Stakeholder

A group or an individual who can affect/or is affected by an organization or its activities.

Stakeholder dialogue

The engagement of stakeholders in a formal and/or informal process of consultation, to explore stakeholder's needs and perceptions.

Subcontractors

Full time personnel working for the company, who are not on its normal payroll.

Waste

A substance or object whose owner discards it, wants to discard it, or has an obligation to discard it.

WBCSD Carbon Dioxide Protocol

Internationally accepted standard methodology for monitoring and reporting CO_2 emissions from cement production.

List of Acronyms & Abbreviations

A

AFR: Alternative fuels and raw materials

C

CEMBUREAU: The European Cement Association, Brussels

CDM: Clean Development Mechanism

CEO: Chief Executive Officer

CERES: Coalition for Environmentally Responsible Economies

CKD: Cement Kiln Dust

CO_2: Carbon Dioxide

CSDR: Corporate Sustainability Responsibility

CSI: Cement Sustainability Initiative

CSR: Corporate Social Responsibility

E

EMR: Emissions Monitoring and Reporting

EMS: Environmental Management System

EIPPC: European Integrated Pollution Prevention and Control

EPA: Environmental Protection Agency

EUETS: European Union's Emission Trading System

G

GJ: Giga Joule

GRI: Global Reporting Initiative

GTZ: Gesellschaft fur technische Zusammenarbeit (German Technical Cooperation)

GWh: Giga Watt Hour

I

ISO: International Organization for Standardization

ISO: 9001: Quality Management System Standard

ISO: 14001: Environmental Management System Standard

K

KWh: Kilowatt Hour

L

LITIFR: Lost Time Injury Frequency Rate

M

M: Million

MJ: Mega Joule

N

NGO: Non-Governmental Organization

NOx: Nitrogen Oxides

O

OH&S: Occupational Health and Safety

OHSAS18000: Occupational Health and Safety Management Standard

P

PCA: Portland Cement Association, USA

PCB: Poly Chlorinated Bi-phenyls

PEP: Plant Environmental Profile

PAH: Poly-aromatic Hydrocarbons

Q

QPH: Quartzophyllades

S

SD: Sustainable Development

SO_2: Sulphur Dioxide

T

TJ: Tera Joule

U

UN: United Nations

UNEP: United Nations Environment Programme

UNDSD: United Nations Division of Sustainable Development

UNFCCC: United Nations Framework Convention on Climate Change

V

VOC: Volatile Organic Compound

W

WBCSD: World Business Council for Sustainable Development

WRI: World Resource Institute

Acknowledgements

Having spent over three decades in manufacturing operations of cement production and then to decide on thesis writing by spending most of the time, which a practicing manager gets to recuperate for the next working day, was very challenging. Most often, I had to steal the time, which would have been shared with my family. I always felt that it was an injustice to them but my wife Lila, daughter Leema, son-in-law Anuj, son Vishal and daughter-in-law Rupangi were very supportive and encouraged me to pursue this task for a bigger cause.

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Thesis Structure

Chapter 1 begins with an introduction to the cement-manufacturing sector so that the reader learns about the details of cement-manufacturing processes, gains insight into the diverse issues involved in cement production and obtains an overview of the environmental, economic and societal roles of cement production and usage in global economy. The thesis author examined the contextual background of current situation prevailing in the majority of cement plants, the measurement and monitoring status of environmental and social indicators, and the growing concern about evolving roles of the cement industrial sector in regard to local, regional and global climate change.

In **Chapter 2**, the author presents a timeline of developments in the environmental sustainability agenda. Some of the environmental disasters, which have raised issues of business ethics and which have triggered crucial stages of evolution in corporate environmental management systems are highlighted. He then focuses upon the cement industrial sector with an overview of the work done by Cement Sustainability Initiative in the environmental and social context pertinent to this internationally prominent industry. This chapter presents the theoretical context of this thesis and further reviews the literature on Triple Bottom Line/Corporate Social Responsibility (TBL/CSR) and various sustainability reporting tools, which form the foundation for much of the subsequent thesis. Issues of climate change and its relevance to the cement industry along with Kyoto Protocol related tools such as the Emissions Trading Scheme, the Clean Development Mechanism and related voluntary measures are examined for their possible application in the cement industry. Various reporting tools for the TBL/CSR journey and the present status of TBL/CSR implementation in the cement industry are explored. An examination of the drivers and barriers of TBL/CSR in the cement industrial sector and benchmarking for best practices on TBL/CSR key performance indicators for the cement industry is reviewed. Critical review of past scholarship along with conceptual framework for this thesis concludes this chapter.

In **Chapter 3**, the author provides a broad review of some scientific concepts, paradigms and methods in order to contextualise this research. Further, in this chapter, the thesis author provides the details of the research concepts, framework rational, research questions, theories and methods he used in performing the research for this thesis.

In **Chapter 4**, the author presents and evaluates the economic, environmental and social performance indicators data collected from leading cement companies, which represents over 70% of world cement production, and from various other process industries are presented with a detailed analysis of data from the cement companies, which reported on their performance on economic, environmental and social dimensions.

In **Chapter 5**, the author presents his arguments and answers to the research questions on the basis of data obtained and presented in Chapter 4. He also included the details of his recommendations to Oman Cement Company (SAOG) as it progresses on its TBL/CSR journey.

In **Chapter 6**, the author provides a discussion on the possible benefits and opportunities for the cement manufacturing companies willing to proceed on their TBL/CSR journey. Findings and contributions of this research along with limitations of this research work are presented in this chapter.

The author hopes that this thesis will provide useful insights and stimuli for other cement companies to embark upon their TBL/CSR journey.

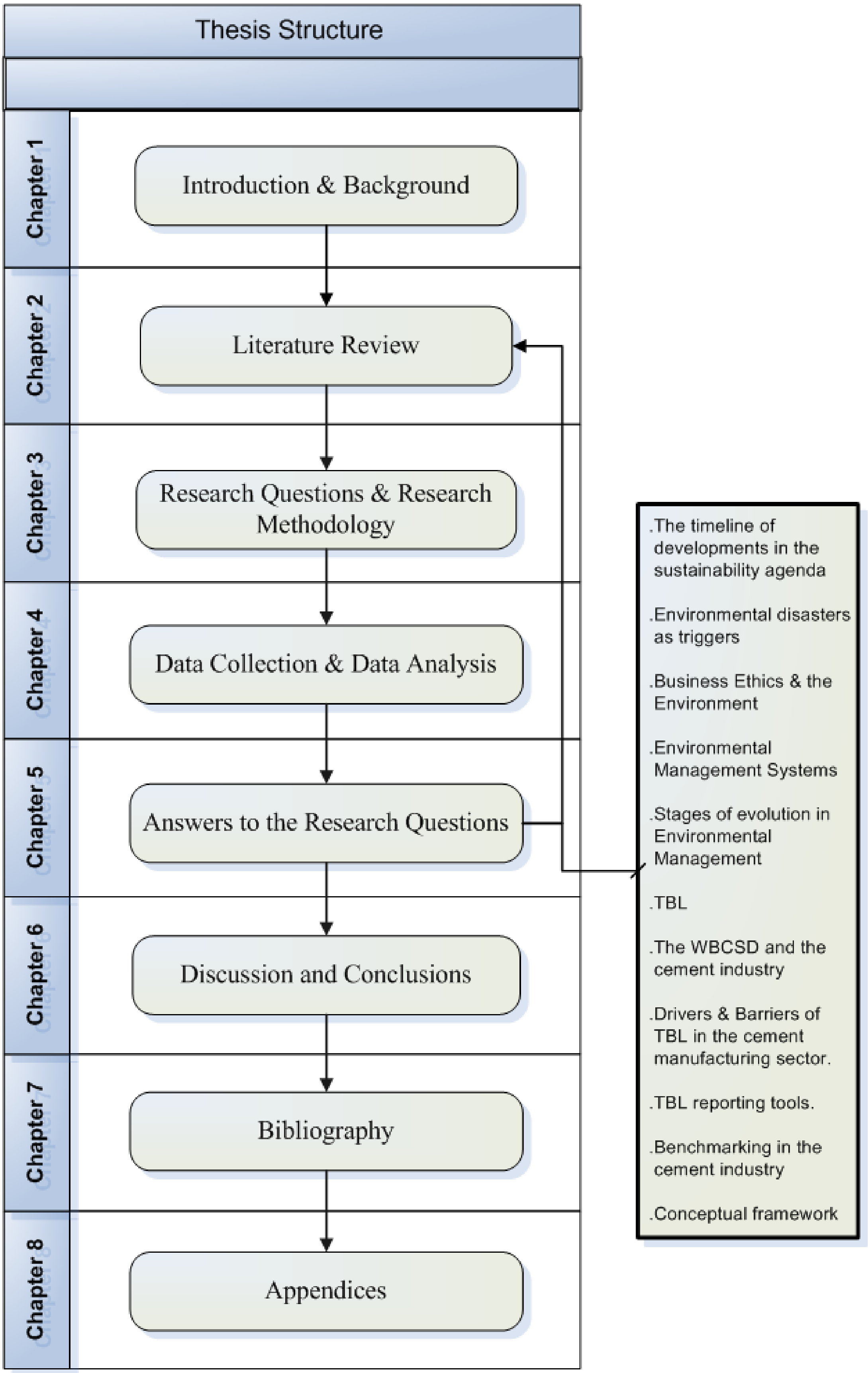


Figure 0-1- This is a diagrammatic outline of the research thesis structure, Source: Author (2010).

1. Chapter 1 - Introduction

In this Chapter, the historic evolution of the worldwide demand and supply for cement is reviewed in relation to the expected growth in demand for cement products. The author also addresses the relationships between the anticipated increases in cement production and the consequent increases in the GHG emissions from this sector. With increases in GHG emissions, various environmental and social issues become increasingly urgent; consequently mitigation of these problems is essential.

During the last two decades, more and more corporations have realised that it makes good economic, ecological and ethical sense for them to strive to move from a sole focus upon the single bottom line of economic profits to striving to achieve the broader facets of the Triple Bottom Line (TBL). Some business leaders realise that working towards achieving the TBL is essential for their very survival in the context of increasing stakeholder demands. Jennings (2004) illustrated examples of Novo Nordisk, Shell, BP, South African Breweries, Cascade Engineering, British Telecom, and many other companies working towards TBL integration in their day-to-day business. Some cement companies have responded in by implementing the holistic TBL and Corporate Social responsibilities (CSR) approaches. These leading cement company's actions were used in the benchmarking process for this thesis.

Cement is one of the basic building blocks of society. From time immemorial, it has been used in construction activities. Joseph Aspdin (1824), an English mason, patented cement, which he called "Portland Cement" because it resembled stone quarried on the isle of Portland, off the English coast. Aspdin's recipe was a mixture of limestone and clay, pulverized, burned and reground into cement. In simple words cement is inorganic "glue" which binds when mixed with water. Callister (1994) stated that cement is manufactured by mixing together several natural ingredients viz. limestone, clay, iron ore and bauxite in a defined proportion, heating the mixture to a temperature of 1450^0C (2640^0F), and grinding the resulting material (clinker) with Gypsum to a powder.

This relatively inexpensive and durable construction material is used throughout the world for construction of roads, bridges, dams, seaports, airports, buildings and other infrastructure projects. The unprecedented demand of cement has lead to tremendous growth in the cement industry's manufacturing capacity worldwide. The following section provides details of current and future projected demand and supply of cement in various countries.

1.1 Demand and Supply Scenario of Cement

The demand for cement is growing as the human population continues to increase. The per capita cement consumption has increased tremendously. Figure 1-1 is a scatter diagram plotted for cement consumption per capita in kilograms verses GDP per capita in US dollars. It provides evidence of the cement demand worldwide. Since, large quantities of data from more than 55 countries are presented, clustering of consumption are evident within the diagram. The data show the consumption patterns for matured markets, developing markets and countries struggling to survive.

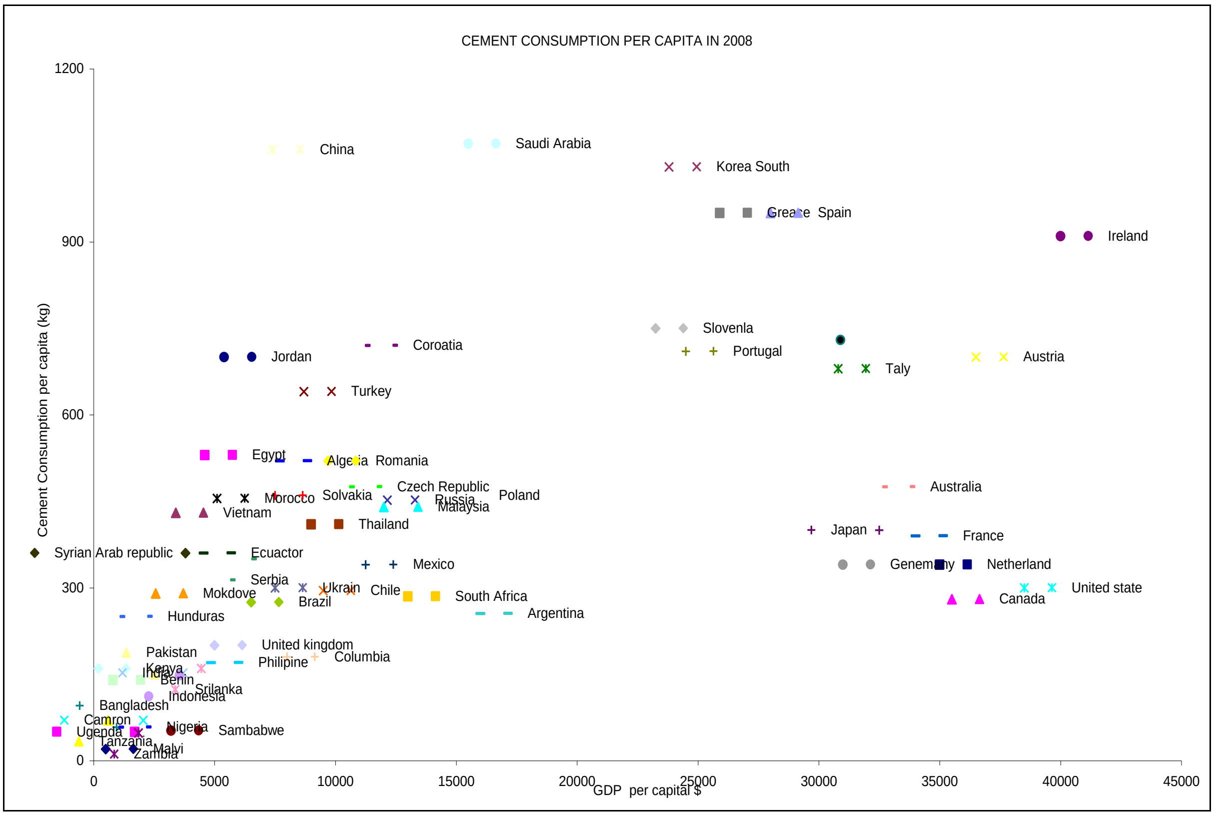


Figure 1-1: Per Capita Cement Consumption in 2008; Source: CEMBUREAU (2009)

Figure 1-1 presents data from a large number of countries with a low per capita GDP. It is clear that their low per capita cement consumption clusters near the X and Y-axis intersection. (Viz. Cameron, Zambia, Tanzania, Uganda, Malawi and etc.) The data are presented in Kg of cement consumption per capita per year in relation to GDP per capita on country-by-country basis. It is interesting to note that consumption of cement in developed countries like USA, Japan, Canada, France, Germany, Netherlands and Australia has stabilised at an average consumption of 330 kg per capita per year. However, for developing countries like China, South Korea, Saudi Arabia and others, have consumption above 1000kg per capita per year. R. Chehouri (2009) reported that countries like Qatar and UAE have cement consumption, 4,000 and 3,800 Kg per capita per year respectively, in 2008.

Figure 1-2 shows the projected cement demand on the basis of past consumption with an average growth rate of 5% per annum.

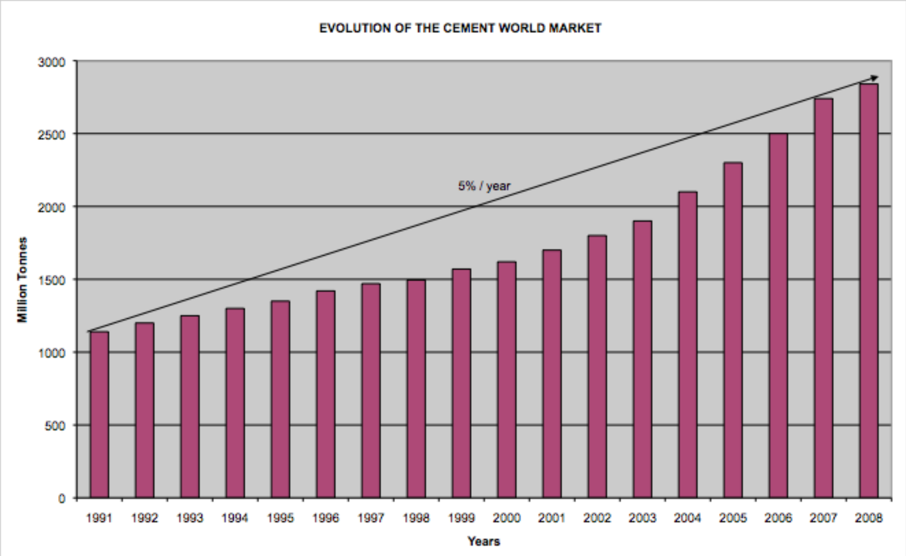


Figure 1-2: Evolution of the global cement market from 1981 to 2008, Source: CEMBUREAU (2009)

It is valuable to observe from the data presented in Figure 1-3 that the forecasted cement production by 2050 is about 5300 Million tons; this is more than a two-fold increase in production since 2008.

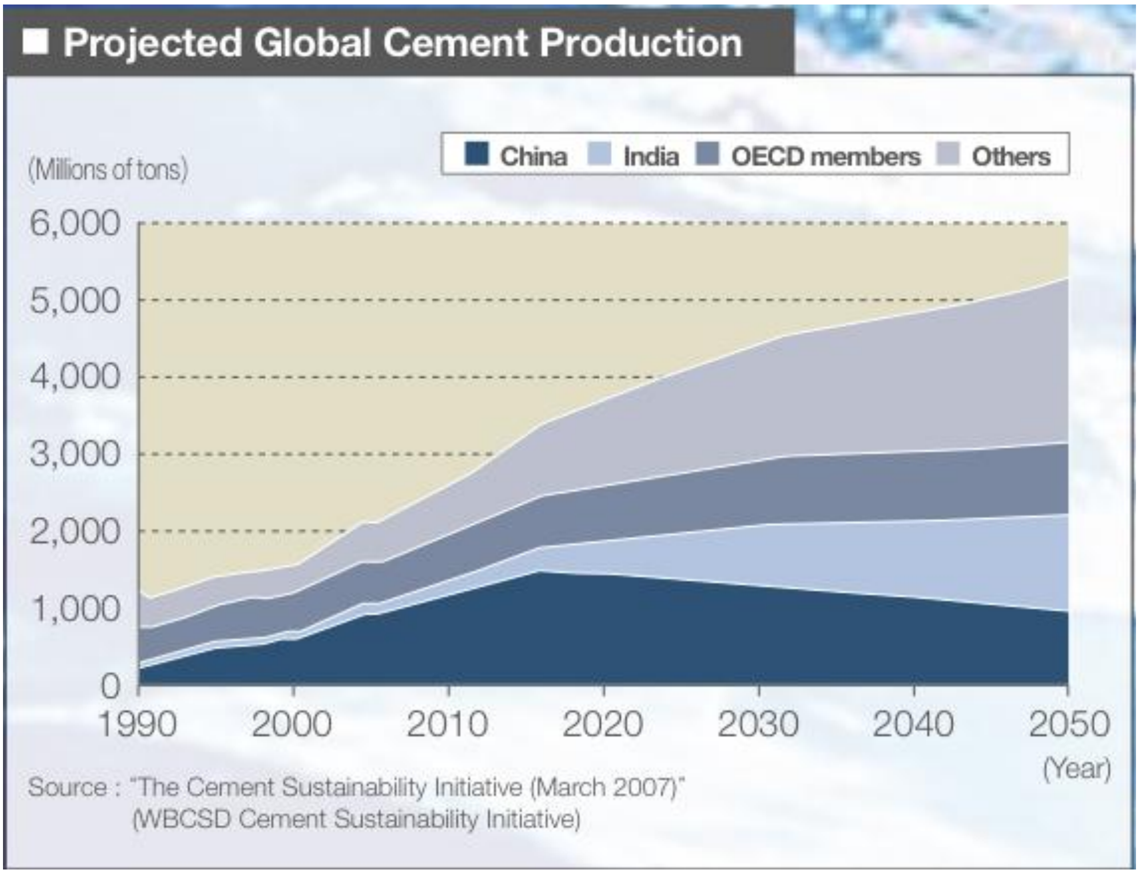


Figure 1-3: Projected Global Cement Production to 2050, Source: WBCSD (2007)

1.2 Manufacturing of Cement

Today, cement is produced in more than 150 countries with a more or less similar recipe but the process technology has undergone many improvements. Cement is produced either by a wet process or a dry process technology. These processes are distinguished by the amount of water present in the feed streams of the cement kilns. The wet process consumes much more fuel than the dry process because more heat is required for drying the kiln feed. The wet process plants use approximately 4,800 kJ/kg of clinker with water content of 35% in the kiln feed. New dry process plants with six-stage pre-heater and in-line calciners, consume about 2,950kJ/kg of clinker, whereas four-stage pre-heater dry process plants consume approximately 3,450kJ/kg clinker. Sillem et al (1977) reported that change in process technology from "Wet" to "Dry" have resulted in energy savings of approximately 39%, these improvements are primarily due to technological improvements such as high efficiency burners, low pressure drop and high efficiency cyclones, and improved design of pre-calciners. Most commonly, fossil fuels are used for heating the cement kilns, but recently alternative fuels are being blended with fossil fuels in some cement companies in order to conserve fossil fuels.

If we consider the history of improvements in the kiln system over the last century, it can be noted that the technological milestones have considerably reduced the energy consumption and therefore, the carbon dioxide emissions per unit of product. A brief description of the technological milestones in the history of kiln system is presented in Table 1-1:

Year	Kiln systems
1850	Intermittent shaft/bottle kilns in use;
1864	Introduction of the Hoffmann annular kilns as a first step of conversion from Intermittent to Continuous process;
1877	Patenting of rotary kiln by Crompton;
1883	Improving in shaft kiln by Dietzsch;
1855	Further patent on rotary kiln by Ransome;
1888	Another patent on rotary kiln by Stokes; continuous shaft kiln design by Hauenschilo;
1896	Practical development of the rotary kiln in USA by Hurry and Seamen;
1903	Installation of chamber kilns but not widely adopted due to the advent of Rotary kilns;
1928	Design of Lepol grate kilns by Lelep; (no commercialization till 1935)

Year	Kiln systems
1934	Suspension Preheater originally patented in Czechoslovakia;
1905-1920	Extensive parallel adoption of Rotary kilns and Shaft kilns;
1950-1951	Commercialisation of Suspension Preheater by Humboldt;
1951-1958	Intensive studies on improving cyclone vortex chambers, riser ducts etc.;
1963-1966	Conception of precalcination system; 1st German trials in 1966;
1980	Separate tertiary air duct to precalciners;
1985	Five stage preheaters with improved precalcination and firing technology;
1990	Five stage preheaters with low pressure drop cyclones and low NO_x burners;
1995- 2000	Six stage preheaters with low pressure drop cyclones and improved low NO_x burners;

Table 1-1: The development of the cement process engineering as reflected in congress reports; Source: Sillem, et al (1977)

Manufacturing of Ordinary Portland Cement begins with extracting the raw materials from geological deposits. Since limestone is the major component of the raw materials, the location of the limestone quarries in relation to the plants is a major consideration for setting up a cement plant. Drilling and blasting are often required to loosen the limestone. The dislodged limestone is transported by dump trucks to the crusher, where the large pieces are reduced to the size of gravel. Crushed limestone is transported to stockpiles using conveyor belts. The other additives such as clay/quartzophyllade, bauxite and iron ore are also crushed prior to transporting to the stockpiles by trucks or conveyors. Limestone and other additives are ground in the raw mill to obtain a specific composition of raw meal with the requisite degree of fineness. Normally, grinding of raw meal is done simultaneously with drying. The raw meal is homogenized and stored in large capacity storage silos. The homogenised raw meal is fed into the kiln through the pre-heater for pyro-processing. The pre-heater increases the overall energy efficiency. In modern plants the “precalciner” is installed within the pre-heater to “calcine” (drive out carbon dioxide by applying heat) the preheated raw meal. Calcination is a process in which Calcium Carbonate is dissociated into carbon dioxide CO_2 and lime (CaO) and Magnesium Carbonate into MgO and CO_2. This is illustrated by the following equations:

$$\mathbf{CaCO_3 = CaO + CO_2}$$

$$\mathbf{MgCO_3 = MgO + CO_2}$$

Lea (1970) explained the above mentioned dissociation reactions that take place above 700°C. Carbon dioxide is the primary greenhouse gas that contributes to global climate change and is the main greenhouse gas emitted by the cement industry. In old pre-heater kilns only 30 to 35% calcinations occurred while most of the calcinations (65%) took place in the kiln, but now with the introduction of “precalcination” technology, 90 to 95% of the calcinations take place in the pre-heater “calciner” and a very small portion occurs within the kiln. This development has tremendously improved the kiln capacity. The kiln is a cylindrical vessel lined with heat resistant refractory bricks. The horizontal axis of the kiln is slightly inclined (3 to 4%) to cause the movement of the material as the kiln is rotated. Hot meal enters the kiln from the higher end, which is connected to the pre-heater tower and fuel is fired from the lower end. Burning of fuel in the kiln heats the material to a temperature of 1450^{O}C. The materials that have attained this temperature are converted into cement clinker. It is cooled in a clinker cooler by air quenching to 100^{O}C. Clinker is stored in storage silos and is used for grinding cement by mixing with gypsum. Grinding of cement is done to achieve predefined fineness. Cement is stored in cement silos and is sold to consumers in bags or in bulk. The process of cement manufacture is shown in Figure 1-4.

The solid lines in the process flow block diagram indicate the material flow. The dotted lines indicate the flow of gases that pass through a dust collector. The dust collector could either be an Electrostatic Precipitator or a Bag House. Over the period of time it has been established that the bag filters are more effective in arresting dust during start-ups and shutdowns and they have better collection efficiency during normal operation as well.

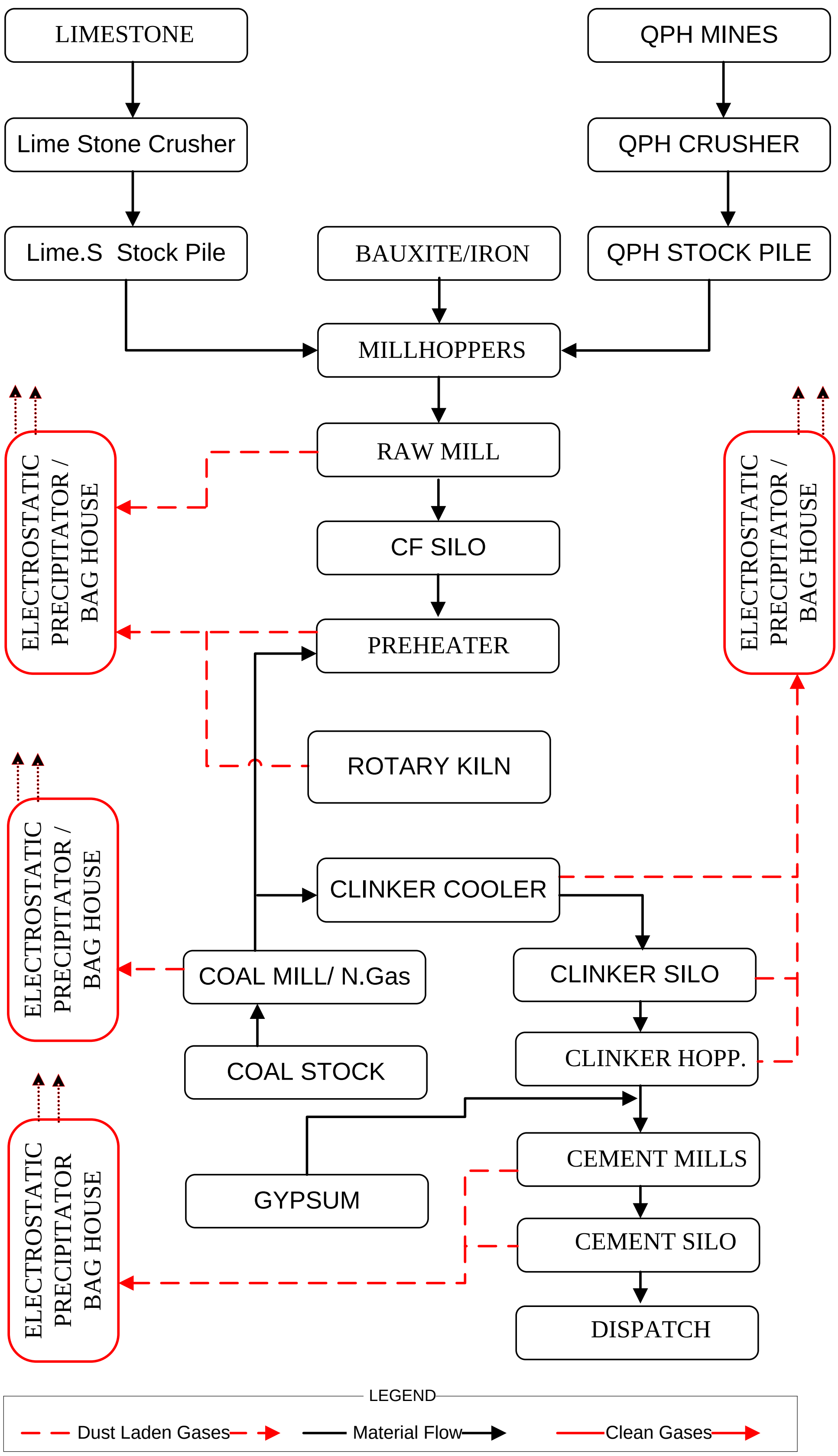


Figure 1-4: Typical Cement-manufacturing Process Flow Sheet. Oman Cement Company (SAOG) uses natural gas as fuel and not coal. Source: Author (2009)

Having reviewed the improvements made in cement kilns and in the related processes, this thesis author now reviews the changes in the trend of fuel consumption and power consumption in the cement manufacturing operations.

Ghosh (1992) suggested that average heat consumption for all processes, taken together was more than 2000 kcal/kg clinker in 1950, which has been reduced to 710 kcal/kg clinker due to various technological developments achieved in cement production by 2004. The power consumption, which was approximately 140 KWH/tonne cement in 1950, was reduced to about 102 KWH per tonne cement in 2004. Figure 1-5 shows the trend of energy consumption in the cement manufacturing (All processes taken together):

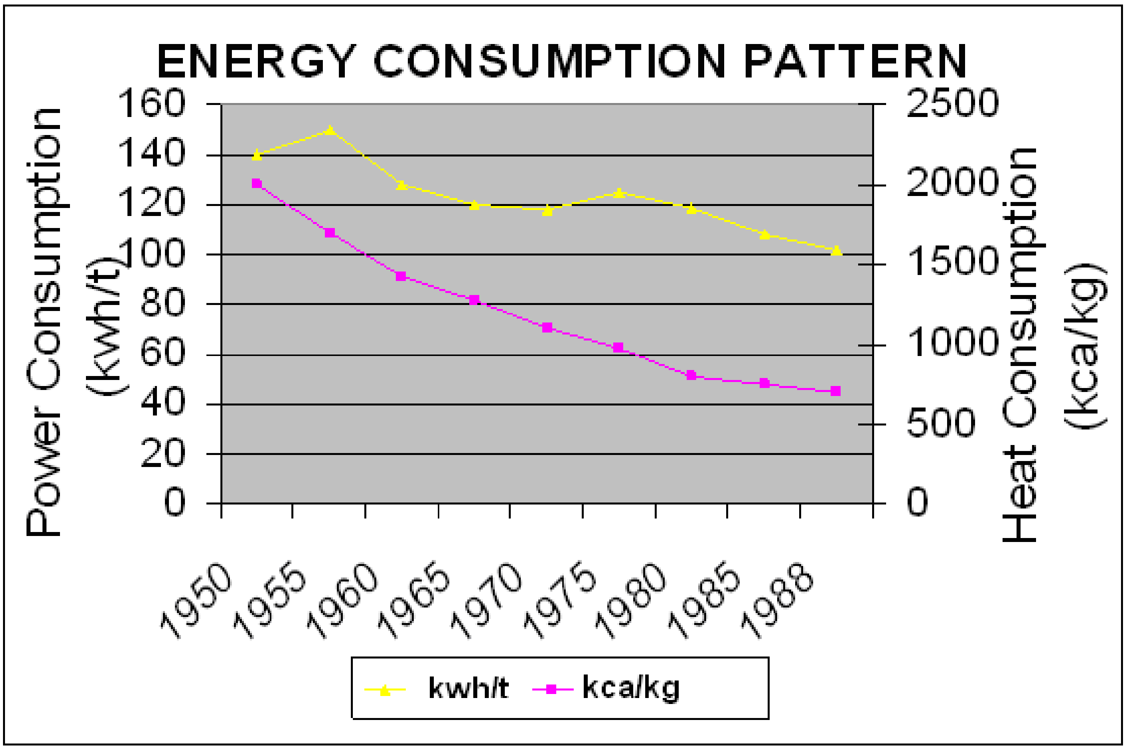


Figure 1-5: The energy consumption pattern in cement manufacturing, Source: Advances in Cement and Concrete Science & Technology, Vol. I (1992) Edited by Dr. Ghosh, S. N.

A study conducted by Battelle (2002) projected cement demand in 2020 in a range of 2.5 to 3.2 billion tonnes annually. The Battelle (2002) report projected the global cement industry reference for CO_2 emissions, which is shown in Figure 1-6:

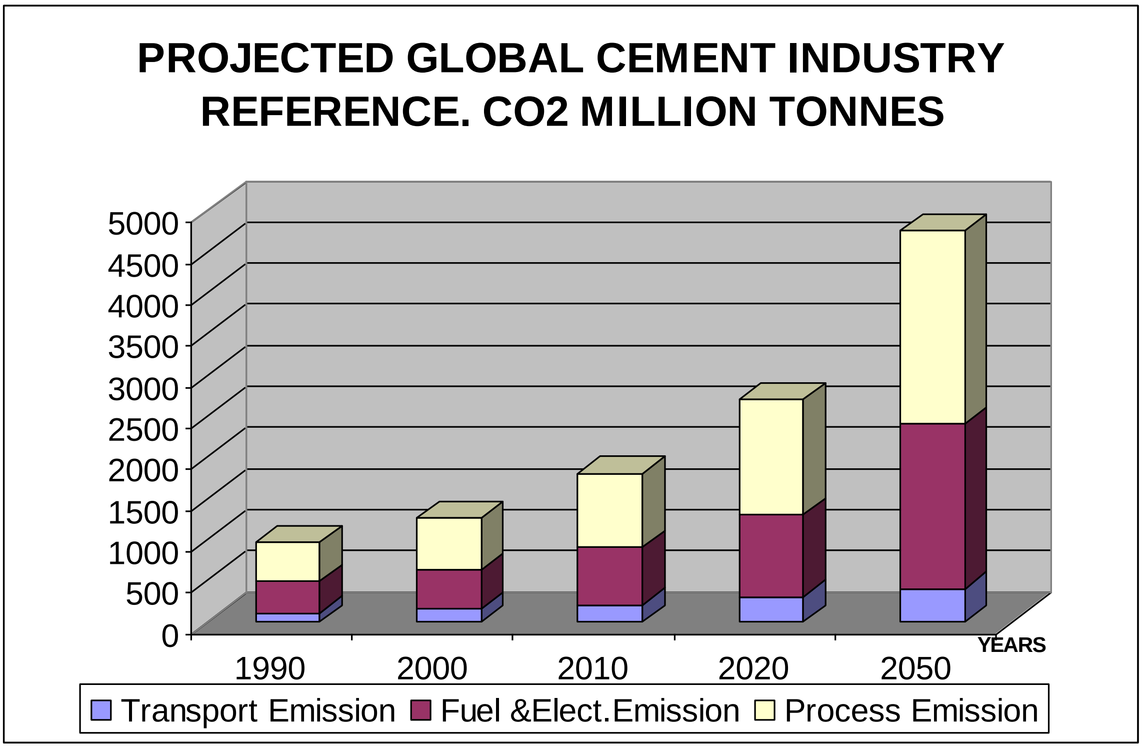


Figure 1-6: Projected Global Cement Industry CO_2 Emissions; Source: Battelle (2002)

From Figure 1-6, it can be deduced that the main CO_2 emissions are from the process that includes calcinations. Battelle (2002) highlighted in its report that the cement industry is responsible for approximately 5% of the global anthropogenic CO_2 emissions.

Burning of fossil fuels generate carbon dioxide (CO_2) and water (H_2O). So, the higher the fuel consumption the higher the quantity of CO_2 released into the atmosphere/ unit of cement production. The United States Geological Survey (2002) estimated that the global cement production in 2001 was 1.65 billion tonnes. Cembureau (2009) reported that cement industry currently emits 730 to 990 kilograms of CO_2 for every 1000 kilograms of cement produced. The emissions per tonne differ due to the types of equipment, the effectiveness of the management and maintenance, the process energy efficiencies and the product composition that varies from country to country. Figure 1-3 shows that the expected cement production by 2050 will be 5,300 million tonnes per year. Figure 1-6 highlights the projected annual CO_2 emissions from cement manufacturing sector of more than 4,600 million tonnes.

1.3 Environmental and social issues in the cement manufacturing

In cement manufacturing, which is a mineral-based industry, there are numerous environmental issues that should be addressed: – the extraction of resources, dust emissions, solid wastes and gaseous emissions and noise.

Table 1-2, presents comparative data on CO_2 emissions from various processes in the cement industry. It is significant that the emissions of CO_2 from process reactions are more than half of the total CO_2 emissions from cement manufacturing. The major portion of cement raw materials is Calcium Carbonate ($CaCO_3$). Magnesium Carbonate ($MgCO_3$) is maintained below 5% in raw materials because higher percentages of magnesium oxide (MgO) in cement leads to unsoundness due to expansion of the cement. Hence, the major release of CO_2 during the process reactions is due to dissociation of $CaCO_3$ into CaO and CO_2. Although, this reaction will always occur, it is possible to reduce emissions of CO_2 with the modern cement plants by using latest high process efficiency technologies. Table 1-2 presents data on the emissions of CO_2 (maximum) as a result of plants continuing to use ‘old’ technologies. The lower emissions (minimum) are from plants in which new technologies have been installed.

Serial No.	Elements of Cement Manufacturing process	Percentage of Total CO_2 released	Kg CO_2 per kg. of Cement (Avg.) Minimum/ Maximum	
1.	Process Reactions: Decomposition of $CaCO_3$ And $MgCO_3$ from raw materials.	50	0.365	0.4995
2.	Fossil Fuel combustion in drying and pyro-processing.	40	0.292	0.396
3.	Transport of raw materials	05	0.0365	0.050
4.	Electricity generation for use in Manufacturing operation	05	0.0365	0.050
	TOTAL	**100**	**0.73**	**0.9955**

Table 1-2: The amount of CO_2 released from various phases of the cement-manufacturing process; Source: Nakicenovic et al (2000)

(It is difficult to accurately quantify the cement industry's CO_2 emissions because data are not collected on a systematic basis worldwide. As a result, data in Table 1-2 are drawn from a variety of sources and are presented as a consistent set of emissions estimates.)

Nakicenovic et al (2000) have estimated unit-based emissions by region and sub-region from the cement industry in a special report on Emission Scenarios that are presented in Table 1-3:

Region Unit Based Emission				Sub-Region Unit Based Emission			
	Region Name	1999	2000		Sub-Region Name	1999	2000
I	North America	0.99	0.99	1	Canada	0.94	0.91
				2	USA	0.99	0.99
II	Western Europe	0.85	0.84	1	W. Europe	0.85	0.84
III	Asia	0.91	0.89	1	Japan	0.73	0.73
				2	Australia & NZ	0.80	0.79
				3	China	0.95	0.90
				4	SE Asia	0.96	0.92
				5	Rep. of Korea	0.94	0.90
				6	India	0.98	0.93
IV	Eastern Europe	0.84	0.83	1	Former USSR	0.81	0.81
				2	Other East Europe	0.94	0.89
V	South & Latin America	0.86	0.82	1	South & Latin America	0.86	0.82
VI	M.E.& Africa	0.87	0.85	1	Africa	0.87	0.85
				2	Middle East	0.87	0.85
Global Average		**0.89**	**0.87**			**0.89**	**0.87**

Table 1-3: Data on unit based CO_2 emissions from the cement Industry, kg CO_2/ kg of cement produced, Source: Nakicenovic. N. and R. Swart, eds. (2000).

From Table 1-3, it can be shown that the specific CO_2 emissions in 1999 and 2000 are the least from the cement companies in Japan followed by Australia and New Zealand. Specific CO_2 emissions are quite high in USA followed by India, South East Asia, Canada and China.

The Carbon Dioxide Information Analysis Centre (CDIAC) is an organisation within the United States Department of Energy, which has published data on global emissions of CO_2 and emissions of CO_2 from the cement industry. The emissions data of the cement industry in relation to the total emissions of CO_2 due to human activities are presented in Table 1-4:

ASPECT	QUANTITY	UNIT	WEIGHTAGE	SOURCE
Global CO_2 emissions due to Anthropogenic activities	35.412	Billion t per year	-	CIDAC 2004
Global CO_2 emissions due to Cement-manufacturing	1.8	Billion t per yr.	5%	Estimate
Global Cement Production	2.690	Billion t	-	Research market
Indian Cement Production 2007- 2008	0.168	Billion t	6.24%	CMA
China Cement Production 2008	1.388	Billion t	51.6%	NDRC

ASPECT	QUANTITY	UNIT	WEIGHTAGE	SOURCE
(Clinker - 0.952Mt)				
India and China combined CO_2 emission (Cement)	0.974	Billion t	54.1%	Estimate

Table 1-4: Key statistics of CO_2 emissions from the Cement Industry and Global Emissions.
(Source: Emerging Markets Report 2009, A World Cement Publication, England; CIDAC, Cement Manufacturers Association-India, National Development Reform Commission-China and www.researchmarket.com)

Clinker production for 2007-2008 in India was 0.130 billion tonnes and in China 0.952 billion tonnes corresponding to the cement production figures presented in Table 1-4. The conversion factor from clinker to cement in China was reported to be 1.423 by NDRC, China, whereas, CMA-India reported a conversion factor of 1.36. From the Table 1-4 it is clear that China manufactures almost half of the world's cement production. China and India emit more than half of world's CO_2 of the cement-manufacturing sector.

Battelle et al (2002) reported that the cement industry was highly fragmented, but recently it has undergone tremendous changes in structure, with significant consolidation and vertical integration. The global leaders in the cement industry include Lafarge (France), Holcim (Switzerland), Cemex (Mexico), Italcementi (Italy), Heidelberg (Germany) and Taheio Cement (Japan). Many multinational cement producers are capitalising on the strong growth in the Asian markets such as China and India and in Middle Eastern markets. This is often occurring, through joint ventures with local cement producers. While continuing to expand, the industry leaders have realised the potential hazards of environmental pollution; consequently they are working to reduce their environmental impacts through investments in air pollution control equipment, energy-saving technologies, alternative fuels and recycling of materials.

In relation to environmental, social and economic dimensions of the cement industry, some of the leaders are using the TBL/CSR approach to help them to improve their accountability for the impacts their actions have on internal and external stakeholders. They feel that the basic motivation for CSR is to increase the positive and to decrease the company's negative impacts on the society and stakeholders. The former president of India, Dr. A. P. J. Abdul Kalam (2009) suggested that the corporate India should participate in the TBL/CSR journey. He underlined the need for evolving national ethics for sustained economic prosperity and peace. He further stated, "If a nation is to have ethics, society has to promote ethics and a sound value system. If society is to have ethics and a value system, families should adhere to ethics and value systems; if families have to get evolved with ethics and a value system, parenthood should have in-built ethics and the parental ethics should come from great learning value-based education and creation of clean environment that leads to righteousness in the heart."

Economic dimensions of companies are well established and they can be quantified empirically. In fact, this is one of the most important reasons that growth is reported in terms of economics since it is easy to place a monetary value on things such as goods produced or services rendered. However, corporate managers should not ignore the short-term and long-term social and environmental aspects of their organizations because they also have important economic implications. This is because, in the long run, the environmental and social costs of degradation of soils and waterways due to increased pollution, the increased cost of health and welfare services due to toxic exposures, employee absenteeism and social dislocation may eclipse business and societal survival itself.

EPA (2006) stated that, apart from CO_2, the other key pollutants from cement production are oxides of nitrogen (NO_x), Sulphur dioxide (SO_2), Carbon monoxide (CO), Volatile Organic Compounds (VOCs) and organic micro pollutants like Polychlorinated Dibenzodioxins, and Polychlorinated Dibenzofurans (together they are known as dioxins), Polychlorinated Bi-phenyls (PCBs) and Poly-aromatic Hydrocarbons (PAHs). Combustion conditions in cement kilns are controlled to achieve complete combustion to achieve optimum fuel economy and to ensure that only a small proportion of the fuel is converted to volatile organic compounds and carbon monoxide. Green (2008) cautioned that carbon monoxide, detrimentally affects air quality and human health. Emissions of VOCs, due to incomplete combustion vary among different cement kilns due to differences in combustion optimisation process. EIPPC (2001) reported VOCs contents of kiln exhaust gases ranging between 10 to 100 mg/Nm^3. Emissions of VOCs are of concern because they form ground-level ozone and other photochemical oxidants under certain atmospheric condition in the presence of oxides of nitrogen. Dioxins and PCBs may be formed in the kiln if chlorine is present in the raw materials or in the fuels. Formation of dioxins takes place at a relatively low temperature. EIPPC (2001) recommended that the kiln gases should be cooled as quickly as possible between 450 to 200^0C to minimise the possibilities of dioxins formation. Understanding of the PCBs and PAH formation mechanism and emissions characteristic is not well defined and there is no international agreement on a measurement standard for stack emissions of PCBs and PAHs. It is understood that their formation mechanisms are analogous to those for formation of dioxins. Thus, this implies that the control techniques developed for dioxins can also reduce PCBs in emissions, with suitable optimisation.

Battelle et al (2002) estimated that during the decade of the 1990s, the global cement production increased approximate 20% while the per unit cement industry carbon dioxide emissions decreased by approximately 1.5%. WBCSD (2002) reported that, during the same period, in some other sectors of the economy, the intensity of energy use and associated CO_2 emissions decreased by more than 10%. Thus, on an industry-wide basis, the cement industry has made only a very modest improvement of CO_2 emissions/ton of cement produced.

Sayer and Campbell (2004) suggested that sources of negative environmental burdens contribute to:

- **a.** Depletion of non-renewable resources;
- **b.** Ecosystem disruption;
- **c.** Climate change
- **d.** Human health and safety risks.

The prosperity of the mineral based industries is linked, in many ways, to their ability to reduce these stakeholder and environmental impacts. Manufacturing of cement requires exploitation of geological deposits of limestone and fossil fuels, which leads to depletion of non-renewable resources. Mining operations for exploitation of deposits such as blasting and transportation activities create ecosystem disruptions and release of carbon dioxide during cement clinker production contributes to global warming and climate change. Naomi (2004) stressed that environmental protection is a prime concern of today’s societies in view of the impacts of global warming, ozone layer thinning, species diversity losses, habitat destruction, increasing desertification and the consequent rupture or failure of ecosystems to provide nature's usual services, consequently increasing numbers of people are becoming environmental refugees in many countries.

EPA (16^{th} June, 2007) published that increasing numbers of scientific studies have shown that impacts from industrial and domestic activities have caused increase in the average global temperature by around 2^0C during the last century. If the pattern of increases in emissions of carbon dioxide and other greenhouse gases continues at the current or higher rates, the average global temperature will rise an additional 1.5 to 2.5^0 C during the next 100 years. The effects of such global warming are expected to be far-reaching, including further acceleration of melting of glaciers, changes in wind patterns and ocean currents, which are causing, dramatically increased severity and frequency of major storms, changes in seasons, changes in vegetation zones, reductions in bio-diversity and spreading of diseases. These types of changes will result in flooding of large areas of coastal regions, submergence of many low-lying island countries and draught conditions in many landlocked countries.

Secretariat, Climate Change (2002) stated that, the major causes of these climate changes are the emissions of greenhouse gases viz. CO_2, SO_2, NO_x, and CH_4. CO_2 and methane (CH_4) are the gases mainly responsible for global warming. Although, nature produces both of these gases, since the industrial revolution, humans, through extensive utilization of fossil fuels are rapidly increasing the global concentration of both with the consequence that global warming is occurring. Global cement production in 2007 was estimated to be 2,690 million tonnes, up from 2,540 million tonnes in 2006, and by 2012 the production of cement is likely to reach 3,370 million tonnes (www.researchmarkets.com retrieved on 10th Feb, 2010). Nakicenovic et al (2000) reported that emission of CO_2 in cement production varies from 0.73 to 0.99 kg per kg of cement. Hence, it may be expected that total CO_2 emissions from global cement production in 2012 will be approximately 3,355 million tonnes. This is a major threat for global warming.

The social perspectives include community concerns about plant operations, community health effects, worker health & safety, noise, dust, transportation and aesthetics. There are important worker health & safety issues throughout the entire chain from mining and transportation to processing, storage and use of the products. Considering the complexity and severity of the manufacturing operation there is a clear need for a more sustainable approach for managing the manufacturing operation.

The economic issues include the financial prosperity of both external stakeholders as well as those internal to the cement industry. Papmehl (2002) examined that there are international accounting standards concerned with reporting financial performance but there are no agreed standards on environmental and social reporting.

Elkington (1997) captured a novel approach that is being increasingly taken is sometimes called the ‘People, Profit and Planet’ or the ‘Triple Bottom Line’ (TBL). They are basically the same and both challenge industrial leader to integrate the environmental, ethical or social and economic dimensions into their corporate goals, strategies and practices. Consequently, they focus upon the TBL and not solely upon the single bottom line of “profit”.

Although, the three dimensions of TBL are sometimes addressed individually, application of a holistic, integrative approach of achieving the TBL can help companies to simultaneously achieve enhanced economic prosperity, improved environmental quality and strengthened social equality. In order to help companies make more efficient progress in the integration of environmental, social and economic dimensions into their entire operations, the Global Reporting Initiative (GRI) was first convened in 1997 by the Coalition for Environmentally Responsible Economies (CERES), along with United Nations Environment Programme (UNEP). Since then, a series of GRI guidelines and checklists have been developed, due to their work. Those guidelines are being, increasingly used by leading companies to guide the development and implementation of TBL/CSR in their business.

In a scenario of globalisation it is very difficult, if not impossible, to do business as usual. Earlier, businesses mainly performed their work locally; their only motive was to earn a profit. Industrialists used to ignore their responsibility towards the environment and society. Within recent years, with instant global communications, many businesses have expanded globally. As a result, it is time to step back and take a look at the long-term implications of corporate activities, which are threatening the survival of humans on earth.

Developments in knowledge and technology are contributing to economic growth and they offer new choices for organisations to improve their operations, products, services, and other interactions that impact on the environment, people and economies. Innovations in technology and management can contribute to reducing the risks and threats that growth can bring.

In a similar line of thought, the Federal Minister for the Environment and Heritage of Australia, Hon. Robert Hill (Sept. 2000) said, *"If we looked at the annual financial statements of our major companies, we would see financial values allocated to items such as capital equipment, buildings, inventory and other assets. We would see revenues from sales and expenses for labour, marketing and other items. We would also see figures relating to expenditure on resources for the production process. But how many of these financial statements would include an analysis of the health of the natural resources upon which the company relies?"* (Retrieved from www. Google/search/client on 16th February 2008)

His statement reveals his doubts about 'business as usual' in which economic growth is an end goal in itself and other dimensions are seldom addressed. In order to move our economy and its companies away from such a mono-focus on short-term profits to a sustainable path that focuses upon environmental, social, and economic facets for the short term and long term, we must bring about changes in our societal culture, where environmental and social values are integrated into corporate strategies and practices in ways that are as central as are the economic emphases, today.

Hawken (1999) stated that sustainable development represents a vision of industrial progress that respects both human needs and global ecosystems, by preserving the foundations upon which human quality of life depends. Inspired by the Hawken's vision, this thesis author has developed a method designed to help cement company managers to integrate social, environmental and economic emphases of sustainability in their policies, strategies, and procedures of producing cement.

Currently, the cement industry is poorly understood. Battelle (2002) expressed that trust between communities and the cement industry vary depending on the location. In some parts of the world, the public has considerable trust that the cement company is looking out for the communities in which it operates but in many regions there is a deep distrust. For example, the stakeholders in Thailand considered the industry in a much more benign fashion than in the other areas such as Brazil and Portugal where the stakeholders do not trust the companies to do the right thing, either because the communication was generally lacking or because they perceived that the companies are causing environmental and health harm, despite what they say.

The goal of this thesis author is to improve upon the current management practices in the cement manufacturing industry by comparing the case study company with the world's best practices in the cement industry. The case study company, Oman Cement Company (S.A.O.G) is based in Muscat, Sultanate of Oman. On the basis of literature review-based comparisons and survey-based comparisons, an action-based research methodology was used to help the case study company make progress on its journey of becoming a more 'Sustainable Cement Company'. The research was focused upon finding answers to the following preliminary research questions:

a. How are the TBL/CSR concepts implemented in cement-manufacturing organisations throughout the world?

b. How can the TBL/CSR concepts be effectively implemented within this thesis author's company, OCC?

A sustainable business must be able to anticipate and meet the economic, environmental and social needs of present and future generations of customers and stakeholders. The integration of environmental, economic and social dimensions calls for a new corporate accountability, the so-called TBL/CSR. To contribute to the knowledge base and to help the managers in the cement and mineral based industry this researcher embarked on this thesis research and developed this thesis.

2 Chapter 2 - Literature Review

2.1 *Introduction*

The literature review presented in this Chapter is designed to help in understanding the evolution of TBL/CSR and the responsibilities associated in implementing TBL/CSR accountability in the cement manufacturing. John Elkington (1987) introduced the TBL concept, which is concerned with the simultaneous environmental, social and economic accountability and responsibility of business. The literature review was structured into nine parts.

The first part, presents a timeline for developments in modern sustainability agenda. It is designed to help in thoroughly understanding the UN efforts in promoting international co-operation for protecting environment and societal responsibility. This time line is important to leaders of cement-producing companies to a point that they will engage in TBL/CSR journeys.

The second part presents some of the world's worst environmental disasters, which have resulted in societal questioning of the ethical and social irresponsibility of business. Examples reviewed in this part clearly identified the huge gaps in practices adopted towards preservation of environment and safety issues and the desired minimum standards organisations should implement in order to progress on their TBL/CSR journeys.

The third part deals with academic literature on the moral development model of the way leaders of business organisations act from pre-conventional level to post-conventional level and examine the ethical responsibility of conducting business with profit and social accountability.

The fourth part presents a general, historical overview of environmental management systems.

The fifth part discusses the evolution of environmental management systems.

The sixth part reviews various management systems of environmental management, their evolution, merits and limitations. The seventh part focuses on the concept of TBL/CSR and its relevance in today's business.

The eighth part deals with the reporting tools of TBL/CSR/Sustainability, such as Sustainability Index, Global Reporting Initiative, The UN Global Compact and Social Responsibility reporting.

The ninth part deals with the sustainability study of the WBCSD in the cement industry and its relevance to TBL accountability.

The tenth part describes drivers and barriers to corporate implementation of TBL accountability and the integration of the economic, environmental and social aspects of CSR into corporate strategies and daily performance.

The eleventh part reviews the benchmarking process for cement industry and other industries that have set examples of best practices in their businesses.

Prior to end of this chapter, in part twelve, the author presents the results of a critical review of the relevant literature to establish a foundation from which to identify the gaps in past research. Based on the foundation and the gaps in knowledge this author developed the conceptual framework and the research questions for this research.

The literature review helped the author to develop a more through understanding of the evolving meaning of the Triple Bottom Line (TBL) and Corporate Social Responsibility (CSR), so that he could effectively examine their application in the cement manufacturing. Working through the past research work of WBCSD provided an understanding of drivers and barriers of TBL/CSR in the cement manufacturing industry and helped this author to identify the areas for sampling and data collection in order to achieve the research objectives.

This literature search was conducted in three steps. First, academic databases were searched, including the Vancouver, B.C, Canada Public Library, the University of Bradford and the Tias-Nimbas on-line libraries. Secondly, internet sources were searched, including the WBCSD website/publications, the Harvard Business Review website/publications, the Global Reporting Initiative (GRI) website/publications, the U.S. Environmental Protection Agency's (EPA) website, the Academy of Management website/ONE pages, the ISO website/publications, Cleaner Production publications, the Journal of Cleaner Production, cement companies' websites/CSR reports and Google/scholar. Third, information was collected through personal contacts, including e-mails with authors of published papers, seminars and symposia.

2.2 The Time Line of Developments in the Sustainability Agenda

The U.N.'s Economic and Social Council (1968) passed a resolution noting mankind's urgent need to limit damage to the world's environment. This resolution called for an international conference to discuss ways to clean up the environment. As a result, the first international conference of its kind, the UN conference on the Human Environment was held in Stockholm in June 1972. Gaecek et al (1992) stated that participants at the Stockholm Conference called for "Environmentally sound development". It was advocated that third world economic development should consider environmentally safer ways, but it was anticipated that strict environmental regulations would negatively affect their economic growth and corporate profits. It was feared that strict enforcement of strict environmental regulations would result in shutting down manufacturing facilities with inadequate control mechanisms and inefficient pollution control equipments. This could result in losses of productivity and consequently lower the country's GDP.

As a follow-up to the Stockholm Conference, the U. N., in 1972, established the United Nations Environment Programme (UNEP). It was established to promote international cooperation on the environment and to set general policy guidelines for the U.N.'s environmental policies. The headquarters of UNEP are in Nairobi, Kenya. It is funded by voluntary contributions. UNEP projects, among other things, monitor global and regional environmental needs, underwrite scientific research on the environment and disseminate studies to promote economic growth that is less or not harmful to the environment.

With growing concern about the environment worldwide, the U.N became even more involved in environmental issues. The United Nations General Assembly

(1992) passed a resolution 44/228 on December 22, 1989. It called for an "Earth Summit" which was subsequently held in Rio de Janeiro, Brazil in 1992 to promote policies to lead to "Environmentally Sustainable Development" or to economic development that does not harm the environment. The Rio Summit produced five key documents on SD issues; two "hard laws"- the convention on Biological Diversity, and the Framework Convention on Climate Change; and three "soft laws"- the Rio Declaration, Agenda 21, and the Forest Principles that were adopted by consensus at Rio de Janeiro, Brazil in 1992.

2.2.1 The Rio Declaration on Environment and Development

The Rio Declaration on Environment and Development (1992) describes states' obligations for promoting the principles of SD. This principle involves managing resources in a way that provides for human needs in using those resources, as well as providing for their protection – both for their inherent value and to preserve mankind's future needs for them. The obligation to "conserve, protect, and restore the health and integrity of the Earth's ecosystem" is framed in a way that recognizes that states have differing abilities and methods to draw on when dealing with environmental problems.

The Declaration identifies 27 guiding principles on SD. Among call for open economic system, eradication of poverty, development of people, improvement in quality of life, strengthening endogenous capacity it focused on environmental protections, which includes:

- Intergenerational equity – That there should be equity among the rights and needs of the current generation and of generations to come;

- Precautionary approach – That the lack of full scientific certainty of the causes and effects of environmental damage should not be a reason for delaying action to prevent such damage (s);
- Polluter pays – That polluters should bear the cost of pollution, and that the costs of environmental damage should be reflected in cost-benefit analyses of actions affecting the environment;
- Responsibilities – That the world community has a common responsibility for protecting the global environment. However, countries that pollute more should do more for environmental protection than countries that pollute less.

Rio declaration provides a guidance and focus to move towards 0wning the responsibilities of environmental pollution and commitment to societal issues. Understanding these aspects help the researcher to unfold the complexity of environmental and social issues in a global context.

2.2.2 Agenda 21

The United Nations General Assembly called for "Earth Summit" which was held at Rio de Janeiro, Brazil in 1992 and adopted Agenda 21. The UN Agenda 21 (1992) provided comprehensive blueprint of actions, which is to be taken globally by governments, local authorities and individuals to implement the principles of SD contained in the Rio Declaration. The number 21 refers to twenty first century. The full text of Agenda 21 was made available at the 1992 United Nations Conference on Environment and Development, voted by 179 governments to adopt the programme. This 40-chapter document has significant status as a consensus document. It is divided into four sections, which are:

Section I: Social and Economic Dimensions

This section includes combating poverty, changing consumption patterns, population and demographic dynamics, promoting health, promoting sustainable patterns and integrating environment and development into decision-making.

It calls for environmental considerations to be built into policy-making actions from the start rather than being added as an afterthought.

Section II: Conservation and Management of Resources for Development

This section includes atmospheric protection, combating deforestation, protecting fragile environments, conservation of biological diversity (biodiversity) and control of pollution.

Pollution control includes management of air, water and soil resources, toxic chemicals, hazardous wastes, solid wastes and radioactive wastes.

Wasteful consumption and production associated with industrialization and wealth acquisition are highlighted as the most serious causes of global degradation of the environment.

Section III: Strengthening the Role of Major Groups

This includes the role of children and youth, women, Non-Governmental Organizations (NGOs), local authorities, business and workers.

This recognises that, although trade may be adversely affected by unjustifiable environmental concerns, such as, technical barriers, however untrammelled and monopolistic trade can and has repeatedly adversely affected the environment as it so often results in unsustainable production or unsustainable use of natural resources.

Section IV: Means of Implementation

This includes governmental guidance in governance, science, technology transfer, education, international institutions and mechanisms and financial mechanisms.

2.2.3 The Forest Principles

The Forest Principles (FP) addresses the management, conservation and SD of all types of forest. One aspect of work pursuant to the Principles concerns the development of criteria and indicators for the sustainable management of forests. Since Rio, work on the FP has been advanced by an “Ad Hoc Intergovernmental Panel on Forests” (the IPF) and by an Intergovernmental Forum on Forests (the IFF), both under the auspices of the Commission of Sustainable Development (CSD). The conferees at the 2002 World Summit held in Johannesburg agreed upon the “ Johannesburg Plan” of Implementation of SD.

Between Rio and Johannesburg the world’s nations met in several major conferences under the auspices of the UN, including the International Conference on Financing for Development, Monterrey, Mexico (March, 2002); as well as the Doha Ministerial Conference (Qatar, 2001). These conferences defined a comprehensive vision for humanity for SD. The problem of environmental deterioration was recognized in Stockholm in 1972 and in Rio it was agreed that the protection of environment and socio-economic development are fundamental to societal development.

To achieve such development the global Agenda 21 programme was adopted by the world’s leaders in 1992. The Rio Conference was a significant milestone that set a new agenda for sustainable development/TBL accountability. The United

Nation's World Summit Outcome Document (2005) referred to the interdependent and mutually reinforcing pillars of SD as economic development, social development and environmental protection.

It was argued by indigenous peoples through various international conferences, such as, the United Nations Permanent Forum on Indigenous People's Issues and the Convention on Biological Diversity, that there are four pillars of SD rather than three; the fourth being cultural. The Universal Declaration on Cultural Diversity (UNESCO, 2001) further elaborated on this concept by stating that "Cultural diversity is as necessary for mankind as biodiversity is for nature", it becomes "one of the roots of development understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence". In this vision, cultural diversity is the fourth policy area of SD.

Agenda 21 is an action based program and gives an impetus to implementation of TBL/CSR in the business activities at a global scale. This section helps the researcher to move forward on his research objectives.

2.3 Disasters – as Drivers for Environmental Protection Actions

Milton Friedman (1984) stated that business has no social responsibility beyond that of increasing its profits 'so long as it stays within the rules of the game, which is to say, it engages in open and free competition without deception and fraud.' This is an extreme view but Friedman recognised that there are 'rules of the game' which should not be broken. The following examples of environmental disasters provided an understanding of the consequences when the 'rules of the game' are broken by businesses. Analyses of causes for failures provided the thesis author insights into the factors responsible for disasters, which were considered in developing and establishing policies and procedures for OCC.

Ken Whitelaw (2004) stated that environmental events or disasters, no matter where they occur in the world, are now given immediate and full coverage by the media. Such crises act as ‘milestones’ in the development of environmental awareness at the general public level and often result in enforcement of tougher legislation at the commercial levels. Some of the environmental disasters of the 20th century are highlighted in the following paragraphs.

2.3.1 Union Carbide’s Bhopal Catastrophe

Hartley (1993) reported that Union Carbide (UC) was the third largest U.S chemical company, operating plants in 38 countries. One of the worst industrial disasters of all time occurred in Bhopal, India, on the night of December 3, 1984. The Bhopal plant was 49.1 percent Indian owned, and was, essentially, an Indian operation. The accidental release of toxic methyl-isocyanate gas from the Union Carbide India Limited (UCIL) pesticide plant in the congested, low income district of old Bhopal killed 15,000 people and left many thousands more with chronic disabilities leading to their premature deaths. Harmful effects of this accidental release have passed on to the next generations. The tragedy raised the question of the ethics of placing a plant capable of such devastation in a highly populated urban site in a country where labour costs and government-prescribed safety standards were low. Hindustan Times (22nd October, 2007) reported that India had reached an out-of-court settlement with US giant Dow Chemical, which took over Union Carbide in 2001, to clean up the Bhopal Gas disaster site and to end liability claims after more than two decades. Compensation payments to survivors as well as medical attention had been delayed because of bureaucracy and lawsuits since UC concluded an out of court settlement with the Indian Government in February, 1989. This settlement was challenged in local and federal courts calling for more compensation to survivors and to those with ongoing health problems linked to this disaster. The Pioneer (7th June, 2010) published that the Indian court convicted the company and seven of its officials for criminal negligence in the world's worst industrial disaster and sentenced the seven to two years in jail. However, all seven were released later on bail.

UC was totally negligent in the way it did not ensure that proper maintenance of the facility was performed. In February 2001, UC refused to take responsibility for UCIL's responsibilities in India. All the necessary safety alarms, evacuation plans, facilities and plans for emergency medical services were total failures.

This giant disaster clearly showed that the Indian government, the local Indian operators and the mother company from the United States of America were grossly negligent. This led to worldwide outcries for improved worker health and safety laws, standards and strict enforcement of all such safety precautions.

It led to the development by the Chemical Manufacturer's Association of Canada of their program, "Responsible Care" (RC). A detailed literature search was performed on the RC program to track the trail to the development of the CERES principles, the current TBL and GRI concept, are described in Section 2.7 and 2.8.2, respectively.

2.3.2 The Chernobyl Nuclear Plant Accident in the USSR

World Nuclear Association (April 26, 1986) reported that the Chernobyl nuclear plant in the Ukraine came close to a core meltdown due to a flawed reactor design that was operated with inadequately trained personnel and without proper regard for safety. As a result, an explosion and fire released at least five percent of the radioactive reactor core's radioactive materials into the atmosphere. It is estimated that all of the Xenon gas, about half of the Iodine and Caesium, and at least 5% of the remaining radioactive material in the Chernobyl Number – 4 reactor core were released in the accident. Most of the released material were deposited close by as dust and debris, but the lighter materials were carried by the wind over the Ukraine, Belarus, Russia and to some extent over Scandinavia, Scotland, Ireland, other parts of Europe as well as Eastern Canada and Eastern U.S.A.

It directly affected over 10,000 people in the former USSR. Some 45,000 residents were evacuated from within a 10 km radius of the plant, notably from the plant operators' town of Pripyat. The World Health Organization (1989) raised concerns that local medical scientists had incorrectly attributed various biological and health effects to radiation exposure. Subsequent studies in the Ukraine, Russia and Belarus were based on national registers of over one million people, possibly exposed to radiation. By 2000 about 4000 cases of thyroid cancer had been diagnosed in exposed children.

The tragedy confirmed doubts about the nuclear industry's assurances of the impossibility of acute systems failures. Despite the accident and its implications of nuclear risks now attached to conventional warfare, nuclear power stations continue to be commissioned. Leaving aside the verdict of history on its role on melting the Soviet iron curtain, some very tangible benefits have resulted from the Chernobyl accident. The main ones concern reactor safety, notably in Eastern Europe. Many other international programs were initiated; the

International Atomic Energy Agency (IAEA) safety review protocols for each particular type of Soviet reactor are noteworthy. This initiative brought together operators and western engineers to focus on training of operators and safety improvements. A recent report of the German Nuclear Safety Agency states that a repetition of the 1986 Chernobyl accident is now virtually impossible because all the reactors have been modified and made much safer by installing automated inspection equipment and faster automatic shut down mechanisms.

This incidence is discussed here to highlight the failure of a well planned and technologically pioneering project, where adequate safety measures and proper training of personnel were not implemented to avoid such environmental disaster and causing severe societal impact. Learning from this accident, it is essential for all cement companies to develop and to implement action plans to safely stop the cement manufacturing plants, if the need arises and to immediately implement their emergency response plans to minimise human and capital losses. All manufacturing firms need to integrate societal responsibility and environmental protection with the economic dimensions of their companies.

2.3.3 The Exxon Valdez Alaskan Oil Spill

The most catastrophic maritime oil spill in US history occurred on the night of March 24, 1989 in Prince William Sound, Alaska. The oil tanker 'Exxon Valdez' spilled 10.1 million gallons, creating and oil slick, which eventually covered 1000 square miles, damaging some of Alaska's most pristine waters, extinguishing wildlife and decimating the tourist and fishing industries for decades. The Exxon Corporation, the USA's second largest corporation and the world's third largest oil company, with sales of over $86 billion that year, was reluctant to accept responsibility to fund the $2.5 billion clean-up operation. To date, it has not yet paid the fines that were imposed on it. At the time of this mishap the captain of the ship was drunk; consequently an inexperienced sailor was responsible for trying to bring the ship to safe waters through the very dangerous straits with stormy weather in that region.

All the above-mentioned accidents raise the question of the ethics of the production of highly contaminating materials, which may be released in to the environment. In cement manufacturing hazardous materials, inflammable gases, wastes and semi-finished products at high temperature are commonly handled. Accidents are likely to occur whenever hazardous substances are manufactured and transported, due to human error, human carelessness, human greed, negligence, bad judgments, terrorism or acts of God. Indeed, the cumulative effects of minor leakages and careless waste disposal procedures may cause greater long-term environmental damage than the more noticeable disasters. Analysing the causes of this accident helped the researcher to look for possible improvement in health and safety issues in the cement manufacturing.

2.3.4 The BP Explosion and the Gulf of Mexico Oil Spill

National Safety Council (2006) published that an explosion occurred on March 25, 2005 in the BP refinery, Texas, USA, which killed more than 15 workmen and injured 170 workers. This was one of the worst industrial disasters in 2005. In the week following the accident, BP's operations came under intense scrutiny. Occupational Safety and Health Authority (OSHA), USA had mandated in 1992 that BP should switch to a flare system instead of their practice of releasing evaporative gases through towers. Amoco, which merged with BP in 1998, appealed and OSHA withdrew the request. According to the Texas City Fire Department Chief Gerald Grimm, BP had 30 fire alarms in 2003 and 27 in 2004, although he says this is normal for a refinery plant of this size. The nature of such business is risky and understanding this, BP maintains its own fire brigades, and has a mutual response plan with fire brigades of the other two refineries in Texas City. Texas City is often referred to as “Toxic City” as it is home to four chemical plants and three refineries. These facts call for a higher concern on health and safety aspects for employees and city residents, and a faster emergency response. Current findings by US regulatory authorities have pinpointed BP’s non-compliance with safety requirements on various accounts and compromise on safety expenses budget. OSHA, USA assessed a penalty of U.S $ 21,361,500 - against BP products North America towards this incident. In October 2007, BP agreed with the authorities to pay $380 million as a settlement to resolve all the cases being pursued by the US government, including actions related to its trading activities and oil spills from the pipeline leaks in Alaska. Financial Times (2007-11-23) reported that it as “Shockingly Lenient”.

Additionally, the Deepwater Horizon rig, operated by BP, sank on April 22nd 2010 following an explosion that killed 13 workers, injured 17 works and caused the release of powerful gush of oil into the Gulf of Mexico. Coast guard Admiral Thad Allen stated that the effort of stopping this massive oil gush would be a long-term campaign that would last several months. According to the Flow Rate Technical Group the leak amounted to about 4.9 million barrels of oil and the spill continued from 20 April 2010 to 15 July 2010, well was officially sealed on 19 September 2010. This one was much larger than the Exxon Valdez disaster; there were many contractors involved in the job, which included Halliburton

Worldwide Limited for the cementing work, Deepwater Horizon for building and operating the drilling rig in a safe manner.

This colossal disaster raises serious questions about safety in the global offshore oil industry. Financial Times (20th September 2010) BP was granted a series of exemptions by the regulator, the Mineral Management Services, on safety testing and contingency plans for accidents. In the US, the hope is that the criminal and civil enquires will throw light on the shortcomings of a response plan to manage deepwater disasters and expose the culprits for their greed, selfishness and arrogance. The sustainability report of BP was studied to identify their key performance indicators of TBL but it was really very disappointing to note their failure on safety aspect. It is important to note from this incident that compromise on safety aspects and inadequate emergency preparedness plan can lead to such disasters.

2.3.5 The South Korean Oil Spill

New York Times News Services (7th Dec. 2010) reported that an oil spill took place in South Korea’s pristine beach in 1995, costing $101 million, in damage to fishermen and months-long cleanup operations. Another oil spill occurred a week after the South Korean port town of Yeosu that had obtained the right to host the 2012 expo. Bidding for the international event, South Korea had championed the theme of “the living ocean and coast” a slogan, it hoped, would bolster marine environmental awareness in Asia.

The Times Of India (10th Dec. 2007) reported the worst oil spill in the South Korea’s history, near Mallipo beach, 120 km south of Seoul, was fought by 7000 people to remove dense crude oil, which had been washing up since December

8, 2007, along a 20 km shoreline of the Korea's west coast. This oil spill was estimated to have been about one fourth as large as that of the 10.1 million gallons, which leaked into Alaska's Prince William Sound from the Exxon Valdez in 1989. The affected region was declared to be a catastrophe. By Sunday, it became clear to local residents that they were battling a rapidly growing environmental disaster. The tidal flats, near Taean, about 150 km southwest of Seoul, are/were home to rich wildlife, oyster and fish farms along with a national park. This environmental disaster blackened once-scenic beaches, coated birds and oysters in sludge and drove tourists away with its stomach-churning stench.

The memory of Valdez/Alaskan Oil Spill, which was caused due to shear negligence and irresponsible attitude/actions of the ship's captain and of Exxon, has yet to fade out from the minds of people, but in the meantime other environmental disaster continue to occur. Whatever the enquiries may reveal in the future, about the causes of oil leaks, the fact remains that severe environmental damage is occurring due to human arrogance and technological failures that are causing extreme hardship to the people and to the marine life. Responsible behaviour, ethical business conduct, and appropriate emergency response procedures to prevent and to counteract such oil releases could have prevented all of these disasters or at least reduced their extent and severity.

2.3.6 Incidents in Cement Manufacturing Plants-Worldwide

Xiaoming (2004) has published a paper on "High-temperature cement powder-related burn injuries in China." China is the world's largest producer of cement. He wrote that 26 victims were treated in 148th Hospital of PLA in China, from April 1997 to March 2002. He reported from his study that full-thickness burns (third degree burns) were observed in all 26 patients and 22 patients with inhalation injury had not received adequate respiratory protection. Eleven patients died of severe inhalation injury. He observed that such injuries are rarely reported hence actual data of total cases are not available. He recommended that product education and proper protection appears to be the best preventive measures.

The Hindu Newspaper (September 28, 2004) published that the “Inspectorate of Factories” at Trichi, Tamil Nadu, India, organized a seminar, to discuss the report of the sub-committee set up by the Government for studying the safety, health and environmental (SHE) conditions in the Indian industry. India is the second largest producer of cement in the world, next only to China. The major recommendations of the committee included formation of a sub-committee comprised of members of the Indian Cement Manufacturers Association to monitor ‘SHE’ in the cement industry, to perform SHE audits by experts in all cement producing units once in every two years and to promote safety awareness through workshops and training programs. It also suggested a review of all cement company’s health and safety policies, appointment of safety officers, developing and implementing safe work procedures, installing smoke detectors and preparation of on-site emergency plans. The Chief Inspector of Factories informed that the Sub-committee had conducted field surveys in 13 major cement-manufacturing units in the state of Tamil Nadu to study the SHE conditions. Safety aspects relating to handling of gypsum, coal, crushing of raw materials, use of heavy machinery and various other processes were studied besides problems such as dust, explosions, noise and air pollution and upon the potential impacts of the foregoing recommendations that are based on this study.

The U. S. OSHA Regional News Release (2006) stated that the Middleboro, Massachusetts, cement manufacturing company was levied a penalty of US $71,200 by the U.S Labour Department's OSHA on account of failure to protect its workers from safety and health hazards. Safety hazards included unguarded portions of conveyor belts, fall hazards, propane tank exposed to damage, electrocution hazards, and defects involving a hoist and lifting slings. Health hazards included employee over-exposure to silica, inadequate engineering controls to reduce silica and dust levels, deficient respirators and confined space entry programs, lack of annual audiograms for all workers exposed to high noise levels, ladder misuse, and incomplete illness and injury logs.

2.3.7 Conclusions

These few examples underscore that company practices frequently and clearly violate corporate social responsibilities towards their employees, society and to the environment upon which all of us are interdependent. They can and often result in irreparable losses of natural resources and of human lives, both in the short and in the long term. The Exxon Corporation has yet to pay the fines imposed on it. BP has contested the fines imposed by OSHA, and similarly Union Carbide/ Dow Chemicals fought legal battles in court for decades, claiming that it was not responsible for what happened in Bhopal.

There have been many excess human deaths documented due to these and numerous other accidents. But most of them were not really an accident. In all of these examples, human weaknesses, errors and misjudgements as well as faulty engineering, poor management, maintenance and monitoring, were critical factors, which led to these accidents. These examples underscore the tremendous environmental, human health and safety issues associated with industrial operations. Additionally, the corporate and governmental cover-ups of all the above and of hundreds of similar cases, further underscores the dramatic need for significant improvements all along the entire chain of responsibility. Such blatant examples of corporate social irresponsibility led to calls by many for vast improvements in corporate responsibility.

They helped to build the momentum for the development of:

- **a.** The Chemical Manufacturer's code of conduct called, "Responsible Care";
- **b.** The CERES Principles;
- **c.** The ISO 14000 series;
- **d.** The GRI;
- **e.** The TBL, CSR, and Sustainability Reporting;
- **f.** The OHSAS: 18001;
- **g.** The ISO: 26000 series.

It is important to understand the failures, which caused such crises and the lessons learned from these experiences should help to motivate company leaders and their employees, labour unions, governmental leaders, NGOs, stakeholders and consumers to prevent and/or to minimise such risks through making substantial improvements in their overall management, planning and maintenance etc.

The author of this thesis is very much concerned about such irresponsible corporate acts. As one of his genuine efforts along this path, he has assumed the responsibility of developing a reporting system, which is simple and transparent that can be implemented in the OCC, where he is an employee. In order to make the reporting system effective it is necessary that the policies and procedures to anticipate and prevent such problems from occurring should be in place and monitoring of key indicators by adequately trained staff must be done regularly and the findings should be reported to all stakeholders. Detailed elaboration of all these parameters are made in the recommendations to/for the case study company in Chapter 5.

2.4 Business Ethics and the Environment

In the earlier Sections this author reviewed the historical evolution of the concepts of sustainable development that were often stimulated by major environmental disasters. This thesis author observed that most of the incidents occurred due to human errors, carelessness, negligence, bad judgments, greed and inadequate emergency response preparedness. The author also observed from the past scholarship that ethics and attitudes have direct effects on the business decisions. Thus, it was necessary to explore the theoretical research work on business ethics effects on the environment and social dimensions in business decision-making.

Andrew and Frances (1996) noted that it was difficult to differentiate between the actions and the motivations; only the consequences of the action are relevant in establishing the ethical nature of the action (consequentiality theories). If the actions result in overall good for the majority of the people, it is deemed to be ethical (utilitarianism). The problem then becomes a semantic one, what after all is good? They further stated that within the post-structuralism, post-modern world, words have begun to mean less and less. As a host of interested groups call for a more sustainable society, their different motivations encompass totally different ideas of what they are demanding. One individual may accept the need to move towards a ‘sustainable’ society by taking ‘sustainable’ development to mean ‘sustainable economic growth’. Another may regard ‘sustainability’ as merely ‘sustained economic growth’ placing the focus on the conservation of market leadership rather than on the conservation of natural resources.

Hoffman and More (1990) explored the complexity of business ethics underpinning corporate morality by setting business within the wider social context within which all transactions take place. Although corporate relationships are essentially economic, business must operate within the context of the wider society in which it is located. Friedman (1962) stated that the one and only social responsibility of business is to use its resources and to engage in activities designed to increase its profits so long as it engages in open and true competition, without deception or fraud. In line with this stance, the operating firm calculates the financial costs and benefits of adopting a particular practice and makes its decision based on whether the benefits outweigh the costs or vice versa.

Grübler (1998) stated that for past 300 years, humanity has increasingly liberated itself from the environment through technology. The job is not yet complete as billions of people continue to be excluded from the benefits of technology. And the ecosystem upon which we are all totally interdependent is becoming more and more degraded at an incredibly rapid rate. The next immediate task is to ensure that the benefits of technology reach the common people. Grübler argues that the task ahead is to progressively liberate the environment from adverse human interferences.

Vesilind and others (2006) found that a concrete producer in Vermont, USA typically overloads its trucks, thereby exceeding the weight limit set for the highways. Occasionally, they get caught, but the fine is not enough to deter them from that practice. They noted, as stated by an executive that we simply bill the cost of the fines into the cost of operations. Sorrel and Hendry (1994) defined environmental ethics as 'the attempt to apply moral theory to the human treatment of natural objects'. He observed that many company leaders look for sustainable opportunities solely on the basis of their providing a means of lowering expenses, thereby increasing profitability; other firms may believe that getting on the TBL/CSR journey will provide them with public relation's opportunities to decrease enforcement penalties or tax liabilities thereby reducing their expenses. Building good market reputations and satisfying the customers can lead to increases in sales. If sales are projected to rise more than expenses, this becomes a perfect driver. But again, this is only looking at the single bottom line of short-term profits.

Kohlberg (1981) suggested a moral development model which explains the journey from pre conventional levels of avoiding punishments to post conventional levels where a concern for societal good and respecting universal ethical principals become the way of life for the firms. Kohlberg's moral development model is depicted in Figure 2-1:

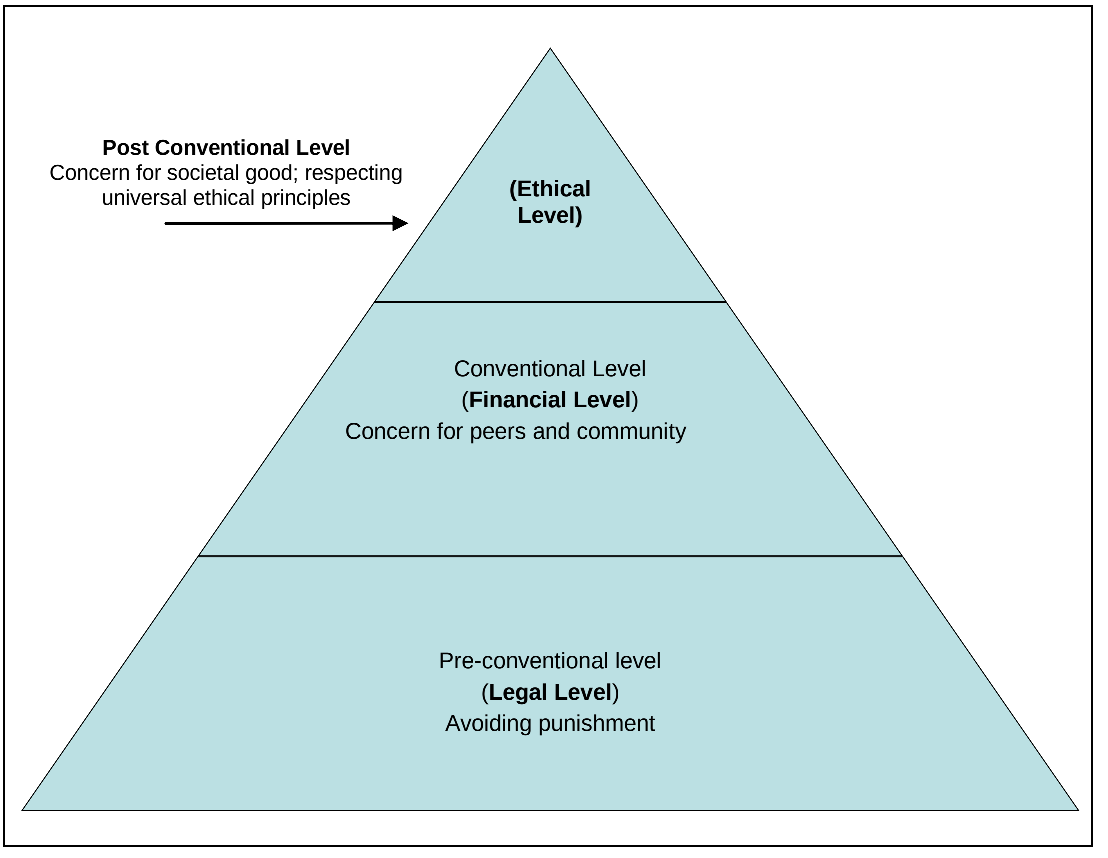


Figure 2-1: Kohlberg's Moral Development Model of the way leaders of corporations act depending upon their phase of moral development, Source: Kohlberg (1981).

This model is not designed to preach or to show post conventional concern for societal good, and respecting universal ethical principles but this should become a role model for business leaders. Once we fulfil the legal requirements the business should automatically move to the conventional level where concern for peers and community becomes increasingly important. Finally, for the post conventional level or Ethical level, business units need to break the threshold and leap into the world of concern and care of this universe and become corporate citizens concerned about the future of their grandchildren and for the eco-systems upon which all are totally interdependent.

2.5 Stages of Evolution in Environmental Management

This part of the historical literature review was undertaken to review the evolving philosophies and procedures regarding the relationships between humans and the natural environment and how various waves of development have changed the practices adopted by the manufacturing sector.

Darwin (1859) stated that evolution is the result of revolution. He argued that the earth is covered with a wide diversity of ecosystems, in which species compete for survival. Only those species whose genotypes provide them the capability of adapting and fitting themselves into the dynamic evolving ecosystems can survive under the laws of nature. The essence of Darwinism is the process of Natural Selection by the law of evolution, emphasizing the "fittest" of the ecosystem and not the "strongest". Probably, dinosaurs were the strongest species on the earth but they were abandoned by nature because they did not fit into it due to drastically changed ecological situations. Spencer (1857) stated that business management was misled by anti environmentalism - representing the idea of natural selection for profit making; this attitude prevailed until the end of the 1970s. Friedman (1962) expressed a similar view. He stated that humans were thought of as managers with unlimited power to manage the unlimited environment and natural resources, as long as the businesses made a profit and operated under the law.

Hawken, et al (1999) criticised the ideas of Spencer and Friedman and defined their approaches to be the philosophical sources of environmental crises long after the manifestation of serious symptoms of environmental problems. If humans had realised the consequences long before the environmental problems, which resulted from their distorted relationships between the natural habitat and human society, today's situation would be entirely different. Roderick Nash (1967) clearly pointed out that humans are a part of nature, not beyond, not above, and not superior to nature. Sarkar (1999) stated that corporate management experienced a philosophical transition from Social Darwinism's distorted version of Darwinism, to Eco-Capitalism. He explained that Social Darwinism takes manpower above the force of nature and is defined as a philosophy completely against the laws of nature. Eco-Capitalism, a derived version of Social Darwinism, represents the mechanism of 'market and price" leveraged management. Eco-Capitalism is considered as a bottom-line-oriented management approach, struggling to compete for cheap raw materials, and cheap labour regardless of the resultant destructive costs to the natural resource web-of-life. Under this philosophy, management pursues efficiency with the goal of maximizing production in the shortest time, regardless of mass consumption and waste of resources. Stead and Starik (2004), Hawken, Loins and Loins (1999) and others have identified Eco-Capitalism as the root of Environmental problems. Sarkar (1999) realised that there was a need for proper management of environmental responsibility to transform eco-capitalism into eco-socialism.

Historically, there has been a progression from wrongful thoughts and actions guided by philosophical regimes such as Social Darwinism and Eco-Capitalism. Eco-Capitalism was based on the idea of profit making; it misinterpreted the idea of "Survival of the fittest" as "Survival of the strongest" or the Power is right. Whereas, Eco-Socialism is a philosophy of needs - a balanced equation of "Demands and Supplies", consequently, Eco-Socialism is "Eco" because "Demands and Supplies" structure the entire ecosystem.

Over the last century, there have been three philosophical waves, guiding the development of management process: Eco-Capitalism, Eco-Socialism, and Natural-Capitalism. The three philosophical waves have worked as the driving forces for the evolution of environmental management. Stead et al (2004) mentioned that evolution of environmental management has passed through four stages. The four stages can be summarized as below:

- **a.** The Socialising stage: from Darwinism, to Social Darwinism and to Eco Capitalism;
- **b.** The Frustration stage: transforming from Eco-Capitalism to Eco-Socialism;
- **c.** The Refining stage: focussing upon sustainable development and triple-bottom-line;
- **d.** The Impact-Oriented stage: optimising the impact of organizational activities and actualising the value of natural resources-natural capitalism.

The philosophical transition from Eco-Capitalism to Eco-Socialism in management approaches was started in the 1980s. In this period the researchers and policy makers were frustrated with environmental problems and environmental catastrophes, which were caused by corporate miss-management that resulted in high levels of pollution, resource depletion, deterioration of environmental quality and poor working/living conditions. Researchers and decision-makers concentrated on identifying and describing the causes of these environmental problems by searching for environmental indicators to use for measuring the environmental impacts and in developing drivers for reversing and preventing such damages in future. In the 1980's researchers such as Aram (1989), Aupperel & Boschken (1985), McGuire, Sundgren & Schneeweis (1988), Nash (1989), and Prescott (1986) expressed their concern regarding a system, which can adequately address the growing environmental problems.

In the 1990s a shift from Eco-Capitalism, "price-and-market oriented management", to Eco-Socialism, "demand-and-supply" based management started. Sarkar (1999) defined Eco-Socialism as a needs-based management system requiring collaboration across the whole society, linked by chains of demands and supplies, aimed at serving the needs of society, the economy and the environment. He stated that management must be leveraged by the needs of the market. This model of management does not leave any room for waste or redundancy. Eco-Socialism can be considered to be an ideological format for the **TBL** or SD.

Soon after the new millennium in 2000, some researchers and business managers, further refined the concepts and theories established in the 1980s and 1990s. For example, Egri (1999) emphasized that the conflict between ecological sustainability and economic profitability can be considered as a revolutionary force for evolution of corporate environmental management. Rugman & Verbeke (1998) stated that the conflict is leveraged by the interaction between environmental policy and corporate strategic development. Maxwel, Rothenberg and others (1997) stated that implementing environmentally proactive strategies could solve the conflict. To deal with increasing ecological pressures and stresses on organizational sustainability, new innovations in environmental management were developed. Tolba and El-Kholy (1992) suggested that environmental innovation should play a key role in reducing material's costs. Innovation is the tool for optimising the impacts of social, environmental and economic activities. King (1995) stated that organizing and managing natural resources in part, as community property played a central role in avoiding surprises. Egri and Herman (2000) concluded that the relationship between organizational environmental attitudes and organizational ecological behaviour is linear. Although, Kaisar, Wolfing and Fuhrer (1999) suggested that organizational environmental attitudes can be used as predictive tools to measure organization's ecological behaviour but it is important that the organizational behaviour must be environmentally friendly in order for it to efficiently use natural resources in sustainable manner.

Feldman, Soyka & Ameer (1996) suggested "Stock Price" as an indicator to measure investment advantage and risk of the environmental management system. Russo & Fouts (1997) suggested a resource-based view to analyse the relationship between corporate environmental performance and profitability. Hoffman, Baseman & Yare (1997) suggested that, in order to reduce the business costs without decreasing the benefits of EMS, companies need to adopt an operational environmental program (This is also a requirement of ISO 14001: 2004), such as Life Cycle Analysis (LCA) or Design for Environment (DfE). This suggestion has definitely attracted the attention of manufacturing companies and driving them towards the integration of environmental management program in day-to-day operations.

This part of literature review revealed that in order to resolve conflicting needs and to optimise the impacts of management on the environment and natural resources over a long period of time, the author identified following three objectives:

a. The first objective was to weave an integrated web of multileveled environmental management systems to meet both the organization's needs for development and the eco-system's needs for sustainability;

b. The second objective underscored that governmental policy and regulations are determinant factors, which must be institutionalised to ensure that corporate organizational performance complies with them;

c. The third objective was to institutionalise environmentalism into the code of conduct of the entire social-political system in order to thoroughly eliminate the conflict between organizational needs and ecological needs.

These objectives are being realised by the organisations that are on their TBL/CSR journeys. This is made clear later in this thesis based upon this thesis author's in-depth analyses of TBL/CSR reports of leading cement companies.

In summary, this section highlighted how the various philosophical waves of thought have influenced the evolution of environmental management from social frustration to impact oriented stage. In this stage an efficient environmental management system can optimise the impact of organisational activities and actualise the value of natural resources. These philosophical waves have affected the environmental management programs in the cement industry; the present impact oriented stage is stimulating the leading cement companies to engage in voluntary disclosure of environmental and social reporting. In deciding the 'right' environmental management system to be adopted by the companies, costs and benefits were always an issue. A usual question is "Does it pays to be green?" Hart & Ahuja (1996); Christmann (2000); Hamschmidt & Dyllick (2001); King and

Lenox (2001, 2002) have answered this question – Yes, it does pay. Many scholars have suggested different indicators to gauge the advantages of having an environmental management system within the enterprise.

2.6 Environmental Management Systems

Worldwide outcries for effective environmental regulations and improved environmental management, effective worker health and safety laws and standards, consumer product safety standards and strict enforcement of all such safety regulations led to the development of extensive international and national legislations, protocols and codes of conducts. At the same time, there was a growth in the activities of communities, interest groups and NGOs. Consumers flexed their muscles by increasingly purchasing products and services marketed on an ethical or environmentally positive basis.

Environmental issues are complex and there may be no single, right, or wrong answer to an environmental dilemma. Emphasis on particular problems may vary from place to place but the significance is universal. For example, air quality in cities is an issue whether in New York, Sydney, New Delhi, Seoul or London. IPCC (1988) described various environmental issues, in order of global to local significance, which include:

- **a.** Depletion of the Ozone layer;
- **b.** Global warming;
- **c.** Loss of bio-diversity;
- **d.** Air pollution;
- **e.** Water Pollution;
- **f.** Toxic chemicals;

g. Nuclear issues;

h. Depletion of natural resources;

i. Quality of life.

Environmental issues are strongly linked with economic conditions. Environment and industrial development are closely linked, whether in the sphere of international relations, creation of national policy or in the management of individual organization.

Development of environmental standards received an impetus from the growth in public concern about environmental degradation and unsustainable use of natural resources. As the industries were subjected to various regulatory controls, in the seventies and eighties, they started to measure and monitor their environmental performance. Auditing of environmental performance on a regular basis became the norm for many large companies. Cement, chemical and nuclear industries with negative environmental performance found themselves under tremendous attack from protest groups and from the media. In order for the companies to survive in the market place, good public relations with regard to environmental performance became essential. A genuine need to adopt a common practice on environmental management system was felt by most of these industries. The Environmental Management system, BS 7750 was developed in the U.K., as the result of a taskforce comprised of representatives from industry, government and environmental groups; as a result the first draft was released in 1992.

Richard Starkey (1995) stated that the English language environmental management system documents that exist worldwide are as follows:

a. The British Standard BS 7750: 1994 – Specification for environmental management systems;

b. Council Regulation (EEC) No. 1836/93 of 29th June 1993 allowing voluntary participation by companies in the industrial sector in a community eco- management and audit scheme. This is commonly known as the Eco-management and Audit scheme (EMAS);

c. The International Standard ISO: 14001:2004 – Environmental Management Systems– Specification with guidance for use;

d. The Irish Standard IS 310: 1994 Environmental Management Systems – Guiding Principles and Requirements;

e. The Canadian Standards Association Standard CSA Z750 – 94 – A voluntary Environmental Management System;

f. The International Standard ISO: 14000:2004 – Environmental Management Systems: General Guidelines on Principles, Systems and Supporting Techniques.

There is a great similarity among these documents. For example, the 1992 version of BS 7750 influenced the drafting of EMAS, which in turn influenced the content of the current version of BS 7750. Furthermore, it is explicitly stated in the foreword of IS 310 that the standard takes inspiration from EMAS. Hillary (1993) clarified that EMAS is a regulation rather than a standard and has the same aim: standardization in the field of environmental management systems. Unlike other prevailing standards in environmental management systems, IS 310 requires that the Environmental Policy of the company must contain a commitment to the sustainability of the natural environment, compatible with economic sustainability of the organization.

ISO: 14001 have been constructed around the Deming Cycle, a process management tool devised by Dr W. Edwards Deming, a pioneer in the field of quality management. The Deming Cycle is diagrammed in Figure 2-2.

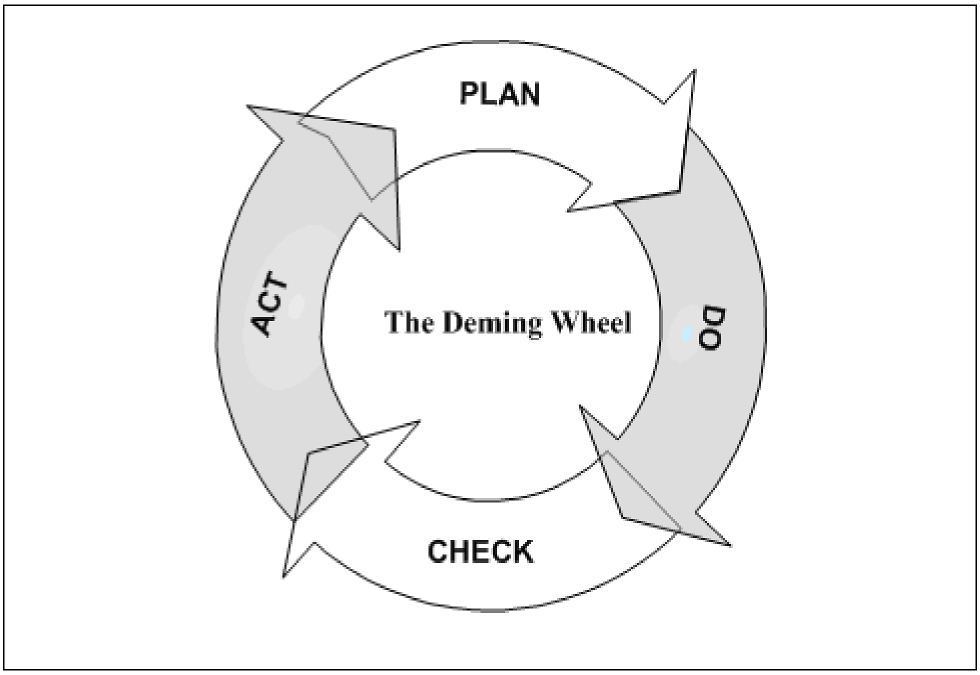


Figure 2-2: The Deming's Cycle for industrial process management and improvement, Source: Latzko and Saunders (1995)

In the Deming's Cycle, **PLAN** refers to planning what is to be done.

DO: refers to doing what has been planned.

CHECK: refers to checking that what was planned has actually been done.

ACT: refers to acting on the results of the checking procedure to revise / modify the initial plans.

This tool has been recognised for continuous improvement. When the cycle is completed and the problem is solved it is required to go back to the planning stage to identify the next problem and the new cycle starts. The International Organisation of Standardization noticed the importance of this tool and it is used by ISO standards. These management systems provide guidelines and standards for managing and monitoring the environmental performance of the organisations that decide to take advantage to effectively mitigate the negative impacts of their activities.

A few of the programs that address pollution problems in the US are: The Clean Water Act (1972, 1977, 1987), The Clean Air Act (1970, 1977), and The Resource Conservation and Recovery Act (1976, 1984). Luken (1990) stated that these mandates employed technology-based standards, ambient-based standards, or benefits-based standards. Thurston and Bras (2001) advocated a new trend of product take-back legislation, which places the logistic and economic burden of product disposal on the manufacturer. Like most other industries, the cement industry is struggling with pollution problems. Their first priority should be to develop waste disposal systems in order to comply with environmental regulations. A survey conducted by The National Association of Environmental Managers of the United States showed that companies employing Environmental Managers entrusted them with the responsibility of compliance with regulatory requirements.

2.6.1 Responsible Care

'Responsible Care' (RC) is the world's leading voluntary industry initiative, first developed in Canada by the Canadian Chemical Producer's Association (CCPA) and was launched in 1985 to address public concerns about the manufacture, distribution and use of chemicals. CCPA is committed to do the right thing and to be seen to do the right thing. They are guided towards environmental, societal, and economic sustainability by the principles of stewardship of products and services during their life cycles, accountable to the public, respect of people, law abiding and striving to continuous improvement. It works for effective laws and standards and inspire others to commit themselves to the principles of RC.

The number of chemical industry associations embracing the ethics has grown from 6 to 52 countries since 1992, when Agenda 21 was adopted at the Rio Earth Summit. RC has been commended by the United Nations Environmental Programme (UNEP) at the World Summit on Sustainable Development, held in Johannesburg in August 2002 for making a significant contribution by the chemical industry to move toward SD. It aims to develop an attitude and culture, which ensures that chemicals are handled and distributed safely using constantly improving operations and techniques. The integrity of the RC programme delivers real business benefits, such as:

- **a.** Insurers now take compliance with RC into account when calculating premiums – particularly in respect to members applying independent third-party verification;
- **b.** RC enhances the industry's reputation with regulators;
- **c.** The European Single Assessment Document (ESAD) for chemical distributors now provides a mechanism for third party assessment of RC.

RC helps the industry to operate safely, profitably and with care for future generations. It enables the industry to demonstrate how its health, safety and environmental performance have improved over the years, through the sharing of information and a rigorous system of checklists, performance indicators and verification procedures. It facilitates development of policies for further improvement.

2.6.1.1 The Responsible Care Codes of Practice

The ethical principles of RC are captured in a set of 6 codes of practice that cover the life cycle of chemical products. Each member company must commit to implement the ethic and codes of practice of RC within three months of joining the Association. The six codes of practices are as follows:

- Community Awareness and Emergency Response (CAER)

  CAER requires each member company to have ongoing processes to identify and respond to community concerns, to inform the community of risks associated with company operations, and to have its own emergency plan integrated and tested with the community's emergency response plan.

- Research and Development

  The Research and Development code challenges companies to fully understand and minimize the risks arising from new chemical products, processes, equipment and uses, or new applications for existing products.

- Manufacturing

  The Manufacturing code covers new and existing manufacturing sites, and deals with all aspects of a company's operation. It covers the design of new plants and the decommissioning of old ones. It requires systems to be in place to protect employees, the community and the environment from any harmful effects – whether immediate or long-term – stemming from manufacturing operations.

- Transportation

  The Transportation code requires that each member company transport chemicals and chemical products in a manner that minimises environmental damages and risk of injury to people living along transportation routes. Selecting and assessing transport carriers and informing communities along the way of safeguards being taken are key aspects of this code.

- Distribution

  The Distribution Code covers members' activities related to the purchase, sale, and use of chemicals, chemical products and services. It calls for standards, procedures and training for the storage and handling of chemical products. Suppliers, distributors and customers are required to comply with the code.

- Hazardous Waste Management

  The Hazardous Waste Management Code challenges companies to avoid the production of wastes in the first place. For unavoidable wastes that can't be reused, recycled, or recovered, it calls for the sound management of all aspects of waste sites. (www.icca-chem.org)

2.6.1.2 Other Aspects of Responsible Care

Verification of how the member companies live up to their obligations under Responsible care is the key aspect to the compliance of ethics. Every three years, repeat visits by the verification team emphasize performance and by ascertaining that the management systems are delivering the results expected by the public. The teams' reports for all verifications are posted on the CCPA website.

The ultimate test of RC is whether it delivers improved performance. On an ongoing basis, CCPA member companies must track, improve and report on how they are performing in all the aspects of health, safety, environmental and social performances that are important to the public. CCPA collates and publishes data from all the companies in which they are particularly interested. These include chemical emissions and wastes, with five-year projections, employee injuries and illnesses, chemical process spills, fires and transportation accidents. RC has transformed the way in which companies operate: from being secretive and defensive about their activities, to being more open, honest, and actively seeking dialogue and partnerships with stakeholders. (www.ccpa.ca/ResponsibleCareHome.aspx)

2.6.2 Environmentally Conscious Design and Manufacturing (ECD&M)

Darnall and others (1994) stated that firms have begun to incorporate environmentally conscious manufacturing models (ECD&M) into their manufacturing processes and corporate strategies to address environmental concerns. ECD&M is a systems-based approach to product and process design, where environmental attributes are treated as primary objectives or opportunities for improvements rather than as constraints, and emphasizes the legitimacy of environmental objectives as consistent with the overall requirements of product quality and economy. Weissman and Sekutowski (1991) wrote that ECD&M involves the planning, development and implementation of manufacturing processes and technologies that minimize or eliminate hazardous waste, reduce scrap, are operationally safer, and can design products that are recyclable, or can be remanufactured or reused. Allen (2001) stated the common objectives of ECD&M worldwide as:

a. Reducing energy and material consumption;

b. Reducing material uses and waste generation;

c. Reducing the magnitude and impacts of product packaging;

d. Managing products that are returned to manufacturers at the end of their designed use;

e. Responding to customer demands for documented Environmental Management Systems (EMS).

The proactive approach towards environmental sustainability paved the path for Environmentally Benign Manufacturing (EBM) rather than end-of-pipe approaches to environmental protection via compliance to regulatory requirements. Thurston and Bras (2001) reported that US manufacturers currently spend approximately $170 billion per year in waste treatment and disposal costs. Design for Environment (DfE) and Life Cycle Analysis (LCA) have gained and are increasingly gaining interest from the manufacturing industry. DfE primarily focuses on considerations of environmentally conscious factors at the product and process design stages, whereas, LCA targets the analysis of environmental impact and costs at each stage of product's life cycle. All of these proactive, preventive approaches are designed to help companies to prevent and/or minimise the risks and inefficiencies of the past and at the same time to reduce the end-of-pipe waste treatment cost. Thereby, they can improve their profitability while reducing risks to their workers, their customers and to the environment.

In this chapter, the researcher highlighted the differences in the various environmental management systems and their implications. ISO: 26000: 2010 has just been launched and is the capstone that builds upon the integration of the goals, objectives and processes of ISO: 9001, ISO: 14001 and OHSAS

18001. This is covered in Section 2.8.4. Subsequent to the Stockholm Conference, regulatory programs were developed in the U.K., the United States of America, France, and Canada and in other countries to discourage or prohibit conduct that would be detrimental to the environment. While it remains cheaper for firms to pollute than to act sustainably, we should not be surprised that they continue to do so. But the prevention oriented approach of cleaner production, both in the short term and for sure in the longer term, performing under the TBL/CSR framework is economically more profitable. In fact, this is the essence of the drive for the integration of the TBL into corporate policy, strategy and practice. Calori and de Woot (1994) examined the growing pressure towards environmental management that is originating from various societal stakeholders. They stated that the business system naturally tends to fit with the society in which it is embedded and any changes in the 'business system' are linked to changes in the whole society. Business operations are governed by the institutions, which form the cultural base of a society, its churches and family structures. The effects of these on the firm are less easy to detect than the influences on the firm of the formal institutions of political systems, financial and labour unions, NGOs, and product-service markets as well as the stock markets. Here the role of the state is crucial, since it defines the rules of the economic game and it designs and implements the educational systems and communications networks. It should also design and uniformly enforce the regulatory framework on SHE. That is clearly one of the most crucial elements that must be addressed much more effectively, if governments are to have a real role in preventing the types of disasters reviewed earlier in this Chapter.

2.7 The Triple Bottom Line (TBL)

Van der Ryn and Cowan (1996) stated that if we are to create a sustainable world – one in which we are accountable to the needs of all future generations and all living creatures – we must recognise that our present forms of agriculture, forestry, fisheries, architecture, engineering, transportation, energy production and uses and other technologies are deeply flawed. To create a sustainable world, we must transform these practices. We must infuse the design of products, buildings, and landscapes with a rich and detailed understanding of ecology.

Goodland and Daly (1996) wrote that SD is classically portrayed as the interface between environmental, economic and social sustainability. Figure 2-3, diagrammatically presents interactions among ecological, economic and social development.

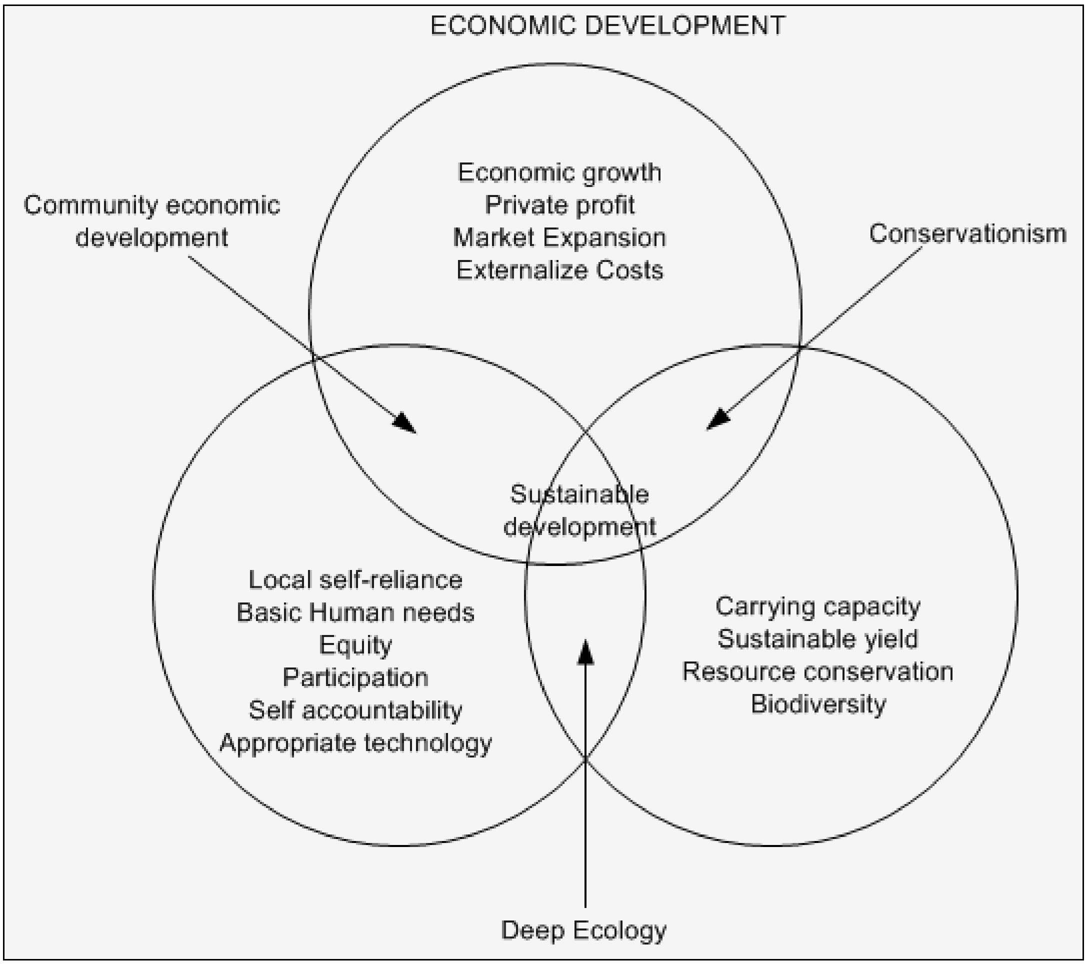


Figure 2-3: Interactions between ecological, economic and social development.
Source: Goodland and Daly (1996)

SD policies require meeting present needs with minimal damage to the physical environment and in a way that avoids compromising the ability of future generations to meet their own needs. The 1992 Earth Summit recognised that this quest for SD has economic, environmental and social dimensions and the three aspects are interdependent. Each of the three aspects has direct implications on the bottom line of an organization. In a broader sense, it can be understood that we operate by living in community, which is surrounded and supported by the environment. A pictorial depiction of this statement can be seen in Figure 2-4:

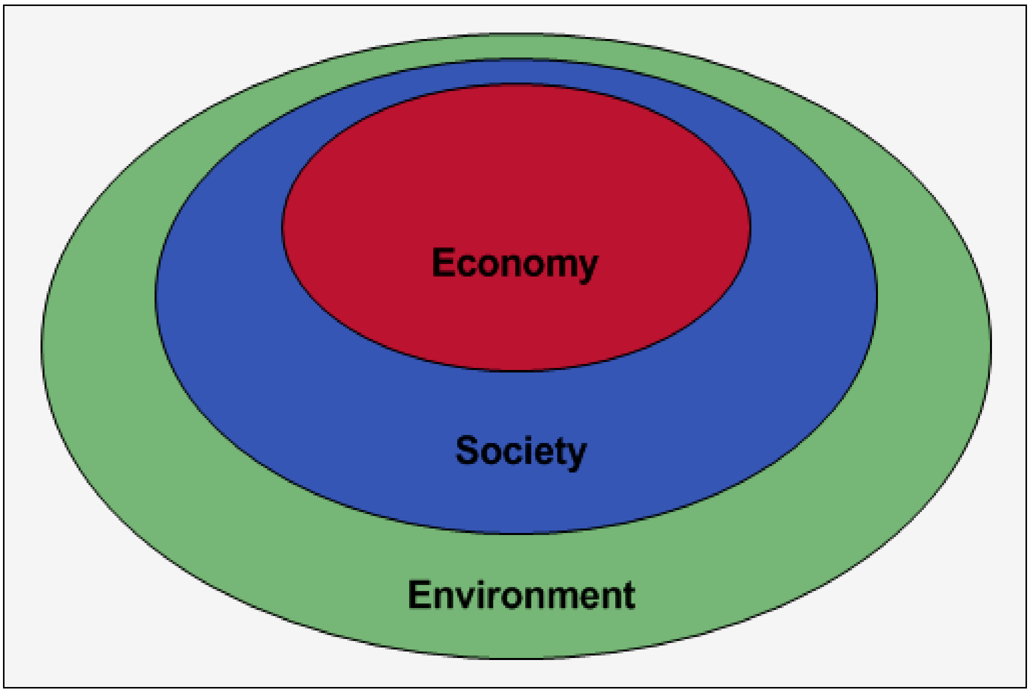


Figure 2-4: Pictorial view of Triple Bottom Line (TBL) approach to Sustainable Development.

The Rio Declaration on Environment and Development advocated that environmental protection must be an integral part of the development process rather than being treated as a separate component i.e., environmental protection has to be mainstreamed into development policies and programmes in all countries. Another key principle is that achieving SD requires both, eradicating poverty in the developing world and making lifestyles in the developed world less environmentally damaging. Maintaining the physical environment is vital for human wellbeing and for economic and social progress, especially over the longer term. Developed countries are responsible for most of the environmental damage due to their rapid industrialisation but developing countries, particularly those achieving rapid economic growth, are responsible for an increasing amount of the present destruction and are vulnerable to the consequences of the ongoing environmental degradation. The main causes of the deterioration of the global environment are unsustainable patterns of consumption and production. Agenda 21, the program of action adopted at UNCED, calls upon countries to adopt a broad package of national policies to foster SD. Establishing or strengthening of environmental protection agencies would enable governments to enforce the successful implementation of these policies. An important dimension of this is ensuring that national initiatives are translated into action at the local level. Elkington (1994) coined the term the Triple Bottom Line. He stated that in 1994, he was looking for a new language to express what he saw as an inevitable expansion of the environmental agenda that Sustainability (founded in 1987) had mainly focused upon to that point.

Hawkens and others (1999) identified four major threats to environment and natural resources, namely, Population, Industrialization, Urbanization and Globalisation. They also suggested that environmental awareness has primary importance to achieve the TBL. Other scholars such as, Edward (2004) and Von Zharen (2001) have also emphasized the importance of dramatically increasing the societal environmental awareness. Only the proper understanding about the environment in which we live and operate will lead us towards proper, systematic and proactively focused environmental management. Concerned with the extent of human impact on the natural environment, Shrivastava (1995) questioned the function of modern science and technology, claiming that science and technology have increased the impact of human activities to a degree that they are degrading the ecological system.

Welford (1995) graded environmental management policies on a five-point scale. Policies range from reactive legislative compliance, which is a minimalist approach to proactive management for ecological sustainability.

Grades of Environmental Management as adapted from Welford (1995):

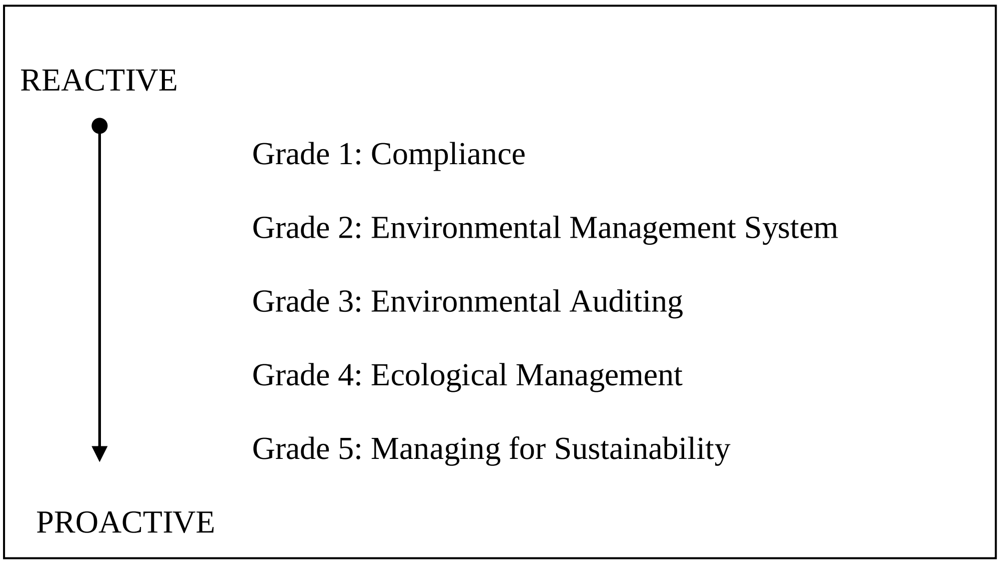


Figure 2-5: Grading of Environmental Management; Source: Welford (1995)

Managing for sustainability is based on a holistic approach, seeking intergenerational and intra-generational equity as well as social and ecological balance. The application of reformist systems of grade 1-4 could, eventually and over the long-term, lead to sustainability through a continuous cycle of improvements. Realistically and in practice, however, the momentum necessary to sustain continuous improvement is unlikely to be maintained. The achievement of a limited number of goals can lead to complacency. Furthermore, the attractions of long-term environmental sustainability can pall in light of conflicting short-term demands on the firm’s resources.

ISO 14001 focuses on compliance to legislation and regulatory requirements but the ultimate aim is to integrate economic prosperity, social justice and environmental performance. Stead and others (2004) state that the TBL concept is designed to help corporations to become socially and environmentally responsible in addition to being economically responsible. In other words, the goal of TBL is to reduce, or eliminate negative impacts of corporate activities, and to simultaneously satisfy the fundamental need for organizational profit, the need for environmental sustainability, and the need for social sustainability. Sustainability can only be defined for complete socio-economic-environmental systems and not for its component parts. Environmental issues illustrate the interdependency of all the world's nations. Brazil, Korea, Middle East countries, and England all have traffic problems of their own but only Brazil has indigenous tropical forests. There are other parts of the world that still have some tropical rainforests. Yet Korea, England and the Middle East Countries also depend on continued existence of those rainforests. Similarly, environmental issues cannot be dissociated from economic issues and societal responsibilities. Environment and development are closely linked whether in the sphere of international relations, creation of national policy or in the management of individual organizations. Development in industrial activity improves country's GNP, employment opportunity, leaving standards and quality of life but brings in pollution problems, which must be adequately addressed for sustainability.

The UN "Brundtland Commission" report (1987) stated that for the business enterprise, SD means adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed in the future. It implies limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the affects of human activities. The report also urged businesses to strive to work to address the economy, environment and society at the same time. In other words, corporate responsibility translates into a singular goal of doing business profitably, sustainably and ethically. The interconnections of ecosystems and human interactions with them is diagrammatically portrayed in Sweden's former environmental protection agency leader Bo Kjellen's 'Diamond of Sustainability' (See Figure 2-6)

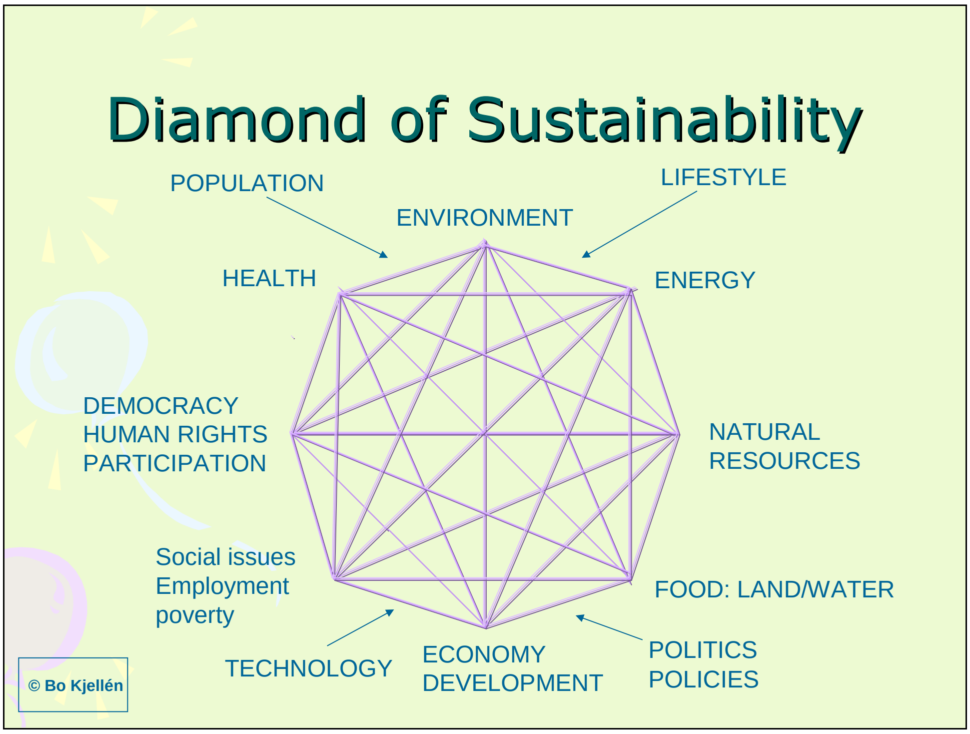


Figure 2-6: Bo Kjellen's Diamond of Sustainability, Source: Bo Kjellen (1999)

The Sustainability Diamond shows the complex interrelationships among eco-systems and all human activities that are totally interdependent upon viable and vibrant functioning of such eco-systems. We can all learn much from the social, philosophical, ecological, economic and ethical implications of the dynamic interconnectedness.

A simplified diagram of the Diamond of Sustainability is presented in Figure 2.7 to capture the essence of sustainability and of the TBL of sustainability for corporations:

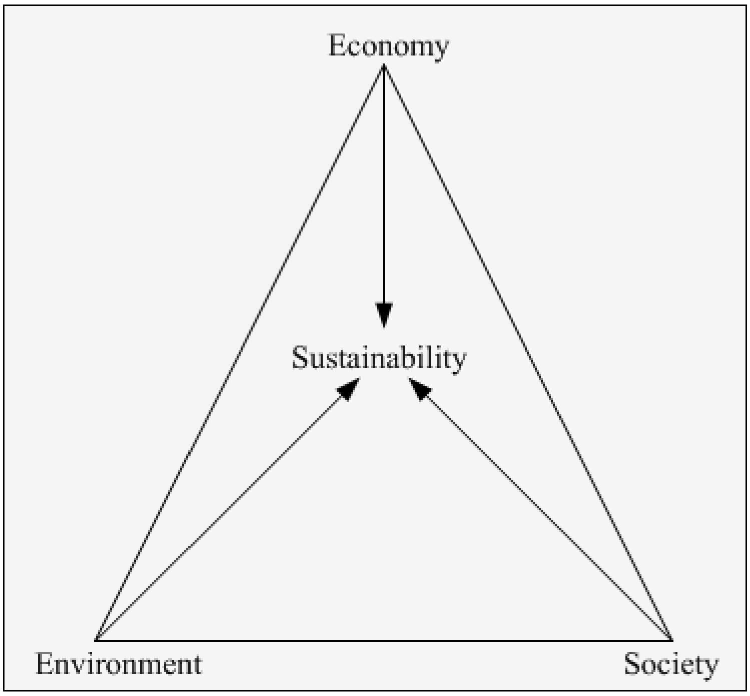


Figure 2-7: Simplified Sustainability Diagram, Source: Author (2009)

For any organization to be sustainable the economic, ecological and societal responsibilities must be shouldered in a cohesive manner. Economic responsibility simply refers to the profit making business of the company. However, in the current scenario of sustainable business thinking, maximizing the profit or shareholder's value as a sole economic responsibility of a company is a highly debatable issue. The World Resources Institute (1999) emphasized that economic responsibility should reflect not only the financial capital (Cash Flow) viability or profitability of the company, but also the growing global economic integration. It also implies cooperation with other market players while maintaining the expectations of the shareholders. They also emphasised that all of this must be done within the context of true ecological sustainability. However, the time dimension is very much important and Figure 2-7 simply shows the concept involved in moving towards sustainability journey.

Environmental responsibility refers to the continuous management of environmental impacts of a company's operation. This means that business should be managed in such a way that it does not cause further pollution and degrade the environment. Many companies attempt to manage their environmental problems by adopting Environmental Management Systems and other eco-efficiency approaches but this cannot be done in isolation; it requires involvement of internal and external stakeholders. Social responsibility refers to taking care of different expectations of all stakeholders - shareholders, employees, suppliers, customers, communities and other interested groups that comprise civil society and of course of the environment upon which all companies and all of society is totally interdependent.

Fulfilment of the TBL concept requires that firms look for and work out strategies that guarantee financial success and at the same time manage their environmental and social responsibilities. Environmental costs are most often hidden as overheads i.e. they are accounted for "indirect production costs" or "administrative costs" instead of being allocated directly to the product or process creating the cost. The US EPA (1995) defines overheads as any cost that, in a given cost accounting system, is not wholly attributed to a single process, system, product or facility. In other words, the cost is shared across all activities not enabling to make anyone specifically accountable for it. The use of overheads can prevent optimal decision-making from being taken because appropriate cost information is not available. It might for instance be unclear which environmental costs are fixed and which are variable. Fixed costs are difficult to reduce where as variable costs can be reduced by preventive environmental measures. The UNDSD (2001) underlined that at a time when environmental compliance costs were marginal and profits high, this might have been reasonable but with increased environmental awareness, strong competition and the need to improve production efficiency, especially with regard to material efficiency, the cost of tracking and tracing material flows, throughout the company are by far outweighed by the improvement potentials identified and realized. Reviewing available literature on environmental accounting it was noted that many different accounting methods have been developed to overcome these shortcomings, including two of particular relevance for practical application: Full Cost Accounting (FCA) and Activity Based Accounting (ABC).

Full cost accounting recognises economic, environmental, health and social costs of an action or decision. Unlike other common methods of accounting that record only current outlays of cash, FCA takes into account all of the monetary cost of resources used or committed, which may differ from cash outlays. ABC is a costing model that identifies activities in an organisation and assigns the cost of each activity resource to all products and services according to the actual consumption by each. ABC method assigns more indirect cost (overheads) into direct cost. Kaplan and Burns (1987) defined ABC clearly for the first time and initially focused on manufacturing. In the cement manufacturing, increasing uses of technology and productivity improvements have reduced the relative portion of the direct costs of labour and materials, but have increased relative proportion of indirect cost. For example, increased automation has reduced labour, which is a direct cost, but has increased depreciation, which is an indirect cost. Drucker (1999) stated that traditional cost accounting focuses on what it costs to do something, for example, to cut a screw thread; activity-based costing also records the cost of not doing, such as the cost of waiting for a needed part.

The Centre for Innovation in Corporate Responsibility (CICR) stated that there is no clean-cut or straightforward approach to implement the TBL accountability. The TBL approach or framework looks at how corporations manage and balance all the three responsibilities for a sustainable business. What is required today is a comprehensive management framework that would address, check and balance these economic, social and environmental responsibilities of business units. Although, there has been a proliferation of management systems, accounting, auditing and reporting standards, most of them are focused on one or on a combination of two responsibilities. The need to integrate all three responsibilities, although acknowledged by many, leaves a question of what framework is needed and how to really proceed with it in their firms on strategic and on a day-to-day basis.

KPMG (2002) reported that progressive and well-intentioned companies like Baxter, BC Hydro, Novo Nordisk, South African Breweries, Shell, Holcim, Lafarge, CRH Group, Titan Cement and many others have attempted, with varying degrees of success, to bring the three responsibilities together under one performance management, evaluation and reporting framework. International organizations such as the WRI, the CERES, the UNEP, the ICC, the GRI, and the WBCSD are actively contributing to the development of concepts, standards, checklists and processes within the TBL framework.

2.8 TBL Reporting Tools

Knoepfel (2001) stated that accounting for economic, environmental, and social impacts (i.e. TBL, CSR reporting, etc.) in broad terms is synonymous to “Sustainability reporting”. Sustainability reporting is the practice for measuring, disclosing and being accountable for organizational performance towards the goal of

SD. Achieving the goal of SD can be more of an aspiration than a reality. With increasing globalisation of political- economy, new and unprecedented opportunities of wealth generation appear via knowledge sharing and access to innovative technologies. But with these opportunities, excessive strain is caused on sustainability of the environment. Environment being the principal source for economic development, the burden of an ever-increasing human population with differentiated opportunities for participation into the global economy is resulting in severe damages to the environment. Transparency about the sustainability of organizational activities is of interest to a diverse group of stakeholders, viz. investors, employees, community, business associates, non-governmental organizations, governmental regulators and etc.

2.8.1 Sustainability Index

Elkington (1998) stated that it is clear that progress or the lack of it can be measured against a wide range of indicators associated with each of the three bottom lines of sustainability. Sustainability index or attribute refers to a systemic characteristic such as carrying capacity of the environment or the interrelations between economy, environment and society. Its fluctuations reveal the variations of components in the ecosystem. The objective of measuring SD can be accomplished by measuring financial growth, ecological improvement, and ethical equity. Therefore, individual indices established for each perspective of the TBL are presented in the following paragraphs:

The Economic Prosperity Index set (EC), which contains attributes that only describe economic characteristics, e.g., profit;

The Environmental Quality index set (EN), which contains attributes that only describe environmental characteristic, e.g., energy consumption; and

The Social Justice index set (SC), which contains attributes that only describe social characteristics, e.g., percentage of minority professionals employed by the company.

Through the literature search, this author found that these are the most commonly used indices but there are some overlapping areas that contribute to more than one area, e.g., eco-efficiency. These overlapping areas are known as "Shear Zone" areas and need to be integrated into the overall assessment of company's performance. They are described as follows:

- The Eco-Environmental index (EE) set contains attributes that describe both economic and environmental characteristic e.g., reuse rate;
- The Eco-Social index (ES) set contains attributes that describe both social and environmental characteristic, e.g., Job creation;
- The Socio-Environmental index (SE) set contains attributes that describe both social and environmental characteristics, e.g., toxicity, and;
- The Eco-Social-Environmental index (ESE) set, which contains attributes that describe characteristics of all the three bottom line elements, e.g., sustainability audit and communication.

Reichheld (2001) stated that we assess the company's economic prosperity in its contribution to the satisfaction of shareholders, customers, employees, and the company itself. However, the cultural dimension is not taken into account in this index system. Based on these seven criteria of selecting sustainability indices, Dow Jones Sustainability Index was developed. Companies have voluntarily participated in this program and investors use corporate sustainability as a proxy to enlightened disciplined management, which is one of the most important factors that investors consider in buying a stock. In this regard, Knoepfel (2001) further stated that in long-term sustainability companies deliver more predictable results and the DJSI need to be aligned with Global Reporting Initiative (GRI).

Collecting data and reporting on each of these indices could be one way forward on the CSR/TBL journey. In this research, the author focussed upon the TBL/CSR accountability of cement companies that reported upon their social and environmental performances in line with GRI methodology. The GRI methodology and its requirements are discussed in the following section.

2.8.2 The Global Reporting Initiative (GRI)

In order to help companies make more efficient progress in the integration of environmental, social and economic dimensions into their entire operations, the GRI was first developed in 1997 by the Coalition for Environmentally Responsible Economies (CERES), along with the UNEP. Since then, a series of GRI guidelines and checklists have been developed and are being increasingly used by leading companies to guide their development and implementation of their TBL or their CSR.

The mission of the GRI is to fulfil the need by providing a trusted and credible framework for reporting. The GRI reporting framework (G3, 2006) was intended to serve as a generally accepted framework for reporting on an organization's economic, environmental, and social performance. Performance indicators are organized under each of the three domains. Social sustainability indicators are further categorized into labour, human rights, society and product responsibility. Each category comprises a disclosure on management approaches and a corresponding set of core and additional performance indicators. Core indicators are of interest to most stakeholders and are assumed to be material unless demonstrated not to be on the basis of the GRI reporting principles. Additional indicators represent emerging practice or address issues that may be material in the context of specific organizations, but are not relevant for a majority of organisations. Information should be presented for the current reporting periods and for at least two previous periods, as well as information should be provided about future targets for the short and medium period for the company.

Illustrative performance indicators for economic, environmental, and social dimensions are given in Table 2-3:

Dimensions	Symbol	Performance Indicators
Economic	EC1	Economic value generated and distributed, including revenues, operating cost, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and to governments (core)
	EC2	Financial Implications of climate change (core)
	EC3	Coverage of the organization's defined benefit pension plan obligations (core)
	EC4	Financial Assistance received from government (core)
	EC5	Entry level wage compared to local minimum wage for significant locations of operation (core)
	EC6	Practices and proportion of spending on locally-based suppliers at significant locations of operation (core)
	EC7	Procedure for local hiring, and promotion of senior Management in locations of significant operation from the local community (core)
	EC8	Description of infrastructure investments and services supported that provide public benefit (core)

Dimensions	**Symbol**	**Performance Indicators**
	EC9	Indirect economic impacts (additional)
Environmental Aspect: Material	EN1	Weight of materials used (core)
	EN2	Percentage of materials used that are recycled (core)
Aspect: Energy	EN3	Direct energy consumption broken down by primary Energy source (core)
	EN4	Indirect energy consumption broken down by primary Source (core)
	EN5	Percentage of total energy consumption met by renewable resources (additional)
	EN6	Total energy saved due to conservation and efficiency improvements (additional)
	EN7	Initiative to provide energy-efficient products and services (additional)
	EN8	Initiative to reduce indirect energy consumption (additional)
Aspect: Water	EN9	Total water withdrawal by source (core)

Dimensions	Symbol	Performance Indicators
	EN10	Water sources and related habitats significantly affected by withdrawal of water (additional)
	EN11	Percentage of total volume of water recycled and reused (additional)
Aspect: Biodiversity	EN12	Location and size of land owned, leased, or managed in, or adjacent to, protected areas (core)
	EN13	Description of significant impacts of activities on protected areas (core)
	EN14	Area of habitats protected or restored (additional)
	EN15	Programs for managing impacts on biodiversity (additional)
	EN16	Number of IUCN Red list species with habitats in areas affected by operations broken down by level of extinction risk (additional)
Aspect: Waste, Emissions and Waste water	EN17	Greenhouse gas emissions (core)
	EN18	Emissions of ozone-depleting substances (core)
	EN19	NOx, SOx, and other significant air emissions by weight (core)
	EN20	Total amount of waste by type and destination (core)
	EN21	Total water discharge and quality (core)

Dimensions	Symbol	Performance Indicators
	EN22	Total number and volume of significant spills (core)
	EN23	Other relevant indirect greenhouse gas emissions (core)
	EN24	Weight of transported, imported, or exported waste deemed hazardous under the terms of the Basel Convention Annex. I, II, III, and VIII (additional)
	EN25	Water sources and related habitats significantly affected by discharges of water and run off (additional)
Aspect: Product and Services	EN26	Initiative to manage the environmental impacts of products and services and extent of impact reduction (core)
	EN27	Percentage of products sold that are reclaimed at the end of product’s useful life by product category (core)
Aspect: Compliance	EN28	Incidents of, and fines or non-monetary sanctions for, non-compliance with applicable environmental regulations (core)
Aspect: Transport	EN29	Significant environmental impacts of transportation used for logistical purpose (additional)
Aspect: Overall	EN30	Total environmental protection expenditures by type (additional)
Social	LA1	Breakdown of total workforce by employment type and by region (core)

Dimensions	Symbol	Performance Indicators
Aspect: Employment	LA2	Total number and rate of employee turnover broken down by age group and gender (core)
	LA3	Minimum benefits provided to full-time employees, which are not provided to temporary or part-time employees (additional)
Aspect: Labour /Management Relations	LA4	Percentage of employees represented by independent trade union organizations or covered by collective bargaining agreements (core)
	LA5	Minimum notice period(s) and consultation and negotiation practices with employees and/or after their representatives regarding operational changes (core)
Aspect: Occupational Health and Safety	LA6	Percentage of workforce represented in formal joint management-worker health and safety committees that help monitor and advise on occupational health and safety programs (core)
	LA7	Rate of injury, occupational diseases, lost days, and absenteeism and number of work-related fatalities (core)
	LA8	Education, training, counselling, prevention and risk-control programs in place for assisting workforce members, their families or community members affected by HIV/AIDS or other serious communicable diseases (core)
	LA9	Elements of occupational health and safety management approach (additional)

Dimensions	Symbol	Performance Indicators
	LA10	Health and safety topics covered in formal agreements with trade unions (additional)
Aspect: Training and Education	LA11	Average hours of training per year per employee broken down by employee category (core)
	LA12	Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings (additional)
	LA13	Percentage of employees receiving regular performance and career development review (additional).
Aspect: Diversity and Opportunity	LA 14	Composition of governance bodies and breakdown of employees per category according to gender, age group, minority group membership, and other indicators of diversity (core)
	LA 15	Ratio of average remuneration of men and women broken down by employee category (additional)
Aspect: Human Rights	HR1	Percentage of significant investment agreements that include human rights clauses or that underwent human rights screening (core)
	HR2	Percentage of major suppliers and contractors that underwent screening on human rights (core)
	HR3	Type of employee training on policies and procedures concerning aspects of human rights relevant to operations, including number of employees trained (additional)

Dimensions	Symbol	Performance Indicators
	HR4	Incidents of discrimination (core)
	HR5	Incidents of violation of freedom of association and collective bargaining (core)
	HR6	Incidents of child labour (core)
	HR7	Incidents of forced or compulsory labour (core)
	HR8	Procedure for complaints and grievances filed by customers, employees, and communities concerning human rights, including provisions for non-retaliation (additional)
	HR9	Percentage of security personnel trained in organization's policies or procedures regarding human rights (additional)
	HR10	Incidents involving rights of indigenous people (additional)
Aspect: Community	SO1	Programs and practices for assessing and managing the impacts of operations on communities, including entering, operating, and exiting (core)
Aspect: Corruption	SO2	Extent of training and risk analysis to prevent corruption (core)
	SO3	Action taken in response to instances of corruption (core)

Dimensions	Symbol	Performance Indicators
Aspect: Public Policy	SO4	Participation in public policy development and lobbying (core)
	SO5	Total value of contributions to political parties or related institution broken down by country (additional)
Aspect: Anti-competitive Behaviour	SO6	Instances of legal actions for anti-competitive behaviour, anti-trust, and monopoly practices and their outcomes (additional)
Product Responsibility	PR1	Procedure for improving health and safety across the life cycle of products and services (core)
	PR2	Number and type of instances of non-compliance with regulations concerning health and safety effects of products and services (additional)
Products and Services	PR3	Procedure for product and service information and labelling (core)
	PR4	Number and type of instances of non-compliance with regulations concerning product and service information and labelling (additional)
	PR5	Procedure related to customer satisfaction, including results of surveys measuring customer satisfaction (additional)

Dimensions	Symbol	Performance Indicators
Aspect: Marketing Communication	PR6	Procedure and programs for adherence to law, standards, and voluntary codes related to marketing communications including advertising, promotion and sponsorship (additional)
	PR7	Number and type of instances of non-compliance with regulation concerning marketing communications including advertising, promotion, and sponsorship (additional)
Aspect: Customer Privacy	PR8	Percentage of customer data covered by the data protection procedure (core)
	PR9	Number of substantiated complaints regarding breaches of customer privacy (additional)

Table 2-1: "GRI" Environmental, Economic and Social Dimensions and Performance Indicators, Source: GRI G3 (2006)

GRI encourages all organizations to report against the guidelines whether they are beginners or experienced reporters. Some organizations may choose to introduce reporting on all material issues at once, while others may start with the most practicable issues first and phase in reporting on other issues over time. All reporting organizations should describe the scope of their report. A reporting organization should register with the GRI secretariat in connection with a regular reporting cycle, typically annually or bi-annually. For the purpose of comparability the reporting period should be as consistent as possible.

2.8.3 The United Nations Global Compact

United Nations Global Compact is an umbrella initiative that seeks to foster constructive dialogue among companies and their stakeholders to promote good corporate practices and the exchange of learning experiences in the field of human rights, labour, environmental issues and anti-corruption. The global compact is built upon the following ten (10) principles:

- **a.** Principle 1: Business should support and respect the protection of internationally proclaimed human rights.
- **b.** Principle 2: Business should ensure that they are not complicit in human rights abuses.
- **c.** Principle 3: Business should uphold the freedom of association and the effective recognition of the right to collective bargaining.
- **d.** Principle 4: Business should support elimination of all forms of forced labour.
- **e.** Principle 5: Business should promote the effective elimination of child labour.
- **f.** Principle 6: Business should support the elimination of discrimination in respect of employment and occupation.

g. Principle 7: Business should support the precautionary approach to environmental challenges.

h. Principle 8: Business should undertake initiatives to promote greater environmental responsibility.

i. Principle 9: Business should encourage the development and diffusion on environmental technologies.

j. Principle 10: Business should work against corruption in all its forms, including extortion and bribery.

Principles 1 to 6 cover human and labour rights.

Principles 7, 8 and 9 focus upon protection of the environment.

The three environmental principles from 7 to 9 are based on the declaration of principles and international action plan (the 21st agenda) drafted at United Nations Conference on Environment and Development (Summit Conference) held in Rio de Janeiro in 1992.

The UN global compact is a purely voluntary initiative with two objectives:

a. Mainstream the ten principles in business activities around the world;

b. Catalyse actions in support of implementation of the broader UN goals such as the Millennium Development Goals (MDG).

2.8.4 Social Responsibility

The International Organisation for Standardisation has developed voluntary guidance on Social Responsibility as ISO 26000: 2010, which was released on 1st November 2010 (www.iso.org/pressrelease accessed on 19th November 2010). Clause 3.10 of this standard ISO: 26000 defined social responsibility as:

Responsibility of an organization for the impacts of its decisions and activities on society and the environment through transparent and ethical behaviour that:

- Is consistent with SD and the welfare of society;
- Takes into account the expectation of stakeholders;
- Is in compliance with applicable law and consistent with international norms of behaviour; and
- Is integrated throughout the organization.

To be socially responsible, an organization should consider the following core issues:

- Organizational governance;
- Human rights;
- Labour practices;
- The environment;
- Fair operating practices;
- Consumer issues;
- Social development.

Each of these core issues includes a range of issues that are summarised in the Table 2-2. Many of the issues are interrelated. In implementing actions related to social responsibility an organisation, in awareness of the expectations of its stakeholders, should identify the relevance of the issues. Relevance will be affected by the nature of the organization, its location, activities and other factors. An organisation should address material issues and should address them holistically. There is no pre-determined order in which organisation should address the issues but while working with each of the seven issues, an organisation should consider the ramifications of its activities throughout its supply chain and take the initiative in addressing them.

Table 2-2 illustrates the core issues with an explanation of their primary focus and other related issues with core issues:

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
1	Organizational Governance	Organizational governance is the system by which an organisation is directed and managed in pursuit of its objectives. An effective governance should lead to: Better decisions that are easy to implement; Improved operational performance; Better identification and management of risks and opportunities; More awareness of impacts on stakeholders; and trust in the actions taken by the company.	a. Legal Compliance b. Accountability c. Transparency d. Ethical conduct e. Recognition of stakeholders and their concerns.
2	Human Rights	Safeguarding human rights and respecting the dignity of every single human being is a fundamental obligation for all organizations. It is the basis for economic and social	a. Non-discrimination; b. Civil and political rights; c. Social, economic and cultural rights;

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		development in the world. Organisations should address the human rights that are most relevant to their operations. Protection of vulnerable groups deserves special consideration.	d. Vulnerable groups; e. Fundamental rights at work;
3	Labour Practices	The labour practices of an organization encompass all policies and practices related to work performed within, by or on behalf of the organisation. Labour practices include the recruitment and promotion of workers; disciplinary and grievance procedures; the transfer and relocation of workers; termination of employment and any policy or practice affecting condition of work. Labour practices of an organisation can have great impact on society and thereby, can contribute significantly to SD. Labour practices can have a	a. Employment and employment relationships; b. Condition of work and social protection; c. Social dialogue; d. Health and safety at work; e. Human resource development;

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		significant impact on reputation of the organisation.	
4	The Environment	The organisation should take environmental responsibility, i.e. it should assume responsibility for harm to the environment caused by activities within its control or sphere of influence. Some of the environmental problems faced by the world are depletion of natural resources, climate change, pollution and destruction of ecosystem. Environmental issues are closely linked to human rights, social development and other core issues of social responsibility. A precautionary approach should be used to protect human health and the environment. In line with the "Polluter Pays Principle" the organisation should bear the cost of pollution prevention. The UN Rio Declaration 1992 stressed that	-Identifying and managing environmental aspects of activities, products and services; a. Emission to air and water' b. Waste minimization and recycling; c. Reducing use of toxic and hazardous materials. -Promoting sustainable consumption and production: a. Cleaner production b. Environmental risk c. Life cycle approach

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		Cleaner Production, which is a precautionary approach, should be used. A key element of a precautionary approach is the idea that prevention is better than cure. Cleaner production takes into consideration one or a combination approaches for conserving raw materials, water and energy, eliminating toxic and dangerous raw materials and reducing the quantity and toxicity of all emissions and wastes at source during production processes. For products, cleaner production aims to reduce the environmental, health and safety impacts of products over their entire life cycle. For services, cleaner production implies incorporating environmental concerns into designing and delivering services. An organization should implement programs to reduce resource use,	d. Eco-efficiency and eco-design; e. Green procurement; f. Product-service system; g. Consumer role and related policies - Sustainable resource use: a. Energy efficiency; b. Efficient water use; c. Sustainable land use. - Combating climate change: a. Climate change mitigation; b. Climate change adaptation.

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		while ensuring that the resources are chosen from the most sustainable sources available. Climate change affects the future of human society globally. Man-made greenhouse gas emissions are causing global climate change, which is having significant impacts on the natural and human environment. An organisation should identify the types of action it can take to reduce greenhouse gas emission.	-Valuing Ecosystems: a. Ecosystems restoration; b. Ecosystem services; c. Biodiversity;
5	Consumer Issues	Consumers are among an organisation's most important stakeholders. Consumers are referees in the competitive market place, and their preferences and decisions have a strong influence on the success of most organizations. Consumers play a key role in promoting SD through sustainable consumption. Sustainable consumption is	a. Fair operating, marketing and information practices; b. Protecting consumer's health and security; c. Mechanism for product recall; d. Provision and development of

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		possible, only if consumers have information about the conditions under which goods and services are produced and/or delivered and they can compare the goods and services. In dealing with consumers, organizations should be guided by the principles of fairness, transparency and care, especially towards vulnerable group.	environmentally and socially beneficial goods and services; e. Consumer service and support; f. Consumer data protection and privacy; g. Access to essential goods and services; h. Sustainable consumption; i. Education and awareness;
6	Social development	Social development, together with economic development and environmental protection, is the basis for a sustainable society. A major obstacle to achieve equitable social development includes poverty, social inequality, poor health, unemployment, limited access to	Contribution to social development: a. Citizenship awareness; b. Promotion of good health; c. Promotion of culture and preservation of cultural heritage;

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		education, lack of adequate housing and discrimination against minorities. Even though social development challenges are more acute in developing countries, developed countries also have social development problem. Although the primary responsibility for social development belongs to governments, all organizations have an important role to play. Community involvement allows organisations and communities to get acquainted, to respect their different roles, visions and interests and to build trust. The result of this process is co-operation for social economic development, with justice and equity as its core element. Organisations should promote equitable treatment with respect to criteria such as race, ethnic origin, gender, sexual orientation, religion,	d. Promotion of education; e. Contribution to alleviation of poverty and hunger; Contribution to economic development: a. Use of resources; b. Contribution to the local economy; c. Taxes; d. Innovation, technology and science e. Socially responsible investment; Community involvement: a. Impacts on the community; b. Consultation, dialogue and

No.	Core Issues under CSR	Explanation of Core Issues	Other related issues
		disability, age and disadvantages. Organisations should promote empowerment of people; work in partnership and equitable distribution of wealth and income.	negotiation; c. Community empowerment; d. Community social investing;
7	Fair operating practices	Fair operating practices are the practical application of many principles of social responsibility in relationships between an organization and other organizations such as governmental authorities, partners, suppliers, contractors, competitors and the association of which it is a member. It encourages fair competition, improving the reliability and fairness of commercial transactions, preventing corruption and promoting fair political process.	a. Anti corruption and anti-bribery; b. Responsible political involvement; c. Fair competition; d. Promoting social responsibility through the supply chain; e. Respect for property rights.

Table 2-2: Core Issues under CSR, their explanation and other related issues of CSR, Source: ISO/WG SR 26000 (2010)

This standard distils a truly international consensus on what social responsibility means and what core subjects need to be addressed to implement it. It will provide guidance on translating principles into effective actions and help in refining best practices that have already evolved and disseminating the information for good of the international community. It is worth noting from Table 2.2 that there is considerable importance given to identification and management of environmental aspects of activities, products and services along with sustainable consumption and health and safety issues. Alignment of ISO 26000 with GRI, G3 reporting will further help the progressive companies to establish a unified method of monitoring their progress and reporting.

2.8.4.1 Corporate Social Responsibility

Far-sighted business organisational leaders recognise that lasting success should be built on credible business practices and the prevention of activities such as fraudulent accounting and labour exploitation. CSR if properly utilised, can transform modern day businesses into something worthwhile.

There are many definitions of CSR and they consistently refer to five dimensions:

1. The stakeholders' dimensions;
2. The social dimensions;
3. The economic dimensions;
4. The voluntariness dimensions;
5. The environmental dimensions.

Carroll (1999) conducted a literature review of the definition of CSR and concluded that the environmental dimension was not included in the early definitions and this might have influenced current definitions to not include it either. Another and related reason is that the environmental dimension is not explicitly included in the definition, although it is considered to be a part of CSR. The WBCSD (2000) differentiated between Corporate Social Responsibility and Corporate Environmental Responsibility and issued two definitions of CSR, neither of which includes the environmental dimension. However, when CSR is explained in more depth, the environmental and social dimensions are equally emphasised.

Recent release of ISO 26000:2010 has brought an end to such controversies. Van Marrewijk (2003) stated that a successful CSR strategy has to be context-specific for each individual business, i.e. “What are the specific CSR issues to be addressed and how to engage with the stakeholders?”

Social responsibility should be integrated into an organization’s overall goals and management strategies. To be successfully integrated, it must be supported by the top management, developed through interactive dialogue with the stakeholders and be explained in the context of the organization’s vision, mission and policies. Comprehensively addressing social responsibility is an ongoing activity that takes time. An organization should prioritise and accommodate the activities it undertakes to become socially responsible according to its profile, complexity, context and feedback from stakeholders. To make progress and to allow for accountability, an organization should review and communicate its activities and progress.

2.9 *The TBL Journey and the Cement Industry*

Within the CSR/TBL context, the WBCSD commissioned the development of the document, “Towards a Sustainable Cement Industry,” which was developed by Battelle Memorial Institute, Switzerland. Battelle (2002) identified critical current issues that the cement industry should address today and suggested pathways forward towards a more sustainable future for the cement industry. Ten major cement companies designated for this collaboration as the Working Group Cement (WGC) funded the study. Battelle conducted a worldwide survey of best practices in the cement and allied industries and found that there is a widespread need for a decision-making framework to explicitly account for SD benefits even among leading cement companies that have adopted SD principles. They found that integration of SD into the business case development and into the decision-making processes were embryonic within most cement industry firms.

In 2002, a large segment of the global cement industry formed the 'Cement Sustainability Initiative' (CSI) in partnership with the WBCSD. The Core members who managed and largely financed the initiative included Cemex, Mexico; Cimpor, Portugal; Corporation Uniland, Spain; Heidelberg Cement, Germany; Holcim, Switzerland; Italcementi, Italy; Lafarge, France; Taiheiyo Cement, Japan; and Titan Cement, Greece. Additionally there were seven participating members who had a less active role and had made a smaller financial commitment. The participating members were: Ash Grove Cement, U.S.A; CRH plc, Ireland; Gujrat Ambuja Cement, India; Secil Cement Company, Portugal; Shree Cement Ltd., India; Siam Cement, Thailand; and Votorantim, Brazil. The WBCSD (2005) published the CSI progress report, which covered the following key issues with regard to the cement industry:

a. Climate protection and CO_2 management;

b. Responsible use of fuels and materials;

c. Employee health and safety;

d. Emission monitoring and reporting;

e. Local impacts on land and communities;

f. Reporting and communications.

With regard to implementation of the TBL approach within the cement industry sector, the CSI report made important distinctions between what can be done collectively and what individual cement companies must undertake. The CSI report also made it clear that individual companies are responsible for setting their own targets and for reporting on their progress. It was understood that the companies might only cooperate to a limited extent due to competitive reasons and their adherence to competition law. The list of collective responsibilities and individual cement company actions is given in Table 2-3.

Joint Projects	Individual company actions
The CSI intends to create joint projects to:	As part of our ongoing commitment to good practice and innovation in SD, companies agree to:
Climate protection	
Develop a Carbon Dioxide (CO_2) protocol for the cement industry Work with WBCSD/ World Resources Institute (WRI) and other organizations to investigate public policy and market mechanisms for reducing CO_2 emissions.	Use the tools presented in the CO_2 protocol to define and make public their baseline emissions. Develop a climate change mitigation strategy, and publish targets and progress by 2006 Report annually on CO_2 emissions in line with the protocol
Fuels and raw materials	
Develop a set of guidelines for the responsible use of conventional and alternative fuels and raw materials in cement kilns.	Apply the guidelines developed for fuel and raw materials use.
Employee health and safety	

Set up a Health and Safety task force. Establish a Health and Safety information exchange.	Respond to the recommendations of the Health and Safety Task Force on systems, measurements and public reporting.
Emissions reduction	
Develop an industry protocol for measurement, monitoring and reporting of emissions, and find solutions to more readily assess emissions of substances such as dioxins and volatile organic compounds.	Apply protocol for measurement, monitoring and reporting emissions. Make emissions data publicly available and assessable to stakeholders by 2006. Set emissions reductions targets on relevant materials and report publicly on progress.
Local impacts	
Develop guidelines for an Environmental and Social Impact Assessment (ESIA) process, which can be used at all, cement plan sites and associated quarries.	Apply the ESIA guidelines, and develop tools to integrate them into decision making process Draw up rehabilitation plans for their operating quarries and plant sites, and communicate them to local stakeholders by 2006.
Internal business processes	
Investigate methods to track the performance of the	Integrate SD programs into existing management, monitoring and reporting

cement industry, including development and use of key performance indicators. Produce a full progress report after 5 years and an interim report after 3 years.	system. Publish a statement of business ethics by 2006 Establish a systematic dialogue process with stakeholders to understand and address their expectations. Report progress on developing stakeholder engagement programs. Develop documented and auditable environmental management system at all plants.

Table 2-3: Cement Sustainability Initiative (CSI) Summary of the Agenda for Action. Source: Battelle (2002)

The highlights of collective and individual responsibilities are:

- **a.** Develop a protocol for accounting and reporting CO_2 emissions that establishes a common approach to monitoring and reporting all direct and indirect CO_2 emission from cement manufacturing;
- **b.** Develop a set of guidelines for fuels and materials use, promoting good practice and setting out a consistent approach in line with the principles of SD;
- **c.** Agree upon an industry-wide framework for safety metrics to help to ensure consistent and accurate reporting;
- **d.** Agree upon a common emissions monitoring and reporting protocol that identifies measurement methods for nitrogen oxides, sulphur compounds and particulates, and defines an approach to obtain a fingerprint of key micro-pollutant emissions;
- **e.** Draft detailed guidelines for an Environmental and Social Impact Assessment process to enable companies and communities to work together on issues during each phase of a cement facility's development, operation, and closure;

The above agenda on collective and individual responsibilities is yet to be fully realised. The realistic assessment of the compliance to these agreements is objectively examined by a cross-sectional and longitudinal data collection of the cement-producing companies in Chapter 4.

Based on a survey of leading company practices and a review of sustainability literature, Battelle (2002) developed a customized framework to support the

SD/TBL concept in the cement industry. The matrix shown in Table 2-4, distinguishes between:

- Value to the enterprise and value to the external stakeholders;
- Economic, environmental, and social aspects of value creation.

		Economic	Environmental	Social
Enterprise Value	Shareholders & Investors	Financial results (EBITDA, etc.)	Risk Management	Social Responsibility
	Managers	Business results & Personal income	Resource efficiency & waste reduction	Safety & productivity
	Employees	Personal income	Workplace conditions	Pride
External Stakeholder Value	Neighbouring residents	Property values	Airborne emissions, noise, aesthetics	Employment opportunities
	Labour Unions	Wages & benefits	Occupational health	Worker rights
	Advocacy groups	Poverty alleviation	Ecosystem protections & restoration	Social equity
	Government	Tax	Regulatory	Human rights

		Economic	Environmental	Social
	agencies	revenue base	compliance & cooperation	& justice
	Regional Interests	Economic growth & prosperity	Environmental quality	Education & health care
	Customers	Product price	Recycling practices	Reputation

Table 2-4: Overview of the SD/ TBL framework suggested by Battelle (2002) for the cement industry to help them move forward on their TBL journey.

The top left cell of the matrix measures economic value to the enterprise. In general practice, business decision-makers have focused mainly on this aspect. The framework encourages decision-makers to systematically consider a broader range of direct and indirect consequences, including trade-offs between positive and negative outcomes. For example, use of alternative fuels may be beneficial from the point of waste recovery but it may create stakeholder concern about toxic emissions.

It is important to perform a business case analysis to determine how increasing value to external stakeholders will provide strategic benefits for the enterprise and how improved environmental and social performance will provide financial benefits.

Strategic benefits may be:

- Better relationships with stakeholders,
- Better public image, and

- Improved support for the company's 'right-to-operate'.

Financial benefits could be:

- Improved asset utilization,
- Operating cost reduction,
- Liability avoidance, and
- Revenue growth.

The CSI proposed an agenda for action by the Cement Industry, which is presented in the Table 2-5:

Agenda for Action CSI		Actions and Results 2003
	Climate protection and CO_2 management	Produced and then updated a protocol for accounting and reporting CO_2 emissions that establishes a common approach to monitoring and reporting all direct and indirect CO_2 emissions from cement manufacturing
Environment	Responsible use of fuels and materials	Developed a set of guidelines on fuels and materials use, promoting good practice and setting out a consistent approach in-line with the principles of SD.
	Emissions reduction	Agreed on common emissions monitoring and reporting protocol that identifies measurements methods for nitrogen oxides, sulphur

Agenda for Action CSI		Actions and Results 2003
		compounds, and particulates (the high-volume emissions); and defines an approach to obtain a fingerprint of key micro-pollutant emissions.
Workplace	Employee health and safety	Agreed on an industry-wide set of safety metrics enabling consistent and accurate reporting.
Local community	Local impacts on land and communities	Drafted detailed guidelines for an Environmental and Social Impact Assessment process to enable companies and communities to work together on issues during each phase of the cement facility's development, operation and closure. Established a Senior Advisory Board to advise the CSI leaders on the critical issues.
Communication and dialogue with stakeholders	Reporting and communication	Organized meeting with stakeholders to discuss guideline development and to ensure that critical concerns would be addressed. Developed its website into a

Agenda for Action CSI		Actions and Results 2003
		comprehensive reference source for the critical sustainability issues facing the cement industry.

Table 2-5: CSI Agenda for action by the cement industry; Source: Battelle (2002)

Table 2-5, enumerates the agenda for action by the CSI participating members on environment, workplace, local community and communication with stakeholders. It provides clear direction to the cement producing companies for monitoring, reporting and communication on the important parameters of climate protection, CO_2 emissions, safety and health, responsible use of fuels and raw materials, and local impacts on land and communities.

2.9.1 Climate Protection and CO_2 Management in the Cement Industry

Our earth's biosphere has created an atmosphere, a thin blanket of gases, to protect earth from sun's ultraviolet radiation and to keep it warm enough for continuation of life. The earth's atmosphere mainly consists of nitrogen, oxygen, carbon dioxide, water vapour and some other gases such as helium, argon, oxides of nitrogen, sulphur dioxide, carbon monoxide, ozone, volatile organic compounds, methane and an array of organic and particulate pollutants. Collectively all carbon dioxide, methane, CFCs and other chlorinated hydrocarbons are called Greenhouse gases (GHGs). The GHGs allow incoming solar radiation to pass through and most of the radiation is absorbed by the earth's surface, which keeps it warm. Part of the absorbed infrared radiation is re-emitted in all directions but is slowed down in its escape from the earth's atmosphere by the GHGs. Carbon dioxide is quantitatively, the most important gas in creating the greenhouse effect of the atmosphere. While natural greenhouse gases are critical to life on earth, human activity has dramatically increased their concentration.

Soaring carbon dioxide emissions are causing global warming and risking serious ecological, economic and human health impacts. The global warming, which is driving the climate change is further aggravated by the fast paced industrialization and rapid deforestation for agriculture and human settlements. WBCSD (2002) stated that, the cement industry is currently responsible for approximately 5.0% of the global anthropogenic carbon dioxide emissions. The formation of CO_2 within the cement industry occurs in all phases of the process from wining of the raw materials through to incorporation of the finished products into roads, buildings and in other uses. Helmet (2005) has compiled the worldwide emissions of GHG, which gives an idea of the magnitude of the problem caused by the different industrial sectors that require immediate mitigation measures.

Worldwide GHG emission from the various sectors is presented in

Table 2-6:

Sectors	**Annex I Regions** % CO_2	**Non-Annex I Regions** % CO_2
Electricity Generation	23	20
Unallocated automobile producers	3	1
Other Energy Industries	9	8
Iron and Steel	3	3

Sectors	Annex I Regions % CO_2	Non-Annex I Regions % CO_2
Chemical and Petrochemical	3	3
Non Metallic Minerals	4	6
Non- CO_2 GHG Emissions from Industrial Process	2	1
Other manufacturing Industries, Cement and Construction	6	6
Total GHG EMISSION from some INDUSTRIAL SECTORS	53	48
Transportation	15	9
Agriculture	14	19
Residential	6	4
Other Sectors	8	10
Unallocated non-CO_2 GHG Emissions	4	10
Total of GHG Emissions from All Sectors	100	100

Table 2-6: Worldwide Emissions of GHG, Source: Helmet (2005)

It is significant that the GHG emissions from the Annex I and Non-Annex regions for the industrial sector are 53% and 48% respectively but the GHG emissions for the construction sector (Including cement manufacturing) is the same (6%) in both the Annex I region and Non-Annex I region which is second highest in the specific industrial sector after electricity generation. This high GHG emission from cement manufacturing sector calls for immediate abatement action.

2.9.2 Measures to Cope with the Climate Change

Industrial activities are creating serious interferences with climate as explained in the last section 2.9.1. The United Nations Framework Convention on Climate Change (UNFCC) and its Kyoto Protocol provide the international framework for beginning to combat climate change. UNFCC was adopted in May1992 and came into force in March 1994. So far 189 countries governments in the world have ratified it. It obliges the signatories to establish national programmes for reducing greenhouse gas emissions and to submit regular reports of their progress in achieving their target reductions. It also requires industrialised countries to stabilise their greenhouse gas emissions at 1990 levels by the year 2000. Developing countries were exempted but were asked to voluntarily reduce their emissions. When the UNFCC was adopted, governments knew that the commitments would not be sufficient to seriously deal with the climate change. On 11th, December 1997, in the Japanese city of Kyoto, a further step was taken to adopt a protocol to the UNFCC: the Kyoto Protocol. The Kyoto Protocol came in to force on the 16th, February 2005. Under the protocol industrialised nations are required to reduce their emissions of the greenhouse gases to around 5% below the 1990 level during the first Kyoto protocol period from 2008 to 2012. There are no emissions targets for developing countries. As of February 6, 2006, 160 countries including the EU had ratified the protocol but the USA, Australia and Monaco have still not ratified it. After the election of Mr. Rudd as Prime Minister, Australia ratified the protocol in December 2007.

Several events have taken place worldwide to increase the public interest in global climate change due to greenhouse gases. For the first time in 2007 in his “State-of- the-Union address” the President of United States of America, George W. Bush acknowledged that there is a linkage between human economic activities and global warming. A movie based upon the former U.S. Vice president Al Gore’s, personal mission titled as “An Inconvenient Truth” received widespread attention. Al Gore won two academic awards for the film in 2007 and later he was awarded a Noble Prize together with the IPCC in the same year. As we know the current version of the Kyoto Protocol is only a starting point of economically palatable approaches to reduce GHG emissions. Considerable amount of work is required to workout detailed mechanisms and policies to make the needed progress in reduction of greenhouse gases by all societies.

United Nations Framework Convention on Climate Change (UNFCCC) recognised this challenge and their article 4.1 specifies, “All parties shall formulate, implement, publish and regularly update national and regional programs containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change”. The Intergovernmental Panel on Climate Change (IPCC) (2001) stated that mitigation refers to an anthropogenic intervention to reduce the source of emissions or enhance the sinks of GHGs. This means that it can be done through various actions such as improvement in energy efficiency, creating more energy via renewable sources, sequestering of CO_2 and reforestation. The IPCC (2001) further elaborated on adaptation and stated that adaptation refers to adjustments in natural or human systems in response to actual or expected climatic stimuli or to their effects, which moderate harm or exploit beneficial opportunities.

Thus, there are two distinct paths to cope with the climate change:

1. Mitigation;
2. Adaptation.

Under the Kyoto protocol GHGs reduction targets for the developed countries are the part of mitigation measures. Country/region-wise targets are given in table 2-7.

The developed countries (EU member countries, Canada and Japan) and the countries in economic transition (Russian federation and Ukraine) have legally binding obligations to reduce their emissions. These targets add up to a total emission reduction of 5% from the 1990 level during the commitment period between 2008 and 2012.

Country/ Region	**Target**
Australia	+8%
Croatia	-5%
Canada, Hungry, Japan, Poland	-6%
EU-15, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, and Switzerland	-8%
Iceland	+10%
New Zealand, Russian Federation, and Ukraine	0%
Norway	+1%

Country/ Region	Target
USA	-7%

Table 2-7: GHGs emission reduction targets of the Annex I countries as per Kyoto Protocol. Source: Climate Change Secretariat (2002).

The developing countries that ratified the protocol, without the legally binding emissions, are referred as the “non-Annex I” countries. Negative sign (-) indicates reduction and positive sign (+) indicates increased allowance for CO_2 emissions. Under the protocol the European Union and Japan established targets to reduce GHG emission by 8% and 6% respectively, between 2008 and 2012 with respect to 1990. Some of the developing countries including Brazil, China and India ratified the Kyoto Protocol without establishing specific reduction targets of GHG.

On the other hand, the developing countries, especially the one more vulnerable to the changes in climate system, are asking for financial and technical assistance to implement adaptation measures. In 2001 three funds were established to support adaptation measures, which include:

1. Special Climate Change Fund (SCCF);
2. Least Developed Country Fund (LDCF);
3. Adaptation Fund (AF).

Marrakesh Accords (2001) established the SCCF under the UNFCCC. Understanding the need of developing countries, Jan Pronk, Chairman of the COP-6 had proposed the creation of two new funds: an Adaptation Fund and a Convention fund. This Adaptation fund would implement adaptation projects in non-Annex I parties, with financing from the share of proceeds of the Clean Development Mechanism (CDM). The Convention fund was somewhat similar to mitigation fund, which included technology transfer, capacity building, and assistance with economic diversification. IPCC (2001) concluded that those with the least resources have the least capacity to adapt and are more vulnerable to the impacts of climate change. Due to this perception, negotiations on the operational mechanism of this fund were promptly started at COP-7. The SCC and Adaptation fund were not treated as urgent as LDC fund and no guidelines were produced for their operation at COP-7. Desai (2003) stated that the fund has a complicated history that is intrinsically linked to numerous Convention issues and suggested that the fund should prioritise adaptation, followed by mitigation and finally economic diversification.

Many scholars have studied the linkage between mitigation and adaptation. Dang and others (2003) reflected the link as 'cause and effect' interaction. Stern (2006) and Osborne (2006) stated as follows:

- The benefits of strong early action considerably outweigh the cost;
- Unabated climate change could cost the world at least 5% of GDP each year. If more dramatic predictions come to pass, the cost could be more than 20% of GDP;
- The cost of reducing emissions could me limited to around 1% of global GDP. People could be charged more for carbon-intensive goods;
- Each tonne of CO_2 we emit causes damages worth at least US$85, but emissions can be cut by a cost of US$25 a ton;

- What we do now can have only a limited effect on the climate over the next 40 or 50 years, but what we do in the next 10-20 years can have a profound effect on the climate in the second half of this century.

The Stern (2006) report attracted a great deal of interest among policy makers. It was in fundamental agreement with the IPCC (2001b) report, which also stated that adaptation costs and challenges could be lessened by mitigating climate change. This thesis writer's views are in line with Stern's findings and confirm that mitigation and adaptation are complementary to each other.

2.9.2.1 The Emissions Trading Scheme

The emissions trading scheme is an approach to control pollution by providing economic incentives for achieving reduction targets established by a national or international body. The rationale behind this scheme is to reduce pollution where the cost of reduction is lowest. This lowers the overall cost of pollution reduction. The Environmental Protection Agency of United States, (EPA) (1990) introduced a cap-and-trade scheme for trading SO_2 among the electricity generation companies under the framework of the Acid-Rain program. In 1997, the Emission Reduction Market System was introduced in the state of Illinois for trading of VOCs. In 2003, the Northeast states of USA committed to introduce a cap-and-trade scheme to reduce GHG emission. In the same year, in the Chicago Climate Exchange, many companies started trading GHG emissions voluntarily. As the USA did not sign the protocol, the EU decided to introduce it in 2003 and adopted the EU Emission Trading Directive.

Subsequently the EU adopted the “Linking Directive” to enable trading of credits generated through CDM and JI projects. The Guardian (2009) reported that Barack Obama, the US president, backed a market based cap on carbon and his budget detailed plans to raise US $80 billion annually from selling carbon allowances beginning in 2012. Europe’s four-year old scheme had a traded value for CO_2, of US$ 90 billion last year. An inter-linked US-EU carbon market is a grand vision of EU regulators who want to create a broad, low cost, carbon regime for business.

Economists have examined the implication of the Kyoto mechanism of emissions trading and found that it is an economically palatable solution to reduce GHG emission. Akai and others (1994) stated that firms attempt to minimise the total cost to comply with their reduction targets by making marginal emission abatement cost equal to the price of an emission allowance. This mechanism is diagrammed in Fig. 2-8.

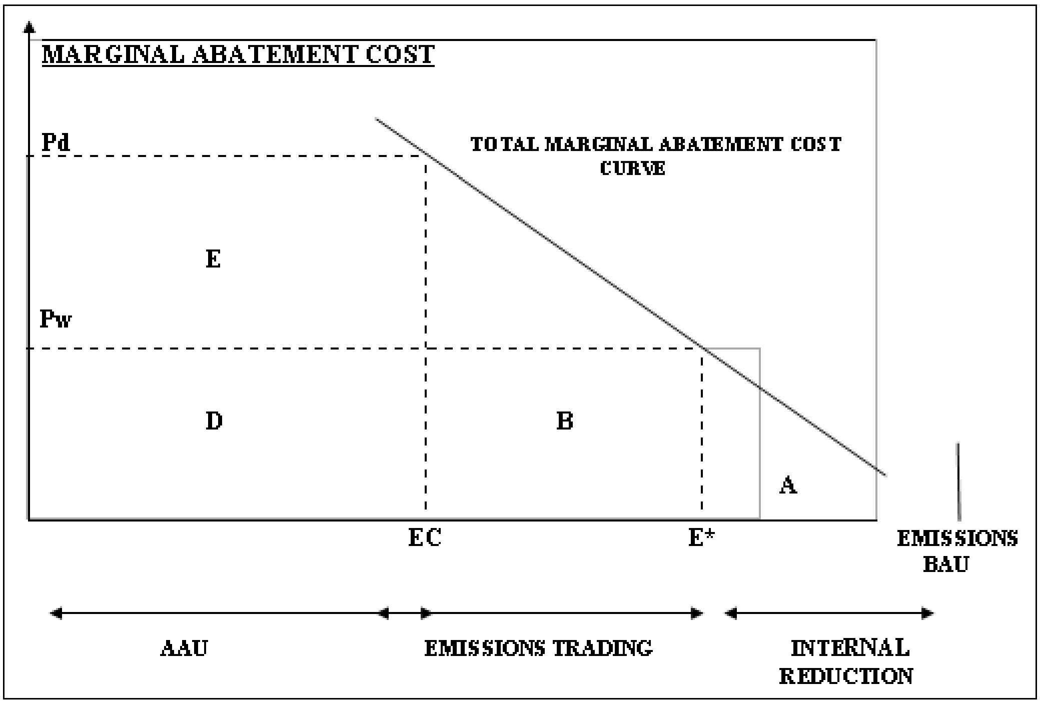


Figure 2-8: Emissions Trading Mechanism in line with Kyoto Protocol, Source: Akai and others (2004)

(Legend for the Fig. 2-8: **Pd**- Marginal abatement cost; **Pw**- Price of the emissions allowance; **EC**- Emissions reduction target; **E***- Firms would reduce emissions to this point from 'Business-as-usual' (**BAU**) by utilising available technology; **AAU**- Assigned Amount Unit, that is allocated by the government to cap firm's emissions to the point of EC.)

In the Fig. 2-8, it can be seen that the present level of the firm's emission is positioned at the BAU. It is necessary for firms to reduce emissions or purchase emissions allowances to the point of EC so that they can operate within their assigned amount of emissions. This, Assigned Amount of Emissions Unit (AAU) is allocated by the government in order to cap the emissions of the firms at the point of EC. The total marginal abatement cost curve, shown in Fig. 2-8, indicates that firms would bear the cost to reduce emissions equivalent to the area A and would purchase emissions allowances equivalent to area B. The total cost that firms bear to meet their emissions reduction target is equivalent to the area A+B. On the other hand, firms save costs equivalent to area C, which they would have paid if they had not bought emissions allowances from the emissions trading market. Thus, firms can reduce their cost to meet the emissions reduction targets by purchasing from the emissions trading market. This is true not only for cement companies but for all firms having emissions reduction targets.

Reinaud (2005) stated in the report published by International Energy Agency that there are four areas of possible economic impacts of climate change policy instruments. The areas having impact are:

1. The cost to reduce GHG emissions internally and/or to purchase emission allowances;

2. Increases in electricity prices;
3. Demand reduction;
4. Losses in competitiveness in the international market.

The authors of that report analysed economic impacts of the EU Emission Trading Scheme in five energy-intensive industrial sectors. The results of the study are tabulated in Table 2-8.

There are two scenarios presented in the table where the industrial sectors need 2% and 10% emission allowances to meet their emissions targets.[1]

Scenarios/ Sectors	Steel (BOF)	Steel (EAF)	Pulp and Paper	Cement	Aluminium
2% Allowance needs	0.7%	0.8%	1.1%	1.9%	3.7%
10% Allowance needs	1.3%	0.9%	1.6%	3.4%	3.7%

Table 2-8: Cost increase in relation to production costs among energy intensive sectors: Source: Reinaud (2005)

The results indicate that the Aluminium sector would incur the highest increase in production costs. The cement-manufacturing sector would also face a relatively high cost increase as their need for achieving emissions reductions increase. It is due to the fact that CO_2 production per unit cement production is quite high.

[1] This analysis has several assumptions. The price of EUA is assumed to be 10 Euro per tons of CO_2. It is also assumed that the electricity generation sector passed through the full opportunity costs to consumers leading to a price increase of electricity prices of 11%.

2.9.2.2 The Clean Development Mechanism (CDM)

The CDM was set up under the Kyoto protocol to the UN framework convention on Climate Change. It was designed to provide new energy financing opportunities for developing countries from industrialised countries, as specified in Annex 1, required to reduce their GHG emissions. The mechanism permits governments and companies in industrialised countries to finance emissions-reduction projects in developing countries as a means of meeting their obligations under the Kyoto Protocol. This mechanism is based on an assumption that generation of CO_2 anywhere in the world, adds to and accumulates in a sink. Hence, in industrialised nations where the cost of reducing GHG is very high they can finance the adoption of low-emission energy technologies in developing countries and meet their commitments at lower cost. The most common funding in the cement industry is for reduction in CO_2 emissions, reduction in NOx, and complete destruction of Halogenated Flouro-Carbons (HFCs). UNDP (2009) supports knowledge sharing and capacity building activities that would allow developing countries to take maximum advantage of the new financing opportunity provided by the CDM.

The emission credits generated through CDM and the joint implementation (JI) project activities are known as Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs), respectively. There is a rigorous process for the approval and registration of a CDM project. For a project to be considered as a CDM activity, the project participants must develop a document known as a Project Design Document (PDD) and obtain approval from the CDM executive board for the methodology used to estimate GHG emissions reduction. However, if there is an approved methodology, which matches the participant's project activity then the participant can use the methodology without an approval from the CDM executive board. The emission credits generated through the CDM projects have been dramatically increasing in recent years. Two percent of CERs were issued for a CDM project activity.

2.9.2.3 Voluntary Measures

Jacobs (1991) defined voluntary as “not forced by law nor persuaded by financial incentives.” Voluntary measures in the present environmental arena are typically referred as Voluntary Environmental Agreements (VEA). As is clearly stated in the definition, there are no legal or financial bindings or links to financial incentives. OECD (1999) published a report in which three types of classification for VEAs is presented:

Type 1: Public Voluntary Environmental Programs (PVEPs): Such programs are initiated by environmental agencies and individual firms are invited to participate. Since the participation is voluntary these are termed as “Optional Regulations.” Examples of such program are the U.S. program 33/50 or the EMAS implemented in EU since 1993.

Type 2: Negotiated Environmental Agreements (NEAS): These agreements involve commitments for protecting the environment through bargaining between a regulating body and industry or even with individual companies.

Type 3: Unilateral Voluntary Environmental Codes and Action Plans (UVEPS): These commitments are set by the industry on their own without involvement of the public authorities. The RC program discussed in section 2.6.1 is a well-known example of UVEPS made by chemical industries in many countries.

Many countries have successfully used VEAs to reduce GHG emissions in the industrial sectors. In the United States, twelve industry sectors announced their emissions reduction targets under the program called Climate Vision. In Japan, the Nippon Keidanren Voluntary action plan was established in 1997. Each VEA is unique in design and implementation hence they need to be carefully adapted, implemented and transparently and accurately monitored by independent agents.

Under the Kyoto Protocol, the above described, three mechanisms were introduced with the goal of reducing GHG emissions in a flexible and cost effective manner. The GHG emission reduction commitment period is from 2008 to 2012. As this period ends in 2012, intensive discussions on the regulatory framework after 2012 have been taking place and hopes were pinned on the December 2009 Copenhagen Summit. This summit included the 15th Conference of the Parties (COP 15) to the UNFCCC and the 5th Meeting of the Parties (COP/MOP 5) to the Kyoto Protocol. According to the Bali Road Map, a framework for climate change mitigation beyond 2012 was to be agreed upon in Copenhagen. Unfortunately, the Copenhagen Accord, which was drafted by the US, China, India, Brazil and South Africa on December 18, 2010, was taken note of as a meaningful agreement[2] by the participating countries but it was not passed to be considered to be legally binding for reducing CO_2 emissions. Harrabin (2009) attributed the failure of the summit to live up to expectations to a number of factors including the recent global recession and conservative domestic pressure in the US and China. It was noted that the carbon price in the EU dropped to a six month low. Michael Grubb (2009) wrote that the current (low price) could cause huge damage on the credibility of emissions trading and could undermine the EU's attempts to forge a platform of leadership in

[2] Editorial of the Guardian, a daily newspaper, published from London on 9th December, 2009 viewed "meaningful" as a political spin.

the Copenhagen negotiations.[3] Unfortunately, the Copenhagen meeting had limited and disappointing results. Now it is really a big question mark in front of the world community of what will be next? The Copenhagen Accord asked countries to submit emissions targets by the end of January 2010, and paved the way for further discussions to take place at the 2010 UN climate change conference at Cancum, Mexico. So, the emissions target can serve as guiding tool to work out tangible solution for controlling emissions.

2.10 Drivers and Barriers of the use of the TBL in the Cement Industry

The WBCSD (2002) identified the challenges facing the cement industry. The various challenges, which can be called the 'forces of change', are the drivers towards TBL accountability.

2.10.1 The drivers

- Stakeholder Demands: As one example, stakeholders are actively involving themselves in political actions and expressing their views. In the USA, environmental justice activists are opposing industrial facilities being concentrated in low-income areas.
- Customer Needs: Many customers are specifying their wishes to purchase 'environmentally preferable' products such as blended cements to achieve high performance and more durable concrete. This will lead to increased emphasis on the life cycle costs and durability of structures.
- Emerging Economies: Population growth in developing countries opens great business opportunities for the private sector. However, there is fear

[3] Michael Grubb is the chief economist at Carbon Trust and Chairman of the Climate Strategies Research Group; he published a draft Climate Strategies paper in The National, published from Dubai, UAE.

that economic growth might occur at the expense of the environment and social welfare.

- Environmental Concerns: Environment issues, which are obvious to the communities surrounding the cement industries facilities such as dust, noise, air and water emissions, and mining land impacts are the issues that must be addressed at the local level. Although, use of alternative fuels and raw materials should be thoroughly examined by the plant management before they are used in cement production processes, but sometimes the local community is sceptical about the human health and ecological safety in using such fuels. Another major concern is the massive releases of greenhouse gases from the cement industry, which contributes to global warming.
- Regulatory Policies: Increasing restrictions on emissions, operating practices, health and safety, and freedom to operate are imposed by government, worldwide. Despite the obstacles in implementing the Kyoto protocol, many countries will adopt carbon management policies.
- Innovation: Discovery of new technologies, products and processes are driving cement manufactures to think outside of the box. For example, product innovations could lead to viable substitutes for Ordinary Portland Cement (OPC).
- Transparency: Disclosure has become a key issue in corporate governance and businesses are increasingly being held accountable for their policies and practices with respect to human rights and environmental stewardship.
- Energy Prices: Energy costs are major expenses in cement production. There is large variation in the energy price from one region to another.

The cement industry is working on efficiency improvement and use of alternative fuels to replace conventional fossil fuels.

- Global Consolidation: Acquisitions and mergers are taking place in cement industry and this is expected to disseminate good practices and increase availability of resources for environmental and social investments.

2.10.2 The barriers

The barriers to the usage of the TBL approach in the cement industry include:

- Mature Material: OPC is a very familiar product to customers and they resist any change in product characteristics. Sauer (1998) stated that making changes in cement or concrete recipes or manufacturing processes has been proven to be difficult.
- Company Inertia: Mature industries have a typical problem of resistance to change. There is always scepticism about new ideas. Inertia is one of the greatest barriers to sustainability or in the implementation of TBL approach. If there is no crisis it is quite difficult to overcome the inertia.
- Market Pressures: Due to competition many companies produce high early strength cement to please customers and they use it as a plus point of their product. Mostly, such cement is used for non-critical jobs like plastering and flooring. But to produce this type of cement, one has to keep high lime in cement, which requires higher fuel consumption to burn this material and results in faster resource depletion of high-grade limestone.

- Commodity Product: Commodity product is one for which the primary basis of competition is cost. Cement is a commodity product and prices within a given market are relatively uniform across the selling companies. As a result, cement companies are hesitant to invest in TBL/SD, as this does not help them to improve their short-term cash flow.

2.11 Benchmarking and the Best Practices in Cement Manufacturing

The research questions and research objectives required this thesis author to make comparisons of the social and environmental performance indices across the cement industry in order to establish best practices for benchmarking the performance of OCC. To achieve this objective it was necessary to understand the mechanism of benchmarking.

Juran (1964, 1999) explained that those firms that adopted the total quality management system (TQM) are practicing benchmarking. He believed that the method of benchmarking might have evolved in the early 1950s, when W. Edward Deming taught the Japanese the idea of quality control. Daniels (1996) wrote that benchmarking is the process of comparing one’s own organization with its peers worldwide to identify and to learn from the best practices of other firms in the same industrial sector. The essence of benchmarking is the continuous process of comparing a company’s strategy, products, and processes with those of the best-in-class, world leaders and to continue to make improvements to achieve or to exceed those benchmarks.

2.11.1 Framework for Benchmarking

Benchmarking for any operation is aimed at understanding the current performance and bringing continual improvement by way of planning, implementing the plan, monitoring the performance levels on identified variables and again revising the targets and working to continue this process.

Although, ISO 14031, provides guidelines for environmental performance evaluation, there is limited experience of applying the standard in the area of benchmarking and external rating, especially, when the limitations in data quality are considered. Bahr (2003) demonstrated that the data quality of environmental performance indicators was a limiting factor in benchmarking. He evaluated data from six cement plants located in Sweden, Norway, and Finland for three types of emissions, dust, NOx and SOx. He observed that the data lacked reliability and integrity. So, it is necessary to select data collected and presented in such a manner that it has good integrity and reliability.

Juran (1999) discussed that there are three levels of benchmarking: internal, competitive or strategic (industry-wide) and outside the industry benchmarking. He recommended six steps as the basic approach to benchmarking:

1. Decide what to benchmark;
2. Understand the current performance of your organization;
3. Do proper planning of what, how, and when to do the benchmarking endeavour;
4. Study thoroughly, the practices or indicators you wish to benchmark
5. Collect data and learn from them;
6. Use the findings to help your organization to make improvements.

Battelle (2002) conducted a survey of 'best practice' companies outside the cement industry that were known to have a strong emphasis on environmental, economic and societal development. The companies, interviewed by them, were similar to all cement companies in the industry in the following ways:

- **a.** They are capital intensive;
- **b.** They are all operations involving resource extraction and conversion;
- **c.** There is always significant waste generation;
- **d.** All have 'right-to-operate' concerns;
- **e.** All must address stakeholders concerns about pollution;
- **f.** Many plants are located in remote areas with relatively poor infrastructure and poverty.

In order to have detailed information about the 'best practices' company, identified by Battelle, this thesis author decided to go through their websites. Name of companies whose sustainability/CSR reports were read with keen interest are mentioned as below:

- Holcim, Switzerland;
- Lafarge, France;
- Cemex, Mexico;
- Titan Cement, Greece;
- Italcementi, Italy;
- Taiheiyo Cement, Japan;
- Tokyo Electric Power Company;
- Heidelberg Cement, Germany;
- CRH plc, Ireland;

- Siam City Cement Ltd., Thailand;
- Grasim, India;
- Ash Groove Cement Company, USA;
- Secil, Portugal;
- Alcan, Canada;
- Sulzar, USA;
- Novo Nordisk, Denmark;
- Baxter, USA;
- Aracruz Cellulose, Brazil;
- Dupont, USA;
- Dow Chemicals, USA;
- Electrolux, Sweden;
- BP, UK;
- Dufasco, Canada
- Rio Tinto, UK;
- ICI, UK;
- Unilever, UK;
- Johnson & Johnson, USA;
- Royal Dutch Shell, Netherland;
- Suncor, Canada.

In the case of benchmarking for OCC, data were collected from top ranking international cement companies, which have published TBL/CSR/ Sustainability reports. Since, major cement companies joined CSI group to voluntarily report on their environmental and social performances, it was valuable to collect data from them by analysing their reports for at least three consecutive years.

It was also essential to obtain clarification from them on data that were not reported using consistent performance indicators. With the clarifications, the more systematic quantitative data comparisons were made based upon the minima, maxima and arithmetic average for each parameter. This way the best performance or benchmark was quantified. The case study company, OCC is using these benchmarks to establish the target value for that specific parameter and to prepare its management program to achieve the target values.

2.12 *Conceptual Framework and Prior Literature*

The conceptual framework for this thesis was developed to identify the variables associated with the identified problem of inadequate reporting of environmental and social performances in cement companies and to establish a mechanism for the case study company to proceed on its environmental and social performance. A critical review of past scholarship is presented to identify the gaps in knowledge, which led to refinement of the research objectives and research questions. The methods of data collection and analyses are presented in the research methodology section in Chapter 3, which describes the research design to answer the research questions.

The academic literature on the TBL/CSR provided the framework for understanding the economic, social and environmental parameters, which should be monitored for implementation of TBL/CSR in the cement manufacturing industrial sector. A study of the UN guidelines of the Agenda 21 gave a macro picture of the direction to proceed on the path of sustainable development but it left the control on pollution and social issues on the shoulders of the respective countries and on individual companies. In order to move forward, every country needs to engage its industry on a ‘sector-by-sector’ basis to effectively achieve the essential improvements that must be made for the short and long-term future.

Hooghiemstra (2000) stated that social and environmental disclosures are responses to both public pressure and increased media attention resulting from major social incidents such as the Exxon Valdez oil spill and the Union Carbide disaster in Bhopal. This perspective was termed by him as a legitimacy theory and he argued that the increase in social disclosures represent a strategy to alter the public perception about the legitimacy of organizations. Scholarly research on environmental and social reporting has been conducted from a number of theoretical orientations. Gray et al (1996) introduced political economic theory and Roberts (1992) and Campbell (2000) advocated stakeholder’s theory. The political economic theory was designed to help researchers to better understand the power interests that corporate reporting serves. This approach does not provide the specific means for analysis of social practices and norms entailed in TBL/CSR reporting. On the other hand, the stakeholder’s theory is useful for considering the functions of reports from the perspective of organizational identity and legitimacy. UNEP’s (1994, 1997) benchmarking studies addressed the developing genre of integrated reporting. Elkington (1987, 1996) referred to integrated reporting as the triple bottom line (TBL) and hailed Shell’s report (1995) as a model to be emulated.

Unfortunately, until now, there are no mandatory requirements for TBL accounting and reporting. Zadek (2001) suggested that it is too early to say which (of the many) standards, guidelines, systems, procedures and practices will evolve to be the most valuable for industrial companies and the wider business community and society-at-large. Sullivan and Wyndham (2001) found that legal requirements were cited as the most important driving forces for industry to more adequately address environmental issues in Australia. In the UK, Hayward (2002) reported that approximately 90 per cent of the population believe that the government should act to protect the environment, employment conditions and health even when their efforts may conflict with the interest of multinational corporations. He also wrote, that currently the EC has rejected a regulatory approach to TBL reporting.

Edwards (2004) described TBL as an ultimate goal of ISO 14001-EMS aimed at broadening organizational goals from a sole focus on the profit-making-bottom-line to a three-fold-bottom-line including environmental and social responsibility bottom-line. Delmas (2006) criticized ISO-14001 certification of some companies that lack environmental awareness and instead of improving the natural environment they use it as a tool for increasing their prices and enhancing their market position without really making environmental performance improvements. In such cases, the purposes of actualizing the principles of voluntary disclosure and self-regulation are entirely defeated. Ethical business stresses the leadership role of organizations in meeting their responsibilities for TBL/CSR accountability. This knowledge, in association with the UN Global Compact framework and the GRI's guidelines provided the framework for this researcher to access the real world performance of cement companies on their environmental, economic and social dimensions. This helped this author to answer the research question about how the TBL/CSR concepts are being applied in the cement companies?

Epstein (2009) studied the TBL/CSR initiatives at CEMEX, a leading global cement company headquartered in Mexico. They reported that they saved over $ 60 million in 1994 due, in part, to their holistic TBL/CSR approaches. This achievement was primarily due to the following:

- Developing and implementing new technologies;
- Developing and implementing a new plant design;
- Recycling and reusing materials;
- Using alternative raw materials;
- Using improved and more selective mining techniques.

These changes were driven by the TBL/CSR/Sustainability initiatives.

Epstein further suggested that identifying the impacts created by an industry augmented the development of the company's TBL/CSR strategy. He studied the following environmental issues:

- Depletion of non-renewable resources (i.e. fossil fuel)
- Impacts of resource extraction on the landscape and environmental quality;
- Dust emissions;

He also addressed other emissions including nitrogen oxides, sulfur dioxide and carbon dioxide. His publication discussed best practices but did not cover benchmarking of best practices for improvement in a specific plant.

Matthes (2009) reported a practical example of straightforward benchmarking in the cement industry, including benchmarks, which reflect a wide range of differences in performance in the U. K. and Germany for CO_2 emissions with a range from 0.856 to 0.805 ton CO_2 per ton clinker for EU's Emissions Trading Scheme (ETS). This range is due to the fact that CO_2 emissions from each cement plant are dependent on the quality of raw materials, the processes of manufacturing and the type of fuels used in plant.

In order to understand the application of ETS in the cement industry, it was necessary to study other EU ETS and the broader academic literature on ETS. This led to the development of the baseline study for establishing the levels of emissions/unit of product from the cement industry, the leaders of which are on their TBL/CSR journey.

Bennett and James (1999) reported, in their study of environmental and social performance, that in order to build integrity and credibility in the reported information, the reports must be prepared and presented in accordance with the GRI's guidelines. Krut and Munis (1998) emphasized that as the leaders of increasing numbers of enterprises elect to adopt the GRI guidelines, the opportunities for comparing performances within and across sectors and nations will strengthen stakeholder's capacity to advocate for continuous progress toward business practices compatible with sustainable development.

Based upon insights about these gaps in the previous research, it was necessary to study the GRI guidelines and performance indicators to plan and guide data collection. The GRI guidelines are based on the Valdez Principles. This researcher also used the guidelines of the UN Global Compact. From the critical review of the literature, it can be shown that:

1. The Environmental and Social performance and evaluations reports (EPER) are evolutionary in nature;
2. There are no research documents on the status of the UN Global Compact reporting in the cement manufacturing sector;
3. There is a need for data integrity and uniformity of reporting framework in order to establish valid and comparative best practices for performance benchmarking;
4. Management performance indicators are essential for better understanding of company's commitment;
5. Internal performance evaluation and reporting are complementary to each other;
6. A clear and consistent framework is essential for collection and analysis of data for best practice benchmarking.

The critical literature review and the current industry practices led to a review of the preliminary research objectives and procedures for gathering industrial performance for data analysis and for answering the research questions.

The final research questions for the thesis research were developed based upon the insights obtained from the literature as well as by observing practical problems faced in the cement manufacturing. The research objectives were defined as follows:

1. To identify the manner in which TBL/CSR has been/is being implemented in the cement manufacturing throughout the world by analysing the performance of leading cement producers and by comparing the results with the requirements of the GRI and the UN Global Compact;

2. To identify and to quantify the best practices adopted by the cement manufacturing companies.
3. To identify the drivers for the implementation of TBL/CSR;
4. To identify the barriers to implementing TBL/CSR;
5. To identify the benefits for the cement manufacturing companies of implementation of TBL/CSR;
6. To develop a framework for benchmarking of the OCC on the TBL/CSR, which could ultimately provide the basis for an industry standard, and use it as a performance improvement tool for that company;
7. To prepare recommendations and to develop a roadmap for OCC, to make progress on its TBL/CSR journey.

In order to achieve the research objectives it was necessary to establish a conceptual framework to proceed on a well-defined path for accessing relevant data and for utilising it in benchmarking best practices for OCC, and for other cement companies planning to embark on their TBL/CSR journey.

Considering the fact that the CSR/TBL concept was initiated a decade ago and that, until now, there were a few CSR/TBL reports available from the cement industry, which complied with the GRI guidelines and, which were verified by independent agencies, the depth of the benchmarking data is not as deep as is desirable. However, based on the GRI guidelines the environmental and social indicators being used by top international cement manufacturers are listed in Table 2.10. The list of cement manufacturers that were evaluated is presented in Table 3.1.

The year selected for the purpose of cross sectional analysis to present the status of reporting as per the UN global compact data were collected from the company reports of twelve cement companies representing over 70% of world's cement production for the year 2006. This year was selected because CSR/Sustainability/TBL reports of 2006 were published in third or fourth quarter of 2007.

Unfortunately many parameters were reported in different units, which required to be clarified from the cement companies for authenticity and comparability. Based on the reporting of environmental, social and economic parameters the disclosure status of the leading cement manufactures will be compiled against each parameter of the UN Global Compact requirements.

For establishing best practices for benchmarking OCC, data on economic, environmental and social parameters were collected from six leading multinational cement companies, which had published CSR/Sustainability/TBL reports in compliance with GRI guidelines, level G3. Their reports for 2005, 2006 and 2007 were evaluated. These reports had been verified by independent agency. Some of the other six cement companies reviewed, such as Pretoria Cement have just started their TBL/CSR journey and had not reported on many of the indicators in their reports for year 2005-2007; therefore they were not included in the comparative evaluations reported in this thesis.

A semi-structured questionnaire was developed in order to obtain information from the twelve international cement companies, identified earlier, on drivers and barriers of TBL/CSR, and in order to obtain their feedback on becoming more socially responsible after implementation of TBL/CSR journey in their organisations. The questionnaire was sent by email to the responsible managers of the worldwide international cement companies. Efforts were made to collect feedback from more than 70% of the invited companies. After the information was received, the same was computed and analysed for affirmative or negative response. Feedback on drivers and barriers were compared (Appendix 6) with the earlier literature findings and reported in the study to support the research findings. The drivers and barriers as identified from the literature review are presented in Table 2.9

Drivers of TBL/CSR	**Barriers to the TBL/CSR**
Innovation	Customers resist change in quality parameters.
Transparency	Inertia to change
Energy Prices	Stiff competition and market pressure
Global Consolidation	Cement is a commodity product
Stakeholders Demand	Conventional costing practice
Customer Needs	-
Emerging Economies	-
Environmental Concerns	-
Regulatory Policies	-

Table 2-9: List of Drivers and barriers to TBL/CSR in the cement manufacturing, Source: Author (2011)

The methods used for sampling, data collection and data analysis to fulfil the research objectives and to answer the research questions are presented in Chapter 3.

WBCSD (2005) CSI report made it clear that individual companies are responsible for setting their own targets and for reporting on their progresses. Understanding this responsibility and reporting framework of GRI the author identified the performance indicators relevant to the cement industry. A list of the Economic, Environmental and Social Performance Indicators (KPIs) evaluated for this research, their data source and method of analysis is given in Table 2.10:

GRI	**Parameter**	**Data Source**	**Method of Analysis**
EC1	Company Sales Revenue	Company Reports	Comparative, Quantitative
LA1	Total Number of Employees	Company Reports	Comparative, Quantitative
EN1	Annual Production Rate	Company Reports	Comparative, Quantitative
EN14	Provision for site restoration and other environmental liabilities.	Company Reports	Comparative, Quantitative
-	Implementation of EMS, ISO 14001 % of plants	Company Reports	Comparative Study, Quantitative
EN8	Absolute gross CO_2 Emissions Million tonnes CO_2	Company Reports	Comparative Study
EN8	Absolute net CO_2 emissions, Million tonnes CO_2	Company Reports	Comparative Study
EN8	Specific gross CO_2 emissions. Kg CO_2/ tonne cement	Company Reports	Comparative Study

EN8	Specific net CO_2 emissions. Kg CO_2/ tonne cement	Company Reports	Comparative Study
EN19	DUST; Gram/tonne cementitious materials	Company Reports	Comparative Study
EN19	NOx: Gram/tonne cementitious materials	Company Reports	Comparative Study
EN19	SO_2; Gram/tonne cementitious materials	Company Reports	Comparative Study
EN5	Water Consumption; Lt/tonne	Company Reports	Quantitative
EN11	General Waste Management System; %	Company Reports	Quantitative
EN11	Returned Concrete Recycling; %	Company Reports	Quantitative
EN27	Quarry Rehabilitation Plans in place, %	Company Reports	Quantitative
EN28	Environnemental non-compliance cases ; Nos.	Company Reports	Quantitative
EN15	Biodiversity, addressed at sites, %.	Company Reports	Quantitative
EN2	Thermal Efficiency of Clinker Production; MJ/tonne clinker	Company Reports	Quantitative
EN3	Thermal Substitution rate by	Company	Quantitative

	alternative fuels; % of thermal energy from alternative fuels.	Reports	
EN1	Clinker Factor	Company Reports	Quantitative
HR2	% Global suppliers screened using Social accountability self – assessment questionnaire	Company Reports	Quantitative
EN35	Environmental Investments (Mill. Euro)	Company Reports	Quantitative
LA7	Lost Time Injury Frequency Rate	Company Reports	Quantitative

Table 2-10: Environmental and Social Performance Indicators (KPIs) used for collecting data from Worldwide Cement Companies; Source: GRI (2006)

For each of the cement industry parameters of interest, best practices were determined based upon the comparative data from the companies. Top management support was won and other stakeholders of OCC were engaged in dialogue to proceed on TBL/CSR journey. The best practice benchmarks and other lessons learned from the TBL/CSR reports of the cement companies were used as target indicators for the case study company. These indicators will be monitored regularly to monitor progress on the thesis author's company's efforts for continual improvement. This requires a good understanding of PDCA cycle, discussed in the literature review in Section 2.6. Based on these research findings, a TBL/CSR policy was developed for OCC and it was communicated throughout the company for implementation. There is company-wide support for the company to be travelling on this pathway.

Learning from the lessons of other cement companies on barriers to move on TBL/CSR journey, it was ensured that the employees, throughout the company received training on TBL/CSR accountability. A change management course was conducted for all level of employees to make improvements in management, technology, product quality, efficiency, worker's health and safety aspect. Data were collected within the company to establish baseline for the indicators listed in Table 4.3. The data from the worldwide cement companies were also used for determining their current reporting status in accordance with the UN Global Compact and the GRI. Their shortcomings or partial disclosure and non-disclosure of performance indicators were also noted and presented in Table 5.2 and Table 5.3. An action plan was prepared for improving OCC's performance on each indicator listed in Table 5.7. Monitoring of each performance indicator will be done every six months to provide data to help the employees to know about the progress or lack of progress in each monitoring period. On the basis of this information management program for implementation of action plan will be reviewed for supporting the areas that needs more follow up. Reporting on the performance improvement for each indicator listed in Table 2.11 will provide inputs for OCC's TBL/CSR report, scheduled to be published for the first time in 2012. The theoretical conceptual framework of this thesis is presented in Figure 2.9:

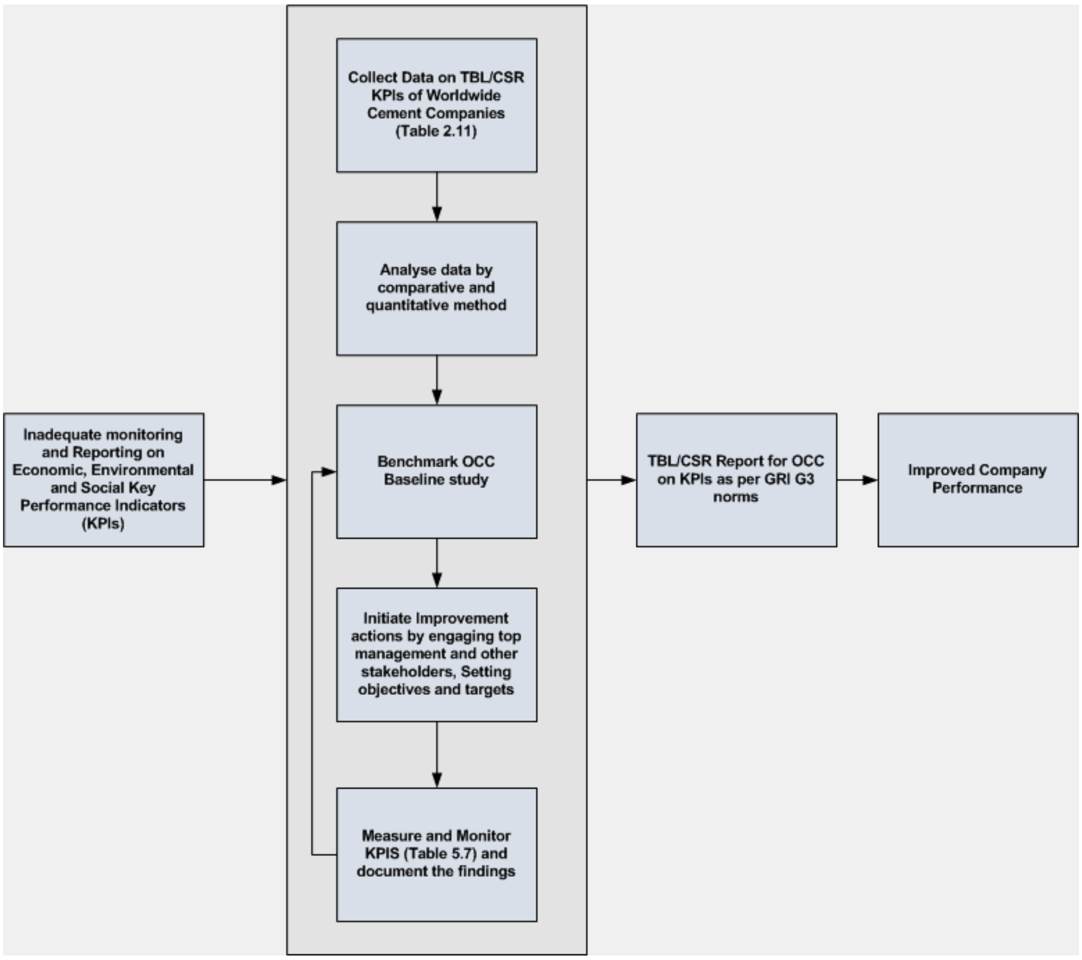


Figure 2-9: Conceptual Framework, Source: Author (2011)

2.13 Summary

This Chapter began with the modern sustainability agenda, examined some of the worst environmental disasters and business ethics. It reviewed the evolution of environmental management systems in general and more specifically with respect to the cement manufacturing. Based upon that review, further investigations on the ethical dimensions of businesses as defined within the Global Reporting Initiative (GRI) and Corporate Social Responsibility (CSR) guidelines were conducted. Review of various management systems addressing environment and social responsibility helped this thesis author to develop an understanding of the strengths and weaknesses of the prevailing management systems. Environmental and social problems faced by cement manufacturing sector were explored to clarify the implications of managing environmental and societal responsibility in this sector. Considering the gap in academic literature and the cement manufacturing company reports, this thesis is one of the first attempts researches, which develops a foundation and a framework to examine/implement the triple bottom line (TBL) dimensions namely, economic, environment and social aspects associated with enhanced corporate social responsibility (CSR) within the cement manufacturing sector. There have been no previous investigations that address these three sustainability dimensions, within the cement industry, from a holistic perspective. It is important to note that the three dimensions are interconnected and interdependent. The economic and technological dimensions influence the environmental aspects and societal responsibilities. This thesis further elaborates upon these interrelations and highlights the resultant ethical responsibilities of the cement industry decision makers. Various reporting tools of TBL/CSR were discussed in detail in order to identify the environmental and social indicators, which should be monitored for the purpose of establishing corporate policies on TBL/CSR and for setting goals and objectives for making progress on the TBL/CSR journey. This implies that the company leadership and their stakeholders should work together to establish KPIs to be used to monitor and to report upon their progress on the TBL/CSR journey. This mechanism has been used to develop corporate policies, goals, objectives and implementation of road-map for OCC in Chapter 5.2, which can be applied in other cement companies and mineral-based industries for moving on their TBL/CSR journey.

3 Chapter 3 - Research Methodology & Research Questions

Introduction

In this chapter the thesis author discusses various issues regarding research methodology in general to contextualise overview of scientific research methods, concepts and paradigms (3.1), the research process (3.2), research approaches (3.3), and the purpose of research (3.4). In each of these sections the selected approach for that paradigm or the research methods considered for this research work are elaborately discussed. Then he focused specifically upon the research methods used to conduct this research (3.5).

Social Scientific Research Methodology is concerned with general principles behind research, whereas methods are the practical techniques used to undertake the research. Research can be conducted by collecting data in various ways and the research question can be answered accordingly. For analysing data, various options are available but the appropriate method of analysis is important for developing reliable conclusions based upon reproducibility of the results. Research methodology offers a special approach to the discovery of reality through enquiry.

Rubin and Babbie (2001) stated that 'Epistemology' is the science of knowing; methodology (a sub- field of epistemology) might be called "the science of finding out". The findings of research studies can be questioned and jeopardised if due consideration is not been given to the measurement error, reliability and sampling techniques in the research design. Understanding of research methods is essential to distinguish studies with adequate scientific methodologies and credible findings from those with weak methodologies and findings of little credibility. An understanding of research methods will help the researcher to critically use research produced by others, communicate effectively with peers and conducive to carry out good and relevant studies. This thesis author now reviews several paradigms in research to help him obtain answers to his research questions.

3.1 Scientific Methods and Paradigms

Buraway (1991) stated that methodology provides the link between technique and theory on the one hand and methods, on the other hand, refers to the techniques or tools used to gather data. Methods can include both qualitative and quantitative data collection techniques. The methodology chosen for the research will depend on the interpretation or understanding of what constitutes knowledge. In our quest to understand things, we should strive to keep an open mind. That means "Knowledge" is provisional and subject to refutation. This also implies that everything is open to question and we should have an open mind about everything we think, we know or what we believe. But having an open mind is not easy. We all have our own beliefs about cultural diversity and affirmative action's, notions, predilections and biases. Thus some aspects of scientific methods are debatable. In particular, the philosophical notions about the nature of reality and the pursuit of objectivity are highly debatable.

3.1.1 The Philosophy of Research

Rudner (1996) stated that the philosophy of social science, in conformity with the principle for the sciences themselves, might be sub-divided into four parts; philosophies of physical sciences, biological sciences, social sciences and natural sciences. He also wrote that philosophy of social sciences has a close connection with moral disciplines, as for example, ethics, social ethics, social philosophy and political philosophy. Lofland and others (1995) expressed that philosophers use the term "naive realism" to describe the way we operate on a day-to-day basis in our lives. There are three views of reality – Pre-modern, modern and post-modern. Most of human history is guided by pre-modern reality. The pre-modern view was based on assumptions and beliefs. But increase in population and cultural exchange brought out the diversity in their views. Philosophers call the modern view - a view that is more closely associated with western industrialized societies, which accepts diversity as legitimate, a philosophical and different for different folks. In the post-modern view of reality one can see various images from different point of view. In philosophical terms we can say that modern view acknowledges the inevitability of our human subjectivity whereas, post-modern view suggests no objective reality can be observed in the first place, only our different subjective views. The different ways to observe the various philosophical stances about the nature of reality are called 'paradigms'.

Paradigms are very important from the point of organising our observations. Different points of views are likely to yield different explanations. Kuhn (1970) stated that paradigms characterise a science in its search for meaning. Although, it is natural to think of science as developing gradually over time but it is the holders of the paradigm, which resists the development in new scientific paradigms. For example, in ancient time it was thought that the sun revolves around the earth but that view was supplanted by a new discovery that the Earth revolves round the sun. But those who believed in the old paradigm were resistant to believe in the new paradigm. That is, when a paradigm becomes entrenched, those who believe or hold it to be true, resist any substantial change, thereby making it difficult for a new paradigm to emerge to supplant the old one. Rubin and Babbie (2001) discussed about various paradigms, which have caused much debate and attention on ways to conduct research in social science include:

- **a.** Early Positivism;
- **b.** Post positivism,
- **c.** Interpretivism;
- **d.** Critical theory.

3.1.1.1 Early Positivism

Mill (2005) stated that Auguste Comte was a French philosopher, who described society as a phenomenon. He believed that society could be understood logically and rationally and it could be studied like any science. He separated his enquiry from religion and based knowledge on observation rather than belief. In other words it can be said that traditional science can be applied to social research. By observations and analysis we can control this world and possibly predict the nature of future problems. People using the positivist paradigm use experiments, manipulation of variables and testing of hypotheses in their research. The drawback of positivism was its believe that only fact is observable.

3.1.1.2 Post-positivism

Rubin and Babbie (2001) explained that positivism evolved into post positivism because it was observed that personal feelings can and do influence scientific research. Post-positivist researchers give high importance to objectivity, precision, and generalisability in their enquiries but they recognise that observations and measurements cannot be unbiased. Regardless, they still attempt to anticipate and minimise the impact of potentially non-objective influences. Post-positivists use highly structured research methods, but they also employ flexible research methods considering the possibility of non-determination of the best way in advance to proceed with investigations. When they use flexible methods they tend to see their findings as essentially tentative and exploratory, and as being useful for generating new ideas for future testing. Post-positivist researchers recognise that research is never entirely free from political and ideological values but they use logical arrangements and observational techniques that are design to reduce the influence of one's values on the research findings.

3.1.1.3 Interpretivism

Williams (1999) explained that interpretivism is a research focus that explores the meaningful nature of people's participation in social and cultural life. The interpretivist paradigm emphasises gaining an empathic understanding of how people feel inside, how they interpret their everyday experiences, and what idiosyncratic reasons they may have for their behaviours. Both post-positivism and interpretivism paradigms involve the use of theory but the function of theory varies across the two paradigms. In post-positivism, theory functions to provide broad generalisations about interrelationships among thinly defined causal variables. Interpretivism, on the other hand, provides detailed description of how a smaller group of people conducts and interprets everyday life. While post-positivist researchers are more likely to test their theories by replicating studies across different samples and seeing if different measurement approaches yield the same findings; therefore, the interpretivist researchers are more likely to be satisfied with a theory if the people they studied say the theory makes sense to them.

3.1.1.4 Critical Theory

McCarthy (1994) stated that critical theory paradigm holders subscribed to the idea of conflict paradigm where social life was seen as a struggle among competing individuals and groups. To distinguish between a post-positivist approach and the critical theory approach, let us consider an example where male social workers tend to earn more than the female social workers but this difference diminishes when we compare males and females with the same job responsibility or years of experience. The post-positivist researcher who is not well versed with women's issues might conclude that this finding indicates that the influence of sexism on salaries in social work is less than many assume. The critical theory researcher, however, might conclude from the same finding that sexism influence salaries through less pay for women workers. In light of this thinking the researcher may not even examine the influence of job responsibility or the length of service on the employee's salaries.

Each paradigm has its own advantages and disadvantages. The disadvantages are most noticeable when an extremist view of a particular paradigm is practiced. Researchers may find that their one study has resemblance to one paradigm and a different paradigm in another study - depending on what is investigated. It is quite possible that sometimes more than one paradigm is combined in one study.

3.2 The Research Process

Saunders et al (2000) stated that social work research, like all scientific pursuits, attempts to find answer to questions. There are probably a great many ways of doing this regardless of the type of questions we seek to answer. Both practice and research begin with the formulation of the problem, which includes, recognizing a difficulty, defining it and specifying it. Researchers and practitioners then generate, explore and select alternative strategies for solving the problems. Finally the chosen approach is used, results obtained are evaluated and the findings are disseminated. In both practice and research, these phases are contingent on one another. The purpose of the study could either be descriptive or causal. If the research objectives are concerned with seeking to ascertain who, what, where, when, or how much, then the study is considered to be descriptive. It is causal if the study is concerned with learning why - that is, how one variable causes change (s) in another variable.

The research process is very well portrayed in the diagram shown in Fig. 3-1:

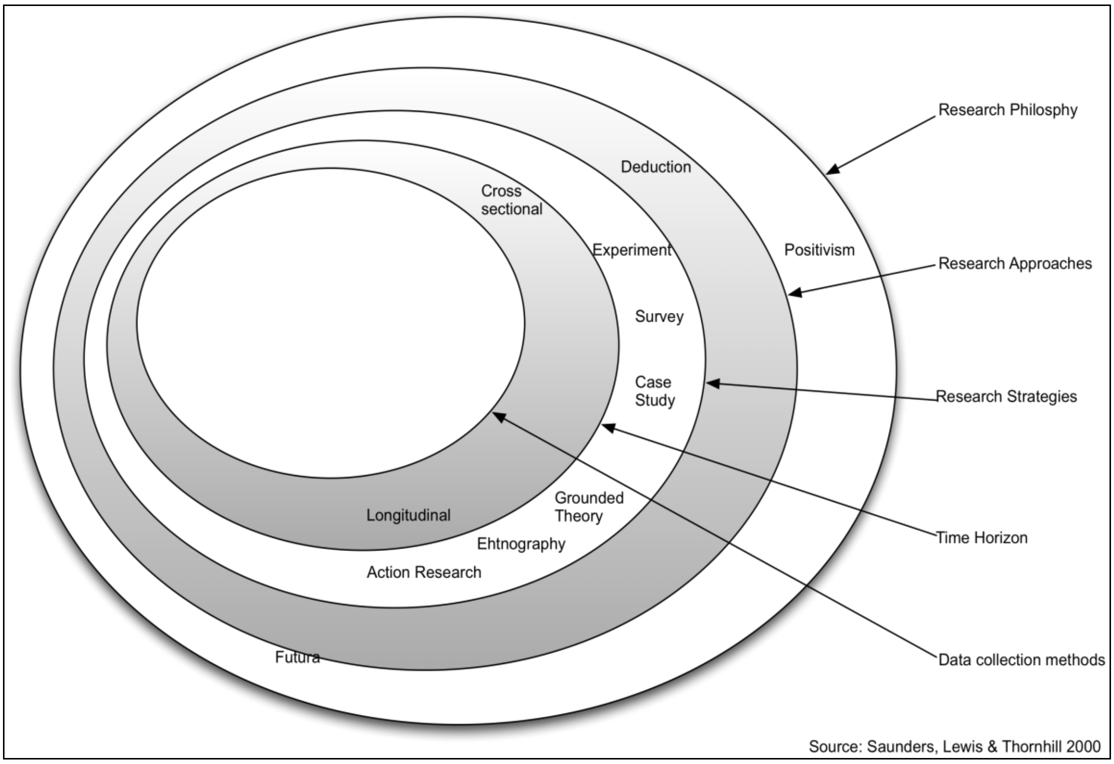


Figure 3-1: The Research Process, Source: Saunders, Lewis and Thornhill (2000)

This thesis author has reviewed the primary set of research processes within the section on the research philosophy in the foregoing section. Now various research approaches are reviewed in the following section.

3.3 Research Approaches

Rubin & Babbie (2001) stated that like paradigms, theories influence scientific investigations. Paradigms are general frameworks for looking at life but a theory is a systematic set of interrelated statements intended to help to explain how people conduct and find meaning in their life. As a generalisation, we may say that scientific theory deals with the logical aspect of science and research methods deal with the observational aspects. Theories are designed to help researchers to examine and better understand the system, which is composed of variables. Variables are logical groupings of attributes. Attributes are characteristics or qualities that describe an object or process. Variables can be dependent and independent. Scientific enquiry is focused on finding relationship between the variables. Social scientific theory and research are linked through two logical methods:

- **a.** Deduction
- **b.** Induction

3.3.1 The Deductive Method

This approach or method is based on deductive logic. Wallace (1971) explained deductive method, one begins with a theory and then derives hypothesis for testing. Next, the variables of each hypothesis are defined and the operations to be used to measure them are established. Finally, specified measurements are implemented to test the hypothesis. The observations may confirm the hypothesis or it may fail. In simple words the deductive theory starts from general to the particular i.e. applying a theory to a particular case. An example of deductive approach in hypothesis building is given as follows:

All birds have feathers,

This creature is a bird,

Therefore this creature will have feather.

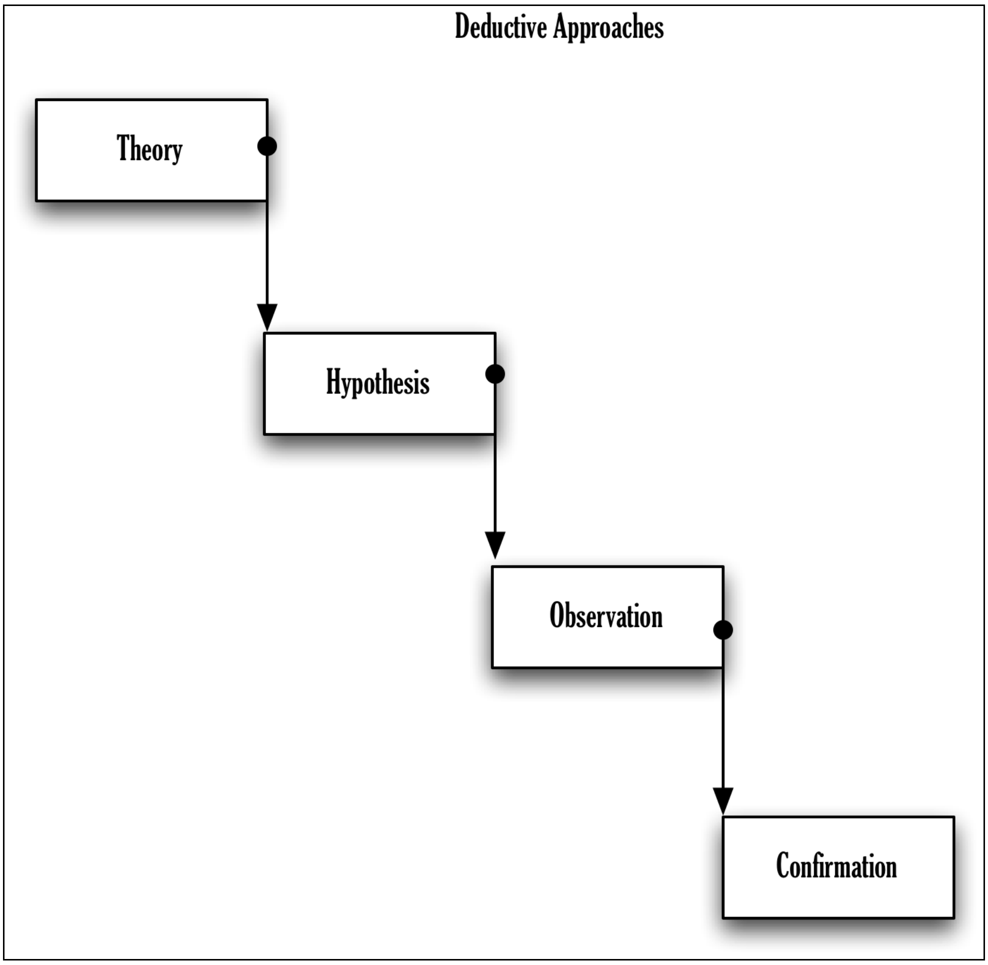


Figure 3-2: The Deductive approach, Source: Wallace (1971)

3.3.2 The Inductive Method

The inductive method is based on inductive logic. In inductive research one starts with observations and develops a generalisation, which explains relationships between the objects observed. We may also understand it in simple words: from fact to theories or from observation of particular instances to developing general principles. Glaser and Strauss (1967) suggested a new term, “Grounded Theory” to refer to this Inductive method of theory construction. It is called grounded theory because the theory is grounded in observation. Field research, – the direct observation of events in progress is frequently used to develop theories from observations.

To illustrate with an example, research can be conducted to answer a question by adopting the deductive approach or the inductive approach:

"All men are mortal; Einstein was a man; therefore, Einstein was mortal." This is a classical illustration of a deductive approach.

Wallace (1971) represented the process of theory and research interaction, which represents a loop. The model is shown in Fig. 3-3:

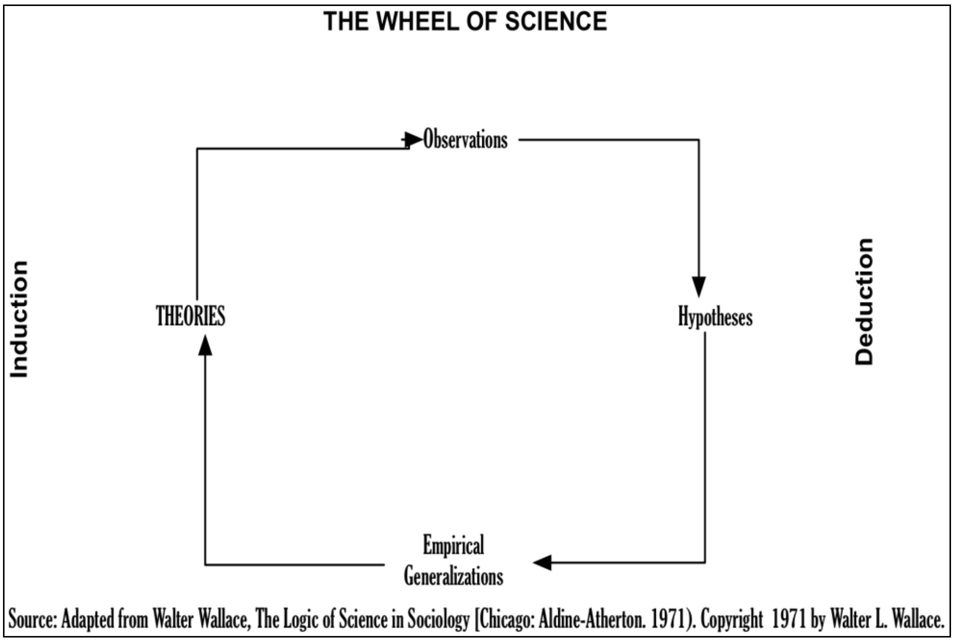


Figure 3-3: The Wheel of Science, Source: Wallace (1971)

The model implies that theories can be used to generate hypothesis, hypotheses suggest observations, observations that should be made. Observations serve as the base upon which researcher can make generalisations and those generalisations can be used to develop modifications to the theory. The modified theory can then lead them to develop modifications in their hypotheses. This new hypothesis can then lead the researcher to make new sets of observations that produce data upon which revised generalisation can be made, that can make it necessary for the researcher to further modifying the theory. In this model, there is no beginning and ending. Thus, the scientific norm of logical reasoning provides a bridge between theory and research. Scientific enquiry in practice involves an alteration between deduction and induction.

3.4 The Purpose of Research

Leedy (1996) suggested that learning from literature review influences early decisions in planning the research process – determining the purpose of research. The three most common purposes of research are:

- **a.** Exploration;
- **b.** Description;
- **c.** Explanation.

Although a selected study can have more than one purpose, this thesis author discusses each of them separately because each has different implications for other aspects of research design. The exploratory purpose is typical when new interests are examined or when the subject of study is relatively new. They are essential whenever a researcher is breaking new ground. Exploratory studies are often taken to obtain at least approximate answers to some questions. The main shortcoming of exploratory studies is that they seldom provide satisfactory answers to the research question. But they can hint at the answers and give insight into the research methods that could provide more definitive answers.

Many scientific studies are undertaken to describe situations and events. In descriptive study the researcher observes and then describes what was observed. Descriptive studies can be both quantitative and qualitative. In quantitative studies description typically refers to the characteristics of a population; it is based on the quantitative data obtained from a sample of people that is thought to be representative of that population. Qualitative studies call for a deeper examination of the phenomena to obtain fuller inside into their nature and characteristics. Qualitative descriptions are usually more concerned with conveying a sense of what it is like to walk in someone's shoes. The descriptions include details about environments, interactions, meanings and everyday lives – than with generalising with precision to a larger population.

Explanatory studies are undertaken for the general purpose to explain a particular phenomenon. For example, there may be an explanation for a higher rate of failure of crops in India than in China, in a particular year. Although, it is useful to distinguish the three purposes of research, most of the research has elements of all three. Sometimes it is difficult to judge how best to characterise a particular study's purpose.

3.4.1 Quantitative and Qualitative Research Methods

Quantitative research depends mainly on a hypothesis, which is derived deductively from theory. In such a case the objective is to test the theory by way of observation and data collection. This is followed by analysis of the data to either confirm or reject the hypothesis. The hypothesis is an attempt to show the causal relationships between the concepts. Primary data collection for such a study is by a survey method using questionnaires, structured interviewing, and structured observation. Secondary data could be derived from governmental statistics, company annual reports and etc, which are all quantifiable. Bryman (1988) stated that quantitative research has been compared with the methodology that natural scientists use in their investigations, with the core language of the approach including terms such as "variables, controls, measurements, experiments, reliability and validity. Quantitative methods emphasize the production of precise and generalised statistical findings and are generally more appropriate to homothetic aims. If a researcher wants to verify the effect of a particular cause he/she is more likely to use quantitative methods. Sometimes, quantitative methods are also likely to be used in idiographic studies employing a single-case design.

Bryman (1995) clarified that qualitative research differs from quantitative research in the usage of language and style as well as generation of the idea. This method emphasizes the depth of understanding associated with the idiographic concerns (to understand everything about a particular case). Qualitative research is situational or contextual. It is often based on a single case study and is quite appropriate for particular circumstances rather than replication or generalisation. Qualitative research methods may be more suitable when flexibility is required to study a new phenomenon for which we have little knowledge, or when we want to gain insight into the subjective meanings of a complex phenomenon to advance our conceptualisation of them and build theory that can be tested in future. Qualitative research is designed to help to discover meanings and involves both interpretation and critical approach. In qualitative research questions are posed rather than hypotheses, and theory is often grounded in data. A variety of data collection techniques can be used in this method, which includes ethnography, text analysis, pictures, field notes and etc. A fundamental question for the qualitative researcher is how to go about theorising or generalising from data and not conclude that data prove or disprove a given theory.

Hammersley and Atkinson (1995) stated that for some researchers quantitative and qualitative methodologies are conceived as “opposing”, or “competing” methodologies for the ways in which the social reality should be studied. However the two research methodologies are simply different ways of conducting social research that may be most appropriate to different kind of research questions. Each approach is useful and legitimate. Each makes its unique contribution to enquiry. Each is a set of tools, not an ideology. Both have their advantages and disadvantages. Bryman (1995) explained that qualitative and quantitative methodologies are not mutually exclusive; the differences between the two approaches are located in overall form, focus and emphasis of the study. May (1993) further elaborated that qualitative researchers may resort to some form of quantification in their work and for a survey to be successful a quantitative researcher must integrate some qualitative knowledge into the survey's design and interpretation and/or must understand peoples frame of reference. Thus, it clearly implies that the researchers need to match the tools they use with the research questions and conditions they face - using quantitative methods for some studies, qualitative methods for others, and both methods in combination for still others.

3.4.2 Time Dimension of Research

Cooper & Schindler (2003) stated that the time dimension is an important aspect of the research thesis. Cross sectional studies are carried out once and represent a snap shot of one point in time. Such a study may have an exploratory, descriptive or explanatory purpose. Explanatory cross-sectional studies typically aim to understand causal processes that occur over time, yet their conclusions are based on observations made at only one time. Where as longitudinal studies are repeated over an extended time period. Such studies are intended to describe processes occurring over time. Usually longitudinal studies require a higher budget and longer time period. Most field studies involving direct observation and perhaps in-depth interviews are normally longitudinal. Longitudinal studies can be of great value in assessing whether a particular attribute increases one's risk of developing a later problem. Such studies can be more difficult for quantitative studies such as large-scale surveys. Three types of longitudinal studies are normally used. They are: Trend studies, Cohort studies and Panel studies. In these three studies sample for observation are drawn from general population (trend), specific sub population (cohort) or the same sample of people each time (panel). A research process for any particular problem has to end sooner or later, but the time and cost of conducting such research needs to be carefully planned. While longitudinal research is important, the constraints of budget and time impose the need for cross-sectional analysis. A longer time dimension of research may also attract a bigger budget hence, striking a judicious balance by focusing on the most appropriate research methods is the fundamental to the suitable research design. In the next section some research methods are explained with a focus on the research method adopted for this research study.

3.4.3 Choice of Research Methods

As we have seen in the foregoing sections how research philosophy gives a direction to the research process and the link between theory and concept, various research methods are discussed in this section. Harvey (1990) pointed out that methodology is the point at which method, theory, and epistemology coalesce in an overt way in the process of directly investigating specific instances within the social world. It is not possible to disengage methodology from method because methodology is the general principle behind research and methods are the practical techniques used to undertake research. Harvey (1990) stated that method refers to the way empirical data are collected ranging from reading archival material or documents, to interviews or observations of controlled or uncontrolled situations. Usually, the data collection methods are chosen from among the following methods:

- **a.** Experiments;
- **b.** Survey research;
- **c.** Interviewing;
- **d.** Questionnaire;
- **e.** Participant observation;
- **f.** Ethnography;
- **g.** Secondary data collection;
- **h.** Case study/ comparative research.

As discussed earlier, the choice of method of data collection depends on the researcher's methodology as well as upon the specific research questions. A brief description is provided on the various research methods before explaining describing the chosen methods for this thesis research.

3.4.3.1 Experiment, Surveys and Interview

Laboratory work is needed for collecting data by experiment. This method is widely used in natural sciences and psychology. Survey research requires structured interviewing and questionnaire for data collection. Maccoby and Maccoby (1954) defined interviewing as a face-to-face verbal interchange, in which one person, the interviewer, attempts to elicit information or expressions of opinion or belief from other person or persons. The research interviewing can be structured, semi-structured, un-structured or informal and group interview depending on the purpose. Ethical issues are predominant in the social research and generally revolve around questions of harm, privacy, consent, deception and confidentiality.

3.4.3.2 The Questionnaire Method

Questionnaire survey depends on how representative is a sample. It is required that all questions be answered, by the people participating in that survey. The questionnaire provides one opportunity to gather data so the researcher must be very careful in designing the questionnaire. Questionnaire design should aim to maximise the possibilities of accurate completion and a high response rate. The prerequisite to questionnaire design is a clear thesis outline which leads to a well focused questionnaire. Questions could be open ended to allow the respondents to give answer in their own words or closed one where respondents can select the answer from a range of answers given to them for selection. Selection of the type of questions depends on the type of data collected, accuracy of completion and response rate. Implementing and administering questionnaires are as important as designing them for accuracy and response. This method was used for data collection in this research.

3.4.3.3 Participant Observation

With the development of social anthropology participant observation emerged as a distinct method for social research. Gans (1982) argued that more often than with other research methods and, participant observation provides great satisfaction, discovering new facts, coming up with new ideas, watching people act by, putting life into, the concepts of sociological theory, and knowing always that, in contrast to any other methods of social research, participant observations puts one about as close to real data and the sources of real data as is humanly possible. Thus, it is potentially useful for all social science research and it provides the possibility of interrogating and making more systematic the process of observation and interviewing.

3.4.3.4 Ethnography

Participant observation is a prime example of an ethnographic method, which has been criticised for being subjective and unreliable. Hammersly (1991) stated that ethnographic data collection that is undertaken by different researchers in the same setting is unlikely to produce similar data because the methods are too flexible. Ethnography uses qualitative research method as it involves the researcher’s participation in the lives of research communities. Hammersly and Atkinson (1995) wrote that the ethnographer is in a position to collect data from multiple sources, which may be relevant to the research topic. In ethnography the concept of reflexivity has emerged as part of the discourse on ethics. Reflexivity challenges ethnographers to be fully conscious of the values, culture and politics of those where study is conducted. Hertz (1996) has criticised that reflexive ethnographers does not simply report facts or truths but actively construct interpretations of his/her experience in the field.

3.4.3.5 Secondary Data

Secondary data are those data, quantitative or qualitative, which others have collected or created. These are made available to different users.

The source of secondary data is governmental data sets, official publications, annual reports or sustainability reports of companies, and other texts such as policy statements. Obvious advantages of using secondary data are the following:

Getting access to large samples easily and cheaply;

Getting access to people who may not otherwise be easily available;

Saving time for the researcher,

Disadvantages of using secondary data could be the possibility of wrong sample having been used by the primary researcher, or the data are obsolete or out-of-date data and/or the data may lack information on certain variables.

The analysis of secondary data involves some constraints especially in a situation where data are partial, ambiguous and contradictory. In this situation the researcher is forced to question the people who collect the data or ask the people who are quoted in the archives. That is they are compelled to collect primary data ad hoc. This is a costly process. However, primary and secondary data are complementary at all stages of research. If primary data is incomplete, it can be complemented by secondary data, so as to better understand the background of an event, or to weigh the case study against information that is external to it. In this research secondary data from annual reports and CSR/Sustainability reports of worldwide cement manufacturing companies were used.

3.4.3.6 Case Study and comparative studies

Kerlinger (1986) wrote, although case studies have been maligned as 'scientifically worthless' because they do not meet minimal design requirements for comparison, they have significant scientific role. Kaplan (1964) stated that important scientific propositions have the form of universals and a universal can be falsified by a single counter instance. Thus, a single well-designed case study can provide a major challenge to a theory and provide a source for new hypotheses and constructs, simultaneously.

Yin (1994) defined the case study method in two parts. Firstly as an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Secondly, the case study as enquiry that copes with the technically distinctive situation on which there will be many more variables of interest than data points, and as one result. The case study enquiry relies on multiple sources of evidence with data needing to converge in triangulating fashion. Further, it benefits from the prior development of theoretical propositions to guide data collection and analysis. In line with Yin's views, Gummeson (2000) wrote that the use of case study is becoming increasingly popular in management research. Case studies are also useful in applying solutions to current problems based on past problem-solving experiences, such as benchmarking a company's performance with others in the same sector or other sectors. By using the case study method we can understand certain phenomenon, such as environmental pollutions and emissions from a specific industrial sector, and generate further theories for empirical testing.

Comparative research method examines the similarities and differences between units and is used to examine diversity. The major aim of comparative research is to develop theory. Data collection in this type of research could be fieldwork research, survey research for trans-national comparative studies and quantitative data from government data or company reports. May (1993) has acknowledged that institutions and governments sometimes undertake or fund comparative research to gather information for governmental purpose or for commercial reasons.

Kohn (1989) identified the following four types of comparative research:

- **a.** Case Study comparative research;
- **b.** Cultural Context comparative research;
- **c.** Cross-national comparative research;
- **d.** Trans-national comparative research.

In each one of these comparative researcher approaches the appropriate data collection method has to be used for answering the research question. For this research, comparative research techniques were used. In the next section, the methodology for this research is described.

3.5 The research methodology used for this thesis

In the Section 3.1.1, we saw that paradigms play an important role in organising our observations. The paradigm for this research is post-positivist because the data in this research were collected from the worldwide cement companies having diverse political, cultural, and regulatory requirements. Hence, it cannot be unbiased. Ryan et al (2006) explained that post-positivist research principles emphasises meaning and the creation of new knowledge, and are able to support committed social movements, that is, movements that aspire to change the world and contribute towards social justice. Post positivist researchers believe that positivist research methods predominantly mirror the representational ideology of the positivist research. The post positivist social research assumes a learning role rather than a testing role. Post positivist paradigms emphasize objectivity, precision and generalisability in research. A postpositivist might begin by recognising that the way scientists think and work and the way we think in our everyday life are not distinctly different. Scientific reasoning and common sense reasoning are essentially the same process. Babbie (1986) stated that postpositivist paradigm recognized that observation and measurement couldn't be as purely objective as the ideal image of science implies, but they help to anticipate and minimize the impact of potential non-objective influences. In order to minimise the potentially non-objective influences, structured research methods were utilised. The Methodology for all research work must be established in order to achieve that aim.

The **Aim** of this thesis is:

To develop a strategy for the implementation of TBL/CSR in the mineral processing industry, in general, and in the cement manufacturing sector, in particular. Related to this, the objective was to expand upon "verifiable" knowledge, with regard to implementation of best practices in the cement industry. It helped the researcher to understand, explain, and predict empirical reality and to apply it in the cement company in which he is responsible for environment management. Based on the conceptual framework the research objectives were further refined. In order to achieve these objectives for the cement industry and for his company, in particular, the following specific research **objectives** were addressed:

1. To identify the manner in which TBL/CSR has been/is being implemented in the cement companies throughout the world;
2. To identify and quantify the best practices adopted by the cement manufacturing companies;
3. To identify the drivers for the implementation of TBL/CSR;
4. To identify the barriers to implementing TBL/CSR;
5. To identify the benefits for the cement manufacturing companies of implementation of TBL/CSR;
6. To develop a framework for benchmarking of OCC on TBL/CSR KPIs, which could ultimately provide the basis for an industry standard, and use it as a performance improvement tool for that company;
7. To prepare recommendations and to develop a roadmap for OCC to make progress on its TBL/CSR journey.

Nachmias and Nachmias (1996) stated that only verifiable knowledge is seen as reliable knowledge, which can be used to improve human considerations. According to the positivist paradigm data are considered to be reliable and valid if they are value free, i.e. free from judgements of personal, cultural, moral or political nature. But post-positivists recognise that observation and measurement cannot be as purely objective as implied by the ideal image of science, therefore, they attempt to anticipate and minimise the impact of potentially non-objective influences.

This study is descriptive as the thesis author, sought to document and evaluate how the TBL/CSR concept is being applied in the cement-manufacturing sector. Although, the TBL concept is relatively new to the cement industry, good theoretical knowledge and understanding are available to work on the integration of these three dimensions in to the cement-manufacturing sector. The Global Resource Initiative (GRI), The World Resource Institute (WRI), The UN Compact, Agenda 21 and the new ISO: 26000 standards are helping company leaders to become systematically involved in integrating social, economic and environmental dimensions of business, but its implementation in the manufacturing sector in general and in the cement manufacturing, in particular, is still in its infancy.

Research theories are primarily made up of concepts. In this thesis research the concepts pertain to the interactions, in real industrial firms, of the economic, environmental and social dimensions. These may seem to be abstract concepts but post-positivist paradigm can be used to address such concepts, which are logically interrelated, even if they are somewhat abstract. For example, environmental problems such as emissions of suspended particulate matters, harmful gases, discharge of waste-water and the consequent negative downstream impacts, abandoned quarry pits, which lead to environmental and social problems and consequent hardship, are illustrative of parameters that must be dealt with from integrative theoretical and practical perspectives. Appropriately selected theories and methods can be used to clarify the interconnections and relationships of these types of issues to a company's broader TBL/CSR opportunities and responsibilities. In such cases, the theory may help the researcher to use the research questions to gain more insight into how the different aspects and processes interrelate.

As stated earlier, the research problems for this research may be described by a set of concepts, which are not easily measurable. In order to define and to achieve objectives of the research by answering the research questions, it was necessary to convert the broad concepts into sets of measurable variables. Concepts such as the environmental and social problems in this research were very difficult to quantify in empirical terms; thus, the thesis author had to select and rely upon the use of indicators to seek to quantify the facets being addressed.

A deductive approach was adopted for this research. Deductive methods of data collection by way of computer-based surveys: questionnaire (Appendix 4) and participant observations were used. Data from worldwide cement companies' were collected by a computer-based survey method. Wherever, data were not comparable due to differences in units or abnormally high or low values additional information were collected by feedback on mailed semi-structured questionnaires to the concerned cement companies.

Data from the thesis author's case study cement company, Oman Cement Company (SAOG) in Sultanate of Oman (OCC) were collected by observation and from the company records as well as data collected explicitly for this research by performing detailed monitoring of the company's environmental emissions.

There could have been other methods for data collection but the worldwide distribution of cement companies made it essential that these distance-methods of data gathering were preferable to physically visiting multiple cement companies.

Considering the research problem and the revised research questions, an intensive research design was developed. The research design for this thesis is described in section 3.6.

3.6 The design for this thesis research

Every thesis is an argument. To support the argument suitable methodology must be selected. As the researcher, by means of a text, is taking the reader on a journey through an ordered and logical argument leading to the conclusion of the study, this thesis author needed to persuade the thesis readers that he had competently applied the appropriate methods in seeking to obtain answers to the research questions. In this respect, thinking clearly about research design is a major step for the research thesis.

The research design is the basic framework, which outlines the interrelationships in various research activities required to effectively answer research questions. Research design essentially addresses the purpose of the study, the types of investigation, the extent of researcher interference, the study setting, the unit (s) of analysis, the time horizon of the study, the measurements, the data collection methods to be used, the sampling design and data analysis procedures to be used. It is important to note that the more sophisticated and rigorous the research design, the greater the time, costs and other expenses that will be incurred in doing the research. It is therefore, relevant to question each and every choice whether the benefits that may result from more sophisticated design to ensure improved accuracy, confidence and generalisability, are commensurate with the larger investment that may be required.

Cooper and Schindler (2003) stated that there are many definitions of research design, but no one definition imparts the full range of important aspects. They suggested the following:

- **a.** The research design is an activity and time-based plan.
- **b.** The research design is always based on research questions.
- **c.** The design guides the selection of sources and types of information.
- **d.** The design is a framework for specifying the relationships among the study's variables.
- **e.** The design outlines procedures for every research activity.

The suggested research design for this research is presented schematically in Fig. 3-4:

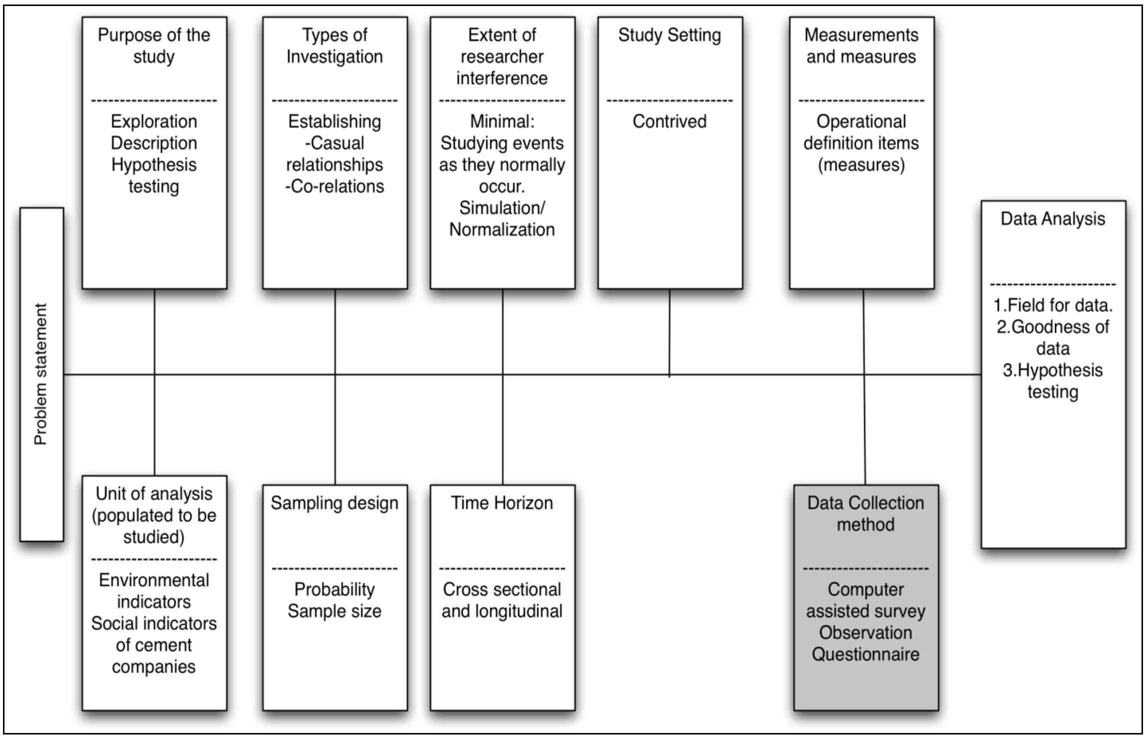


Figure 3-4: Research Design for this thesis Concept, Source: Sekaran (2003)

The research design suggested by Sekaran (2003) was adopted in as a framework for this thesis research with a problem statement: "How to manage environmental and social aspects in cement manufacturing in a holistic manner?" The purpose of this research was exploratory and descriptive in nature and the units of analysis were worldwide cement companies and how they address the environmental, social and economic indicators in their TBL/CSR journey.

Like any business enterprise, sustainable development for the cement industry means adapting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the resources that will be needed in future. Rubenstein (1994) stated that, while the environmental campaign swept the globe, the global environment continued to deteriorate at an alarming rate despite the achievements made to date.

The research work was begun by developing a clear vision of the objectives and then by designing the most relevant research questions. Then the research design and research framework were developed. The research was initiated by, performing an in-depth literature review to investigate the various issues of TBL and Corporate Sustainability management approaches used in companies in diverse industrial sectors and then with special in-depth investigations within the global cement industry. Cement manufacturing processes have immediate economic impacts but the complex problem of environmental aspects and societal issues arising from the related activities require short and long-term, local to global considerations for the present and future generations of humans. By addressing economic, environmental and social dimensions in manufacturing operations, we can lay a solid foundation for sustainable development. Sustainability can/should only be defined for a complete socio-economic-environmental system and not for its components or parts. TBL/CSR accountability helps to guide the organisation towards sustainable development, which cannot be achieved in isolation, since others actions also affect our sustainability just as we can affect theirs. Theoretical possibilities and generic business cases indicate that strategies, which improve environmental and social performance, also increase shareholder value.

Some relevant theories and system models were re-visited to gain insights and benchmarks for developing and integrating the framework and guidelines. Primary and secondary information and data were generated from wide and extensive sources – literature, conference proceedings, company websites, surveys and case studies. Data from other cement companies were collected by questionnaire, evaluating the information on their websites and from their published sustainability/CSR reports. This was done to gain insight into the global evolution of 'best practices' in the cement industry, so as to benchmark other company's practices with respect to the practices of OCC, the thesis author's case study company.

Within this broader context, the overall research questions for this research work were:

1. **How are the TBL/CSR concepts implemented in the cement manufacturing throughout the world?**
2. **How can the TBL/CSR concepts be implemented within the OCC?**

In order to answer these two primary research questions and to seek meaningful solutions, the research focus was addressed on the following sub- questions:

a. How are the concepts of the TBL/CSR being applied in cement manufacturing companies, worldwide?
b. What were the drivers for the companies to make improvements?
c. What were the barriers to make the changes and how are those barriers being overcome by cement manufacturing companies?
d. Did implementation of TBL/CSR help the cement manufacturing companies to become more socially responsible?
e. How can OCC build upon these lessons as it progresses on its TBL/CSR journey?

As the research design was based on research questions, it was essential to identify the key sources of information. A list of major cement producers was prepared and their worldwide web addresses were obtained and accessed for relevant information. Selection of these companies for this research thesis was based on the fact that these companies have already started their journey on TBL/CSR accountability and majority of them are international cement producers with a commitment to make improvement by way of joining CSI group. A brief description of the selected global cement companies evaluated in this research is presented in Table 3-1:

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
01.	**Holcim**	140.7	Holcim Group Support Limited, Hagenholzstrasse 85 CH – 8050 Zurich Switzerland Tel: +41588585858 Fax: +41588585859 www.holcim.com
	Company Description: Operating in more than 70 countries and employs 90,000 people. One of the world's leading producer of cement and aggregates. Recognised as leader of industry in the DOW Jones sustainability Index for the third year running. The company was awarded SAM Gold classification for 2008. It has a target of completing 100% CSR review for the group companies by 2009. By 2007 the company has achieved 16.3% reduction in net CO_2 emissions per tonne cement, compared to 1990 level of CO_2 emissions. The company has published first sustainability report on the journey to integrate economic, environment and social dimensions.		
02	**Lafarge S.A**	143	Lafarge S.A. 61 rue des Belles Feuilles, BP 40- 75782 Paris Cedex 16
	Company Description: World leader in cement and aggregates, incorporated in 1884 as a limited liability company in France. Employs 45,000 in the cement sector out of total 77,721 people in the group. Cement plants		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	are located in 46 countries. Ranked among the 100 most responsible companies in the Global 100. Only cement company included in the Environmental Leaders Europe 40 Index evaluation by FTSE4Good.		Tel: +33144341111 Fax: +33144341200 http://www.lafarge.com
03	**Cemex**	93.00	Cemex Av. Ricardo Margain Zozaya 325, C.P. 66265 San Pedro Garza Garcia.N.L , Mexico Tel: +528188888888 Fax:+528188884417 http://www.cemex.com
	Company Description: Founded in 1906, major cement and aggregate producer. Operating in more than 50 countries and employs 50,000 people. Owning 66 plants and 11 minority interest cement plants. Published its first sustainability report in 2003.		
04	**Titan Cement**	15.0	Titan Group Halkidos 22A P.O.: 11143 Athens, Greece
	Company Description: It is an independent multi-region producer of cement and other related building materials. Founded		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	in 1902, headquartered in Greece, with a track record of continuous growth. It has production and distribution operation into 12 countries and directly employs more than 6,300.		Tel: + 302102591111 Fax: +302102591285 http://www.titan-cement.com
05	**Italcementi**	70.0	Italcementi S.p.A. Via G, Camozzi, 124 24121 Bergamo, Italy Tel: +39035396111 Fax: +39035244905 http://www.italcementi.com
	Company Description: Italcementi S.p.A was founded in 1864 and has 63 cement plants consisting of 103 kilns operating in 22 countries both mature markets and emerging markets. In 2006 total employees were 22,868. For the period 2007-2008 the group has taken co-chairmanship of the CSI. Published its first SD report in 2003.		
06	**Taiheiyo Cement Corporation**	21.048	8-1, Akashi-cho Chuo-ku, Tokyo, JAPAN 104-8518 Tel: +81 3 622 6901
	Company Description: Established in 1881 but this company was formed by the 1998 merger of Chichibu Onoda Cement		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	and Nihon Cement. The company has cement plants in China, Vietnam, USA, Korea, Philippines and Japan. Japan accounts for 85% of Taiheiyo Cement's sales.		Fax: +81 3 622 6915 http://www.taiheiyo-cement.co.jp/english
07	**Heidelberg Cement**	79.71	HeidelbergCement Berliner Strasse 6 69120 Heidelberg, Germany. Tel: +49 6221 481 0 Fax: +49 6221 481 554 http://www.heidelbergcement.com
	Company Description: Heidelberg Cement is the global market leader in aggregates and a prominent player in the field of cement, concrete and other downstream activities. The company employs some 60,000 people in around 60 countries having headquarter in Germany		
08	**CRH plc**	15.6	Belgard Castle, Clondalkin,
	Company Description:		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	CRH plc was founded in 1970 following the merger of two leading Irish Companies, Cement Limited and Roadstone Limited. Originally it was called Cement Roadstone Holding but later abbreviated to CRH. It is ranked amongst the top 6 in the building material sector. It has operation in 32 countries and employed approx. 92,000 people.		Dublin 22, Ireland Tel: +353 1 404 1000 Fax: +353 1 404 1007 http://www.crh.com
09	**Siam City Cement Public Company Limited**	14.5	Siam City Cement Public Company Ltd. Column Tower, 7th – 12th Floor, 199 Ratchadapisek Rd. Klontoye, Bangkok 10110 Tel: +662 797 7000 Fax: +662 797 7001-2 www.siamcitycement.com
	Company Description: The company was established in 1969 and went on production in 1972. In 2007, the group employed 3056 persons and cement sector alone employed 2254 persons. The company was listed on Bangkok Stock Exchange in 1977. In 1998, the company was certified for ISO 14001 and in the same year HOLCIM became a shareholder. Euromoney Asian Company Survey in 2003 voted his company as the best company in Thailand and best Asian company in construction sector.		
10	**Grasim Industries Ltd**	33.27	Aditya Birla Centre

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	Company Description: Grasim Industries Ltd., a flagship company of the Aditya Birla Group, ranks among the India's largest, private sector companies, with consolidated gross revenue of 2.09 Billion Euros. Grasim ventured into cement in mid 1980's and the merger of the cement business of Indian Rayon Group in 1998 along with acquisition of Larsen & Tubro's, UltraTech Cement business in 2004 catapulted the Aditya Birla Group to the top of the league in India. Grasim together with its subsidiary UltraTech is expanding its capacity to 48 million TPA cement, 536 Mega Watt captive thermal power plants and 12.5 million meter^3 of ready mix concrete. Grasim joined CSI of the WBCSD as a participating member in 2006 and it has commitment to fulfil all the majors agreed among CSI members within the stipulated deadline of 2010		'A' Wing, 2nd floor, S.K.Ahire Marg, Worli Mumbai 400 030, India Tel: +91 22 6652 5000 Fax: +91 22 6652 5114 www.adityabirla.com
11	**Pretoria Portland Cement Company Ltd. (PPC)**	7.1	Pretoria Portland Cement Limited PPC Building, Barlow Park, 180 Katherine Street
	Company Description:		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	PPC established the first cement plant in South Africa in 1892 and was listed in Johannesburg stock exchange in 1910. It is a leading supplier of cement in Southern Africa, with eight (8) integrated manufacturing facilities and three (3) grinding units in South Africa, Botswana, and Zimbabwe. It also produces metallurgical grade lime, burnt dolomite and limestone. This company is committed to optimize the consumption of indirect and direct energy, optimise the use of non-renewable resources, reduce green house gas emission and manage the impact on land and bio diversity.		PO Box 787416 Sandton, 2146, South Africa Tel. +2711 386 9000 Fax: +2711 386 9001. www.ppc.co.za
12	**SECIL- Companhia Geral de Cale Cimento, SA Group**	3.9	Fabruca do Outao- Apartado 712901-864 Setuba Tel. +351 212 198100 Email: outao@secil.pt www.secil.pt
	Company Description: SECIL was setup by a public deed on 27 June 1980. SECIL heads a corporate group with operations in Portugal, Spain, France, Tunisia, Angola, Lebanon and Cape Verde. Apart from cement it is also involved in production and sale of aggregates and concrete. SECIL has covered three (3) cement production plants in Portugal in their sustainability report, which represents 69% of the volume of		

Assigned Number	Name Of the Company	Production Capacity (MT)	Address
	sales of the cement production group.		
13	**Oman Cement Company (S.A.O.G)**	1.26	P.O.Box 560 Postal Code 112 Ruwi, sultanate of Oman Tel: +968-24437070 Fax: +968-25537777 Email: admin@omancement. com www.omancement.com
	Company Description: The Ministry of Commerce and Industry, Government of Sultanate of Oman established Oman Cement Company (S.A.O.G). Later the company was privatised and 49% of the shares were offered to the public in 1995. Presently company is in advanced stage of installing a new production line of 1.26 Million tonne per annum to augment its capacity to 2.52 million tonnes per annum. It employees 435 people.		

Table 3-1: Details of major cement producers and their contact details that were used for the in-depth comparative analysis, Source: Author (2009)

From the list and their locations of plants and corporate headquarters it was observed that most of them are multinationals, operating globally. Those cement producers who have voluntarily joined the Cement Sustainability Initiative were short-listed as potential sources for data because they had already agreed with the WBCSD to collect information on their environmental performance and social responsibilities. The most important reason for their consideration in this thesis is that only these companies have published their environmental and social performances for consecutive years. Considering the wide distribution of plants, on a global scale, it was impossible for this researcher to collect primary data from all of them within limited time and financial resources. Hence, he decided to search the company's websites and to obtain as much data in that way. On checking the websites it was very encouraging to note that many companies in addition to cement manufacturing companies have posted their CSR/Sustainability/TBL Reports on their websites. The author is aware about the potential problems of using data from Internet, so data was collected from verified reports only.

The CSR/ Sustainability reports were independently verified and certified for their accuracy by major consulting and auditing firms like Ernest and Young. This eliminated or at-least reduced the unreliability and potential invalidity issue of the data. It was anticipated that some ambiguity in the data might remain, so this thesis author may have to contact the concerned company officials directly to verify and clarify some key data with some of the companies.

To obtain the detailed follow-up information, a semi-structured questionnaire (Appendix 4) was designed and was validated with knowledgeable persons in cement industry and the thesis research supervisor (list of experts is appended in Appendix 1). After validation as a sound questionnaire, it was sent with a cover letter, to the major cement producers included in this study listed in Table 3.1. The cover letter was drafted with due care in order to explain the purpose of the research. This thesis author assured all respondents that their response would be kept confidential. In some cases, responses were not received, even after sending multiple emails. In such cases, questionnaires were sent my postal mail. This method of data collection allowed coverage of large geographical areas at reasonable costs and time. The cover letter and the questionnaire for clarification of data are attached in Appendix 2 for reference.

Detailed data from OCC were obtained to benchmark it with the other cement producing companies in relation to many facets leading to their TBL/CSR efforts and reports. Data accuracy and quality assurance were ensured by proper usage of sampling and analytical equipment and by applying excel for statistical analysis of the data obtained.

This thesis researcher employed both critical and interpretation approaches. Critical theory is a problem-identifying and problem-solving approach that focuses on real problems. This approach was used to establish the framework based on the identified problems and to generate possible solutions that were tested in later stages of the research. The quantitative approach was employed, particularly in data generation and analysis. For example, data on environmental, economic and social aspects in the researcher's company were collected via accurate monitoring and from worker health and safety reports. Calibrating all instruments prior to testing and following good engineering sense ensured accurate monitoring. In some cases it was difficult to obtain the completed questionnaires so the researcher contacted the non-respondents via email and also by telephone. In order to obtain information from relevant stakeholders, regulators and employees, phone and personal interviews were conducted.

After receiving the feedback on data clarification and completed questionnaire (Appendix 6) they were tabulated for comparison and analysis. The relevant comparative information on the practices, drivers and barriers of the TBL journey in cement companies were segregated and analysed. Questionnaires were sent to 12 cement companies and response was received from 9. The response rate was 75%. The best practices of companies on an array of parameters were documented. The analyses revealed the effects upon the cement companies of their activities on their TBL journey. Subsequently, OCC was benchmarked against those ‘best practices’. These benchmarks are providing guidance and challenges to OCC as it embarks on its TBL/CSR journey.

As the research progressed, combinations of research methods were used to systematically answer the research questions. Secondary data in the form of corporate environmental policies, procedures, plans and accomplishments of leading cement companies of the world were reviewed. Wherever, the data were protected, specific permission was obtained to use the information confidentially.

The WBCSD is also working on cement industry sustainability. They have created a general resource page under “Research Tools” where external documents related to the sustainability in the cement industry were available.

Due considerations were paid to ethical issues involved in data collection and analysis. The case study cement company was approached for the permission to use their data in this research and the researcher has obtained written permission for the use of company data and information for steering the company on its TBL/CSR journey.

4 Chapter 4 - Data Collection and Analysis

In this Chapter, the thesis author presents the data collected from the worldwide cement manufacturing companies on their environmental, social and economic indicators. Data were collected by accessing the sustainability/CSR report of the cement manufacturing companies and from other capital and labour intensive industries, which are similar in nature to the cement-manufacturing sector. Wherever there was ambiguity in the data, clarification was sought by sending a questionnaire to officials of that company. Their reply was used to correct the ambiguity. Many follow-ups by email and telephone calls were made to obtain the essential information from those cement companies. Because most of the cement companies have multiple cement plants at different worldwide locations, group average data were used. In order to develop a deeper insight into the world-renowned cement companies with global presence, longitudinal analyses were performed by analysing data collected from 2005 to 2007. Analysis of three year's data revealed the trend and further, helped in answering this thesis author's research questions. Battelle (2002) surveyed companies out side the cement industry adopting best practices in economic, environmental and social dimensions and reported the business case highlights of these companies. The author visited their websites (September/October 2009) and the business case highlights for each of these companies are presented in Table 4.1.

Table 4.1 lists the selected 'best practice' companies outside the cement industry with highlights and examples of their Sustainable Development (SD) initiatives.

Company	Industry	HQ Nation	Business Case Highlights
Aracruz Cellulose	Forest Products	Brazil	○ ROI criteria modified by SD and other strategic factors. ○ Strong alignment and small size enables them to use informal decision-making processes to achieve high minimum standards of performance.
Baxter	Health Care Products	USA	○ Financial statement shows savings due to their environmental activities. ○ Developed financial statements for health and safety activities.
Dofasco	Steel	Canada	○ Project appropriation requests that addressed SD commitments do not have to meet a ROI hurdle.
Dow	Chemical	USA	○ They use a total cost assessment tool to justify investment in alternative waste to energy technology. ○ Use a balanced scorecard as a strategic decision-making tool.
DuPont	Chemicals	USA	○ Their decision-making analysis includes assessment of hidden costs and risks.

Company	Industry	HQ Nation	Business Case Highlights
			○ They use piloting tool to assess social and political issues for initiatives.
Electrolux	Consumer Durables	Sweden	○ Engaged in WBCSD project to link SD to their business values. ○ Customer cost savings increased sales and margin of green products.
Georgia- Pacific	Forest Products	USA	○ Use total cost assessment to evaluate full costs/benefits of alternative capital investments. ○ Use EVA to align environmental management with financial goals.
ICI	Chemicals	UK	○ Engaged in WBCSD project to link SD to business value ○ One business uses a matrix to set priorities and investment criteria for business, environmental, health and safety projects.
Johnson & Johnson	Health Products	USA	○ Use a balanced scorecard to integrate financial, environmental, and customer preference criteria to rank new product ideas for further development ○ Sustainable Growth Team leverages knowledge of stakeholder concerns and corporate reputation to drive product innovation.

Company	Industry	HQ Nation	Business Case Highlights
Novo Nordisk	Pharmaceuticals	Denmark	○ Currently investigating relationships on its TBL/CSR. ○ Eco-Productivity indices are used to estimate cost savings.
Procter and Gamble	Consumer Products	USA	○ Use a checklist tool to support product development decisions.
Rio Tinto	Mining	UK/ Australia	○ Perform intensive review of social and environmental aspects, coupled with stakeholder dialogue.
Royal Dutch Shell	Petroleum	Netherlands	○ Introduced management system that integrates business case development with other aspects of SD management. ○ Use stakeholders' engagement to understand social issues.
Suncor	Petroleum	Canada	○ Support increase in the use of renewable energy as a part of their business strategy.
Tokyo Electric Power Company	Electric Utility	Japan	○ Their policy emphasizes using the 3E's bottom line for all decisions. ○ Use a development environmental cost/benefit accounting system.
Unilever	Consumer Food Products	UK	○ Engaged in an industry consortium project to link SD to business value. ○ Use LCA and stakeholder engagement to assess performance.

Company	Industry	HQ Nation	Business Case Highlights
Westvaco	Forest Products	USA	○ Use a checklist of issues to consider in making investment decisions. ○ Have modified their ROCE criteria with SD and other strategic factors.

Table 4-1: List of best practices used by some companies outside the cement industry with the highlights of their business cases, Source: Battelle (2002)

Based on this study and the findings from the WBCSD report (2005) it was noted that many worldwide companies that are striving to incorporate TBL/CSR into their business decisions used the following approaches:

- **a.** Top management leadership;
- **b.** Strategic alignment with the strategies and goals of the company;
- **c.** Organizational alignment;
- **d.** Use of financial decision-making tools;
- **e.** Focus on environmental aspects;
- **f.** Addressing the challenges of societal aspects;
- **g.** Expansion of the economic aspects;
- **h.** Use of stakeholder dialogue;
- **i.** Absence of business case frameworks;
- **j.** Top-down vs. bottom-up approach;
- **k.** Separate treatment of SD projects

Once policies and priorities are established, it is very important to monitor and interpret consequences. The results of monitoring activity can provide valuable feedback to the development for future decisions. In line with earlier studies of Battelle (2002), this thesis author decided to collect data on TBL/CSR from the core members of the cement sustainability group and also from one or two leading participating members - participating members are not the CSI core members but they participated in the CSI study by collecting and sharing their operational data. Since the data sources are those cement companies, who have begun their TBL/CSR journey, they were the obvious targets for data collection. Data were collected through the websites of the cement companies and via e-mails. This methodology was adopted because it is less expensive, less time consuming and is quite accurate. Independent certifying bodies like Ernest and

Young certify the sustainability/CSR reports for their correctness on the request of their clients.

Data on annual turnover, production capacity, and personnel employed by the core members of the CSI group and OCC are presented in Table 4.2 for the base year 2005:

		Turnover (MEU)	**Employees (Number)**	**Production (MT)**	**Production Capacity (MT)**	**Countries (Number)**	**Emergent market countries (%)**
CSI core members	Cemex	12,986	54,635	98	98	>50	
	CRH	14,449	6000	13.9	14	25	
	Holcim	11,876	59,901	113.3	-	>70	
	Italcementi	5,000	21,854	56.3	70	19	49%
	Lafarge	16,000	80,146	131	-	76	
	Portland Valderrivas	978	2,328	11	11.5	2	-
	Taiheiyo	6,527	17,170	22.21	-	8	30%
	Titan	1,342	6,000	15	15	6	45%
CSI Participants	Siam Cement	4,506	2254	14.5	14.5	2	100%
Case study company	Oman Cement	87.19	373	1.798	2.2	1	100

Table 4-2: Benchmarking: Oman Cement Company performance with leading cement companies, Source: Battelle (2006).

4.1 Data from Leading Cement Companies

Data from various cement companies with regard to their activities, management systems, and indicators for economic, environmental and social aspects were collected and are presented in Table 4.3. The data were taken either from the company's sustainability/CSR reports or they were calculated based upon other publicly available sources. Some of the core CSI members' viz. Portland Valderrivas, CIMPOR and Uniland were excluded because no data were available on their websites (this thesis author tried to retrieve data from their websites on 17.09.2007 to 11.10.2007). The latest set of data for cross-sectional study is for the operating year 2006 for comparison as some of the reports were published in the third quarter of 2007. Obtaining feedback on some reported data of companies took over a year. This Table provides an overview of company data collected and published by individual companies on their own operations. Each indicator is related to the corresponding GRI clause number for comparison purposes in Table 4-3:

Data of leading cement companies

	Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**GRI (2002)**
Activity															
Sales	Billion euros	14.8	8.8	5.248	1.342	5.85	5.32	7.997	2.646	0.512	2.12	0.421	0.247	0.11	EC1
Total # of employees	Number	88,783	41,191	50,000	6000	22,868	17,170	40,983	6000	2254	8698	3025	682	421	LA1
Annual Production (MT)	Million Ton	140.7	143	93	15	70	21.048	79.712	13.9	14.5	34.125	5.7 (In SA)	3.317	1.8	
Management															
Internal environmental management	% of sales	100	67	NA	90.0	90.0	100	90.0	100	100	100	100	100	100	

Data of leading cement companies

	Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**GRI (2002)**
systems															
Of which ISO 14001 certified systems	% of sales	90	54	Many	78	72	NA	84	60	100	100	89	100	100	
Environment															
Total energy consumption	Millions GJ	507.8	10.9	NA	35.22	229.4	94.74	NA	114.1	NA	105.7	NA	13.15	4.74	EN3
Water consumption	Lt/tonne	330	355	100-900	374	439	-	-	98	NA	-	NA	379	458	EN5
% of sites equipped with water recycling	%	N.A	71	NA	100	NA	NA		90	NA	100	NA	100	100	

Data of leading cement companies

	Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**GRI (2002)**
system															
Use of alternative raw materials	% of total R.M consumed	11.7	10.3%	8.5	7.05	NA	11.1	12.0	10.05	Yes	15.98	NA	4.39	2	EN2
Waste disposed of	% of total production	N.A	0.7	NA	NA	NA	NA		1.0	Yes	0.35	NA	0.257	1.4	EN11
NO_x emissions	g/t clinker	1190	2,442	2,007	2,032	1,863	1,222	1521	1,554	272.83@	NA	NA	1971	NA	EN19
SO_2 emissions	g/t clinker	365	957	519	285	757	70	616	154	45.1@	NA	NA	267	NA	EN19
Stack dust emissions	g/t clinker	125	217	215	101	199	41	278	375	31.75@	140	NA	15.7	175	EN19
Quarries with a rehabilitation	%	89.0	74.0	81.0	100	92.9	100	80.0	92.9	Yes	100	71	100	NA	EN27

Data of leading cement companies

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	GRI (2002)
plan															
Specific gross CO_2 emission	ton CO_2/ ton of cement	0.664	0.670	0.700	0.701	0.751	0.784	0.698	0.751	NA	NA	0.91	0.868	0.77	EN8
Specific net CO_2 emission	ton CO_2/t cement	0.645	0.655	0.695	0.698	0.733	0.764	0.667	0.733	NA	0.729	0.91	0.868	NA	EN8
Net CO_2 emission	Millions of tonnes	95.3	92.3	49.97	8.9	44.65	38.34	45.4	9.86	NA	23.16	NA	26.0		EN8
LCR R&D budget	Millions of euros	NA	24.2	NA	NA	NA	4.796	NA	NA	Yes	NA	NA	NA	NA	
Environmental and safety	Millions of euros	351	128	NA	NA	121	41.3	NA	81	Yes	7.61	R 70 M	NA	1.5	EN35

Data of leading cement companies

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	GRI (2002)
investments (amounts committed)															
Social/ health & safety															
Occupational frequency rate	Points	5.3	2.14	7.0	5.87	7.0	1.0	6.0	8.3	0	3.2		13.5	8.5	LA7
Occupational severity rate	Points	NA	0.14	NA	1.6	NA	NA	0.4	NA	0	1.47		0.33	17.0	LA7
Social															
Percentage of women in	%	11	10		10[4]	NA	NA	NA	10	NA	0.89	0	19	0	

[4] Varies with country locations - 11% (Greece) to27% (USA)

Data of leading cement companies

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	GRI (2002)
senior management															

Table 4-3: Data of leading cement companies in comparison with case study cement company on their economic, environmental and social performance, 2006, Source: Author (2008)

In Table 4-3, NA denotes that data were “Not Available”. “Yes” denotes that the company is working on this parameter but no details of disclosure were available on its quantification.

@ The reported results are in mg/Nm^3, 7.0% oxygen. Siam City Cement Company reported their emissions of Dioxins/Furans and Heavy Metals e.g. Antimony, Arsenic, Lead, Mercury and Copper though there are no standards of emissions of heavy metals for cement plants. Siam cement is partly owned by M/S Holcim.

For the purpose of reporting in Table 4-3 the cement companies were assigned the following numbers:

1. Holcim ;
2. Lafarge ;
3. Cemex ;
4. Titan Cement ;
5. Italcementi ;
6. Taiheiyo;
7. Heidelberg cement;
8. CRH;
9. Siam City Cement;
10. Grasim Industries;
11. Pretoria Cement company, S.A.;
12. SECIL, Data of only Portugal operation is included in this study
13. Oman Cement Company

Assigned numbers are only for the purpose of identification and do not indicate any ranking or preference.

Comments and observations on the data in Table 4-3:

While collecting the data, this thesis author observed that the emission results and health & safety data of the different companies were not reported on a comparable basis. Although, the CSI issued guidelines in line with the vision of GRI that the disclosure of economic, environmental and social performance should be comparable as financial reporting, since they also importantly contribute to organisational success. More specifically this thesis author observed that:

- Some cement companies submitted their sustainability reports according to the GRI indicators and followed the principles of the United Nations Global Compact in a very subjective manner.
- Most of the TBL/CSR reports are well written but many companies do not report in quantifiable units. For example, The Cemex reported their efforts on water conservation and quoted the example of Lara cement plant in Venezuela where they have invested USD 280,000 in an eco-efficient water treatment plant to reduce their water consumption and to prevent harmful discharges, however they did not report on the total water consumption in their cement production or on the environmental and economic improvements that resulted from their investment in the new treatment facility.
- Similarly, the Taiheiyo Cement Corporation and Siam City Cement reported emissions data in milligrams per Normal Cubic Metre of effluent gas at 7% oxygen and not in grams per ton of clinker, which is the industry norm. (There is clearly a need for companies to use a standard format for reporting so that inter-organizational comparisons can be made.)
- Some companies reported on their management systems and certification of their operations to ISO 14001 in a concise manner by reporting the

percentage of their sales that were covered by ISO 14001 certified EMS, but many of them only indicated that an environmental management system is used in their operations and X percentage of their kilns are covered by a monitoring system for the main pollutants. Some reported that Y % of their kilns is continuously monitored for the main pollutants. (60% & 42% respectively, Cemex). Such statements on a year-to-year basis can provide evidence of improvement or lack of improvement but cannot be compared among companies. However, CSI guidelines require them to monitor kiln emissions on-line.

- On Health and Safety reporting, there are commitments on implementing and reinforcing a Health and Safety Management System by all the Cement Companies whose performance was compared. But the data on the frequency rate and severity rate of injuries are reported in diverse, non-standard ways.
- Information from Portland Valderrivas Company could not be collected from the web site of the company. Attempts were made to contact them by letter and e-mail to obtain their data but no feedback was received. Hence Heidelberg cement, Germany, who joined the CSI in 2004, was included in this study in place of Portland Valderrivas.
- Data from the author's case study company: Clinker produced in 2006 was 1,260,320 million tonnes. Cement produced was 1,798,642 million tonnes that was accomplished by importing the shortfall in clinker. The data on CO_2 emissions were calculated on equivalent cement produced from actual clinker production.

4.2 Longitudinal Analyses of the Top Cement Producers

Analyses of the individual company's TBL/CSR/ reports were done to obtain insights to achieve the following objectives:

- In what ways do TBL/CSR initiatives of the companies add value for the companies?
- How does the company's TBL/CSR approaches lead to improved working practices? Are the improvements driven by the company's corporate governance principles?
- Do TBL/CSR reports provide clear, complete and accurate information on the company's performance?
- What are the trends in performance according to key performance indicators and how do the companies compare with their peers?

An in-depth study was conducted on the published TBL/CSR reports of leading cement companies to gauge the improvements and effectiveness of their journeys on environmentally and socially responsible management practices. The results of the analyses are presented in the following corporate reviews.

4.2.1 HOLCIM

HOLCIM is one of the leading producers of cement and aggregates. As a range of other services they also supply ready-mix-concrete and asphalt. This company works in more than 70 countries and employs almost 90,000 people. The Holcim group is recognised as a "leader of industry' and was listed in the DOW Jones Sustainability Index consecutively for the third year in 2009. Their major contributions towards environmental and social dimensions are:

- Environmental highlights:
  - 16.3% reduction in net CO_2 emissions per ton of cement in 2009 compared with 1990.
- Social highlights:
  - Increased the percentage of Community Advisory Panels at the plant level from 39% to 50%, from 2004 to 2009.

- 100% of the groups' companies completed a CSR review by 2009.
- Data collected on their last three year's performance are presented in Table 4.4

HOLCIM PERFORMANCE DATA:

Activity	2005	2006	2007	Remarks
Implementation of EMS, ISO 14001 In Percentage of Plants	85	90	93	EMS includes the PEP monitoring and reporting tool which goes Beyond ISO: 14001, covering all operational segments
% of global suppliers screened using Social accountability self –assessment questionnaire	61	74	78	Screening took into account OHS, EMS and labour standards along with social accountability as per GRI indicators HR1 and HR2
Government Relations				Political contributions are publicly disclosed. 24% of group companies received subsidies from national governments.
o Total political contribution (CHF)	308,000	100,000	415,468	
o Avg. Subsidies from local Governments. (CHF)	3,000,000	2,600,000	4,110,436	
o Absolute gross CO_2 Emissions, Million tonnes CO_2	95.4	98.2	102.8	This has increased due to increase in production.
o Specific gross CO_2 emissions, Kg CO_2/ tonne cement	683	664	660	There is a gradual reduction over the years.

Activity	2005	2006	2007	Remarks
Absolute net CO_2 emissions, Million tonnes CO_2.	92.8	95.3	99.7	Increase due to increase in production.
Specific net CO_2 emissions, Kg CO_2/ tonne cement	665	645	640	Shows continual improvement.
Thermal Efficiency of Clinker Production, MJ/tonne clinker	3710	3704	3703	The change is minimal, almost static.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	10.8	11.3	11.4	In 2007 savings are equal to 2.1 million tons of coal by using 2.8 million tonnes of waste.
Clinker Factor	75.2	73.6	72.6	The main driver for reducing CO_2 emissions in cement production continues to be improvement in clinker factor by substituting clinker in cement with appropriate secondary materials.
Other Atmospheric Emissions				These data are only from the cement kiln stacks and do not include other point sources or fugitive emissions.
○ DUST	150	125	110	

Activity	2005	2006	2007	Remarks
o NOx	1,375	1,190	1220	
o SO_2	435	365	320	
Unit: Gram/tonne cementitious materials				
Environmental Investments (CHF)				There is commitment for making ongoing investments. The group maintains appropriate provisions for its obligations.
o Environmental Investments	104	118	144	
o Provision for site restoration and other environmental liabilities.	388	521	518	
Water Consumption L/tonne	430	330	340	There was considerable reduction in 2006 but in increased again in 2007.
Waste Management and Recycling:				There is high level of commitment for waste recycling but no data were provided on use of waste concrete recycling
General Waste Management %	98	98	98	
Returned Concrete Recycling	N.A	N.A	N.A	
Quarry Rehabilitation Plans in place, %	71	89	90	There was gradual improvement

Activity	2005	2006	2007	Remarks
Environnemental Non-compliance cases; Nos.	24	16	8	Non-compliance cases have decreased with increasing implementation of EMS.
Lost Time injury frequency rate	6.9	5.2	3.9	Marked improvement was due to awareness of risks and hazards and to increased practice of safe working methods.

Table 4-4: Three year's data from Holcim Company website for 2006 - 2007; www.holcim.com, Source: Author (2010)

4.2.2 Lafarge

Lafarge Sustainability Report (2008) stated that Lafarge is the world leader in cement and aggregates, and is ranked 1st in cement and 3rd worldwide in concrete and gypsum production. It has acquired by Orascom Cement Company as of January 23, 2008. The group has approximately 90,000 employees in 76 countries. It has 124 cement plants, 32 clinker grinding stations (Cement grinding units) and 7 slag grinding stations. The company has a strong commitment towards sustainability leadership. To assess its sustainable development performance, it used the framework developed by the GRI. Since 2005, Lafarge has been ranked among the 100 most responsible companies. "Global 100 Most Sustainable Corporations" was created by "Corporate Knights et Innovest Strategic Value Advisors" to showcase the international companies which are the most committed to SD. Lafarge is the only cement company included in the Environmental Leaders Europe 40 Index (2006). This index was designed to identify European companies with leading environmental practices and that are doing more to manage their environmental risks and impacts whilst reducing their environmental footprints. Lafarge achieved the best environmental and social reporting scores in the cement- manufacturing sector in an evaluation by Sustainability Asset Management, a D.J.S. Index, in 2006. But in 2007 it was not placed in this index because D.J.S.I considered that their progress on NOx, SOx and dust was not sufficient.

Data on Lafarge performance for the period 2005 - 2007 are presented in Table 4.5

Activity	2005	2006	2007	Remarks
Implementation of EMS, ISO 14001 In Percentage of Plants	34	54	34	New acquisitions have lowered this percentage.
% of global suppliers screened using Social accountability self –assessment questionnaire	NA	NA	NA	Screening takes into account OHS, EMS and labour standards along with social accountability as per indicators HR1 and HR2 developed by GRI.
Government Relations				
○ Total political contribution (Euro)	NA	NA	NA	Political contributions were not disclosed.
○ Avg. Subsidies from local Governments. (Euro)	NA	NA	NA	Not disclosed.
Absolute gross CO_2 Emissions Million tonnes CO_2	89.3	94.4	98.9	This has increased due to increase in production.
Specific gross CO_2 emissions Kg CO_2/ tonne cement	NA	678	667	There was a gradual reduction
Absolute net CO_2 emissions, Million tonnes CO_2.	NA	92.3	96.2	Increase due to increase in production

Specific net CO_2 emissions Kg CO_2/ tonne cement	669	658	648	Shows continual improvement.
Thermal Efficiency of Clinker Production, MJ/tonne clinker	NA	NA	NA	32% reduction in specific heat consumption was reported from 1990 to 2006.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	NA	7.8	8.8	In 2007, saving was equal to 2.1 million tons of coal and due to using 2.8 million tonnes of waste.
Clinker Factor	NA	78	77	The main driver for reducing CO_2 emissions in cement production continues to be improvement in clinker factor by substituting clinker in cement with appropriate secondary materials.
Other Atmospheric Emission				These data are only from cement kiln stacks and do not include other point sources or fugitive emissions.
○ DUST	227	217	199	
○ NO_x	2455	2442	2268	
○ SO_2	1043	957	803	
Unit: Gram/tonne cementitious materials.				

Environmental Investments (Million Euro)				They are committed to ongoing investments; the group maintains appropriate provisions for its obligations.
o Environmental Investments	124	128	118	
o Provision for site restoration and other environmental liabilities.	NA	NA	NA	
Water Consumption L/tonne.	*	355	343	There was considerable reduction in 2007.
Waste Management and Recycling:				
o General Waste Management System %	NA	NA	NA	Waste management was established in the group but was not quantified. Waste disposed of in % of total production: 0.7%
o Returned Concrete Recycling	N.A	N.A	N.A	No data available.
Quarry Rehabilitation Plans in place, %	71	79	75	Due to recent acquisitions of companies, this went down in 2007.
Environnemental Non-compliance cases; Nos.	NA	NA	NA	No data were provided.
Lost Time injury frequency rate	3.0	2.7	1.8	Marked improvement is due to increased awareness of risks and hazards and practice of safer working methods.

Table 4-5: Three year's performance data collected from the Lafarge company reports 2006-2008, Source: Author (2010)

4.2.3 Cemex

Cemex was founded in Mexico in 1906. Over the last 103 years it has grown from a local player into one of the top global providers of cement and building materials. Their operations span over 50 countries and they maintain trade relations with more than 100 nations. As per the latest information they employ over 50,000 people in operations in the Americas, Europe, Africa, the Middle East and Asia. Sustainability initiatives are at the core of their business. SD objectives are included in the performance assessment of executives who have direct responsibility for social or environmental initiatives. The company implements a company-wide Sustainability Management System, which contributes to ensure the safety and well-being of its employees, protects the environment and develops communities for highly efficient and profitable business. SMS are designed to communicate their performance in accordance with GRI G3 guidelines for sustainability reporting.

Cemex reports on their contribution to sustainable development every two years and produces a summary in the intervening years like 2007. Based on the information available from their published report on www.cemex.com (accessed on September 2008, January 2009) an analysis on their performance is presented in Table 4-6:

Activity	2005	2006	2007	Remarks
Implementation of EMS, ISO 14001 In Percentage of Plants	Many	Many	Many	No specific data were provided.
% of global suppliers screened using Social accountability self –assessment questionnaire.	N.A	N.A	N.A	Screening takes into account OHS, EMS and labour standards along with social accountability as per GRI indicators HR1 and HR2.
Government Relations o Total political contribution ($) o Avg. Subsidies from local Governments. ($)	N.A	N.A	N.A	This information was not disclosed.
Absolute gross CO_2 Emissions Million tonnes CO_2	54.7	56.4	57.7	This increased due to increase in production. In 1990 it was 42.6
Specific gross CO_2 emissions Kg CO_2/ tonne cement	739	722	706	There was gradual reduction over the years. In 1990 it was 793.
Absolute net CO_2 emissions, Million tonnes CO_2.	53.9	55.6	56.7	Increase due to increase in production
Specific net CO_2 emissions Kg CO_2/ tonne cement	728	711	694	Shows continual improvement

Thermal Efficiency of Clinker Production, MJ/tonne clinker	3864	3882	3868	Heat consumption increased in 2006 but it improved in 2007; however there is room for improvement.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	5.13	6.05	6.98	There was continual improvement.
Clinker Factor	81.4	81.4	78.5	The main driver for reducing CO_2 emissions in cement production continues to be improvement in clinker factor by substituting clinker in cement with appropriate secondary material.
Other Atmospheric Emission				These data were only from cement kiln stacks and do not include other point sources or fugitive emissions. Raw materials and fuels have played significant role in increased emissions of SOx.
o DUST	307	215	219	
o NOx	1,962	2007	1704	
o SO_2	580	520	599	
Unit: Gram/tonne cementitious materials				
Environmental Investments o Environmental Investments	N.A.	N.A	N.A	There is commitment for ongoing investments and the group maintains appropriate provisions for its obligations. But no figures

○ Provision for site restoration and other environmental liabilities.				were disclosed.
Water Consumption L/tonne	NA	NA	NA	Not reported in absolute figures.
Waste Management and Recycling: General Waste Management System % Returned Concrete Recycling	N.A.	N.A.	N.A.	Data were not disclosed.
Quarry Rehabilitation Plans in place, %	NA	81	94	There was marked improvement in 2007.
Environnemental non-compliance cases; (Nos.)	NA	NA	NA	Environmental non-compliance cases were not reported. Percentage of sites having biodiversity addressed was low.
Biodiversity addressed at plant sites, %	NA	61	69	
Lost Time injury frequency rate.	10.6	7.0	5.2	Marked improvement was due to awareness of risks and hazards and practice of safe working methods. Target for 2010 is 5.0.

Table 4-6: Three year's performance data collected from the CEMEX company reports 2006-2007, Source: Author (2010)

4.2.4 Italcementi S.p.A

ITALCEMENTI S.p.A is one of Italy's 10 largest industrial companies and is included in S&P/MIB index of the Italian stock Exchange and in the Dow Jones Sustainability Index. Italcementi Group's companies combine the expertise, know- how and cultures of 22 countries on 4 continents having an industrial network of 63 cement plants, 13 grinding centres, 5 terminals, 125 aggregate quarries and 614 concrete batching units. Italcementi Group is the world's fifth largest producer of cement. The company reports its environmental and social data by grouping their companies under the following two categories:

1. Mature Markets (MM): Operating in Italy, France, Belgium, Greece, Spain and North America;
2. Emerging Markets (EM): Operating in Bulgaria, China, Egypt, India, Kazakhstan, Morocco, Thailand, Turkey and Saudi Arabia.

	2005			2006			2007			
Activity	**MM**	**EM**	**Avg.**	**MM**	**EM**	**Avg.**	**MM**	**EM**	**Avg.**	**Remarks**
Implementation of EMS, ISO 14001 In Percentage of Plants	NA	NA	NA	NA	NA	72	NA	NA	78	Targeted for 90% by 2010.
% of global suppliers screened using Social accountability self – assessment questionnaire.	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not reported in their sustainability report. Company has made a commitment to evaluate suppliers from 2008. GRI indicators HR1 and HR2 are used
Government Relations o total political contribution ($) o Avg. Subsidies from local Governments. ($)	NA	NA	NA	NA	NA	NA	NA	NA	NA	No information was provided
Absolute gross CO_2 Emissions	22.39	24.43	44.83	21.79	23.05	44.84	21.76	24.11	45.86	This increased due to increase in production.

Million tonnes CO_2										
Specific gross CO_2 emissions Kg CO_2/ tonne cement.	708	790	747	705	779	741	704	762	733	There is gradual reduction over the years. In 1990 it was 725 for the group.
Absolute net CO_2 emissions, Million tonnes CO_2.	NA	NA	NA	21.26	23.39	44.65	21.34	24.1	45.45	Increase due to increase in production.
Specific net CO2 emissions Kg CO_2/ tonne cement.	NA	NA	NA	687	774	730	690	762	726	Shows some improvement. In 1990 it was 704 for group.
Thermal Efficiency of Clinker Production, MJ/tonne clinker.	4109	3843	4011	4080	3915	4016	4057	4158	4110	Heat consumption increased in 2006 but it has improved in 2007. There are still opportunities for improvement.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	NA	NA	NA	NA	NA	NA	NA	NA	4.2	In 2007 alternative fuel uses was 4.2%, which included 1.6% biomass.
Clinker Factor	NA	NA	NA	78.4	86.2	82.0	78.3	85.0	81.5	The main driver for reducing CO_2 emissions in cement production continues to be

										improvement in clinker factor by substituting clinker in cement with appropriate secondary material.
Other Atmospheric Emission										These data were only from the cement kiln stacks and do not include other point sources or fugitive emissions. Marked difference can be noted in dust emissions of matured market and emerging market areas. Raw materials and fuels have played significant roles in increased emissions of SOx due to presence of sulphur.
o DUST	101	186	126	84	306	199	26	304	187	
o NOx	2402	1720	2207	2290	1405	1962	1962	1194	1584	
o SO_2	1116	503	952	1040	453	757	803	467	638	
Unit: Gram/tonne cementitious materials										
Environmental Investments (million Euro)										
o Environmental	NA	NA	NA	NA	NA	121	NA	NA	130	There is a commitment for ongoing

Investments										investments and the group maintains appropriate provisions for fulfilling these obligations.
o Provision for site restoration and other environmental liabilities.	NA	NA	NA	NA	NA	NA	NA	NA	NA	This was not disclosed.
Water Consumption Lt./tonne	419	439	429	449	419	439	499	469	489	Water consumption increased.
Waste Management and Recycling: General Waste Management System % Returned Concrete Recycling	NA	NA	NA	NA	NA	NA	NA	NA	NA	No data was available on waste management. But the company advocates minimising waste.

Quarry Rehabilitation Plans in place, %	NA	NA	NA	NA	NA	70	NA	NA	74	Data were reported for the group only.
Environmental non-compliance cases ; Nos. Biodiversity, addressed at sites, %	NA	NA	NA	NA	NA	NA	NA	NA	NA	Environmental non-compliance cases were not reported. Percentage of sites having biodiversity addressed is low.
Lost Time injury frequency rate	NA	NA	6.8	NA	NA	7.0	NA	NA	3.6	Reported as a group average. Marked improvement is due to awareness of risks and hazards and practice of safe working methods. Their target is Zero Accidents.

Table 4-7: Data of Italcementi collected from their Sustainability Report 2006/2007. (NA - Not Available, MM – Matured Markets and EM – Emerging Markets), Source: Author (2010)

4.2.5 The CRH, Ireland

CRH published its fifth CSR report in July 2008 covering 2007 performance. CRH was ranked among the top six in the building materials sector globally. It has operations in 32 countries and employed approximately 92,000 people at 3,700 locations at the end of 2007. During this year, CRH was ranked among the sector leaders by a number of socially responsible investment rating agencies, such as the Dow Jones Sustainability Indexes (Zurich), FTSE4good (London), Innovest (London), Vigeo (Paris), Ethibel (Brussels), Governance Metrics International (GMI) (New York), Storebrand (Norway). Business in the Community, Ireland (2007) quoted CRH as an example of best practice in CSR reporting within the Irish context. CRH commissioned Det Norske Veritas (DNV) to provide independent, third party assurance services regarding the contents of their 2007 CSR report including accuracy and completeness.

Their CSR report qualifies for the GRI scope "A+" application level requirements that are also verified by DNV. CRH performance data are summarized in Table 4-8:

Activity	2005	2006	2007	Remarks
Implementation of EMS, ISO 14001 In Percentage of Plants	44	48	60	Gradually progressing towards their goal of 100%.
% of global suppliers screened using Social accountability self –assessment questionnaire	N.A	N.A	N.A	Screening takes into account OHS, EMS and labour standards along with social accountability as per GRI indicators HR1 and HR2
Government Relations o Total political contribution ($) o Avg. Subsidies from local Governments. ($)	N.A	N.A	N.A	This information was not provided.
Absolute gross CO_2 Emissions Million tonnes CO_2	9.83	10.11	12.06	This increased due to increase in production.
Specific gross CO_2 emissions Kg CO_2/ tonne cement	751	751	741	There was a slight reduction over the years.
Absolute net CO_2 emissions, Million tonnes CO_2.	9.73	9.86	11.78	Increase due to increase in production.
Specific net CO2 emissions Kg CO_2/ tonne cement	744	733	724	Shows continual improvement.
Thermal Efficiency of Clinker Production,	3992	4071	4033	Heat consumption increased in 2006 but improved in 2007.

MJ/ tonne clinker				However, there is room for improvement.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	7.48	8.57	7.17	There was improvement in 2007
Clinker Factor	85.23	85.03	83.06	The main driver for reducing CO_2 emissions in cement production continues to be improvement in clinker factor by substituting clinker in cement with appropriate secondary material.
Other Atmospheric Emission				These data were only from cement kiln stacks and do not include other point sources or fugitive emissions. Increased coal percentage in fuel, played significant role in increased emissions of dust, NOx and SOx.
o DUST	349	375	412	
o NOx	1684	1554	1929	
o SO_2	144	154	157	
Unit: Gram/tonne cementitious materials				
Environmental Investments (mill. Euro) o Environmental Investments	.48	56	62	There is commitment for ongoing investments and the group maintains appropriate provisions for fulfilling its obligations.

○ Provision for site restoration and other environmental liabilities.	NA	NA	NA	
Water Consumption L/tonne; Across all group activities.	95	94	94	65% of their water requirement is sourced as surface water including rainwater, well water 26% and mains supply 9%.
Waste Management and Recycling: General Waste Management System %	80	83	87	In cement production, waste is only 1.0%. Maximum waste generation is in concrete production.
Returned Concrete Recycling	NA	NA	NA	Not Available. Company discloser shows that 8.7 million tons of construction and demolished material was used in 2007 to replace virgin aggregates.
Quarry Rehabilitation Plans in place, %	92.90	92.90	92.90	This is commendable but does not show improvement over time.
Environmental non-compliance cases; Nos.	NA	NA	NA	Environmental non-compliance cases are not reported.
Biodiversity, addressed at sites, %.	78.6	78.6	85.0	
Lost Time injury frequency rate.	3.64	3.64	3.36	This is high. Improvement is required.

Table 4-8: Performance data of CRH plc. Collected from company reports 2005 - 2007, Source: Author (2010)

4.2.6 Companhia Geral de Cal e Cimento, SA.

SECIL was set up by a public deed on June 27, 1918 and its article was amended in 2000. Core activity of SECIL is the production and sale of cement but it also holds a group of 30 enterprises that operate in complementary areas, ranging from the manufacture of ready-mix-concrete to the manufacture and sale of building materials, besides the operation of quarries, the design and implementation of industrial projects, as well as development of environmental protection solutions and solutions for the use of waste as a source of energy. Their cement manufacturing facilities are in Portugal, Spain, France, Tunisia, Angola, Lebanon and CapeVerde. SEMAPA group holds 46.96% shares and CRH plc. 45.13% shares in this company.

Currently the group employs 2,769 persons. The Sustainability reports cover the three cement plants in Portugal representing about 69% of the volume of sales for cement production group. The total number of workers in these three plants was 690 and the turnover was 285 Million Euros.

SECIL joined CSI in 2004; they published three sustainability reports by 2008. They have adhered to the directives of GRI, G3 level C, which is at the beginner's level, revealing their concern to increase the degree of details of the performance indicators reported and to address the main concerns and expectations manifested by their stakeholders.

Activity	2005	2006	2007	Remarks
Implementation of EMS, ISO 14001 In Percentage of Plants	34	75	100	Reported for the three plants in Portugal.
% of global suppliers screened using Social accountability self –assessment questionnaire	NA	NA	NA	Screening takes into account OHS, EMS and labour standards along with social accountability as per GRI indicators HR1 and HR2.
Government Relations				
○ Total political contribution ($)	NA	NA	NA	No any such disclosure was found in the report.
○ Avg. Subsidies from local Governments. ($)	NA	NA	NA	
Absolute gross CO_2 Emissions Million tonnes CO_2	2.6	2.6	2.6	Company is trying to bring down specific emissions of CO_2 by a number of measures Viz. reducing clinker factor in cement, maximising uses of alternative fuels and decarbonised raw materials.
Specific gross CO_2 emissions. Kg CO_2/ tonne cement	781	869	885	

Activity	2005	2006	2007	Remarks
Absolute net CO_2 emissions, Million tonnes CO_2.	NA	NA	NA	Lowering the percentage of clinker in cement by way of increase in additives has resulted in reducing the specific net emission factor to 650 kg/t cement.
Specific net CO_2 emissions. Kg CO_2/ tonne cement	NA	NA	650	
Thermal Efficiency of Clinker Production, MJ/tonne clinker	3627.5	3811.6	3749	Heat consumption increased in 2006 but improved in 2007. There is still room for improvement.
Thermal Substitution rate by alternative fuels, % of thermal energy from alternative fuels.	10.7	12.4	13.7	Waste derived fuels; fluff, used tyres, animal biomass and vegetable biomass were used. Biomass has a zero emission factor. There was continual improvement.
Clinker Factor	78.3	75.6	78.1	The main driver for reducing CO_2 emissions in cement production continues to be improvement in clinker factor by substituting clinker in cement with appropriate secondary material.
Other Atmospheric Emission o DUST o NOx	13.8	15.03	9.87	These data were only from cement kiln stacks and do not include other point sources or fugitive emissions. Raw materials and fuels play a significant role in the increased emissions

Activity	2005	2006	2007	Remarks
○ SO_2 Unit: Gram/tonne cementitious materials	1772 210	1971 267	1702 238	of SOx.
Environmental Investments (Mill. Euro)				
○ Environmental Investments	N.A	N.A	2.343	There is commitment for ongoing investments and the group maintains appropriate provisions for fulfilling its obligations.
○ Provision for site restoration and other environmental liabilities.	NA	NA	NA	
Water Consumption L/tonne	339	440	399	Though the total water consumption trend shows a diminishing pattern. The specific consumption has increased due to lower production in 06 and 07.
Waste Management and Recycling: - General Waste Management System % - Returned Concrete Recycling	NA	100	100	Waste produced is collected and stored as per defined procedures. In 2008, 60% of waste produced was upgraded, either for energy production or for material recovery.

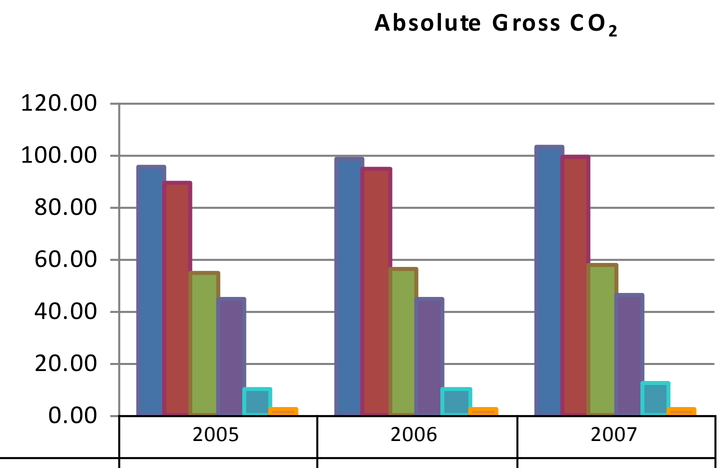
Activity	2005	2006	2007	Remarks
	NA	NA	NA	
Quarry Rehabilitation Plans in place, %	100	100	100	Plans for recovery of Quarries are 100%
a. Environnemental non-compliance cases ; Nos. b. Biodiversity, addressed at sites, %.	NA 100	NA 100	NA 100	Environmental non-compliance cases are not reported. In Biodiversity, only Landscape recovery of quarries was specified.
Lost Time injury frequency rate.	24.8	13.5	15.6	No. of accidents that resulted in sick leave per million man hours.

Table 4-9: Performance data of SECIL 2005-2007 collected from their Company report, Source: Author (2010)

4.3 *Data Analysis*

Analysis of the data was done to determine the best performance in the industry and also to determine the average performance with respect to the performance indicators:

4.3.1 Absolute Gross CO_2 emissions per year in million tonnes

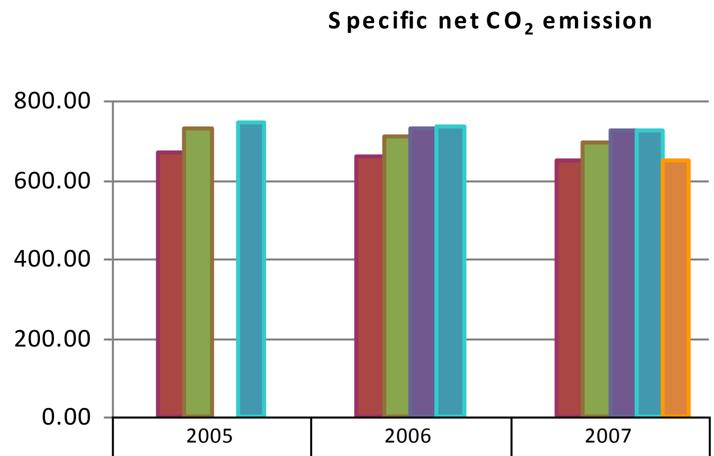


	2005	2006	2007
HOLCIM	95.40	98.20	102.80
LAFARGE	89.30	94.40	98.90
CEMEX	54.70	56.40	57.70
ITALCEMENTI	44.83	44.84	45.86
CRH, Irland	9.83	10.11	12.06
SECIL	2.60	2.60	2.60

Figure 4-1: Data collected from six international cement producers during 2005-2007 on their absolute gross CO_2, Source: Author (2010)

The cement producing company's absolute gross CO_2 emissions are dependent on the quantity of cement produced. From the Figure 4-1, it may be observed that Holcim emitted more CO_2 in all three years in comparison to all other cement producers. This information will be crucial if the concerned governments on these companies establish a cap on emissions. In such cases, companies will be required to remain within their allotted quota by internal reduction of CO_2 emissions and/or by buying emissions allowances under the emissions trading scheme.

4.3.2 Specific net CO_2 emissions per year per company

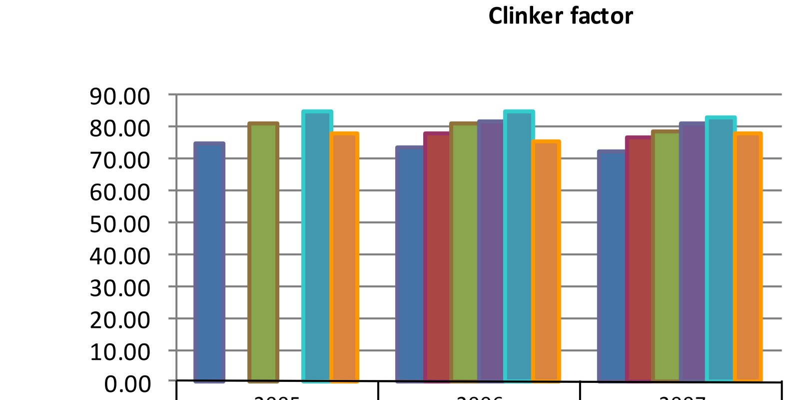


	2005	2006	2007
HOLCIM	0.00	0.00	0.00
LAFARGE	669.00	658.00	648.00
CEMEX	728.00	711.00	694.00
ITALCEMENTI	0.00	730.00	726.00
CRH, Irland	744.00	733.00	724.00
SECIL	0.00	0.00	650.00

Figure 4-2: Specific net CO_2 emissions in Kg/tonne of cement, data collected from six international cement producers during 2005-2007. Holcim has not reported on this parameter, Source: Author (2010)

These data of specific net CO_2 emissions are a true indicator of emissions per tonne of cement production. It indicates the comparative thermal efficiency of the company's manufacturing process. Lower specific emissions are the result of higher thermal efficiency and lesser use of fossil fuels. From Fig. 4-2, it is clear that Lafarge has the most efficient process where, specific net CO_2 emissions were 648 Kg/tonne of cement compared with Italcementi with 726 Kg/tonne of cement produced.

4.3.3 Clinker factor

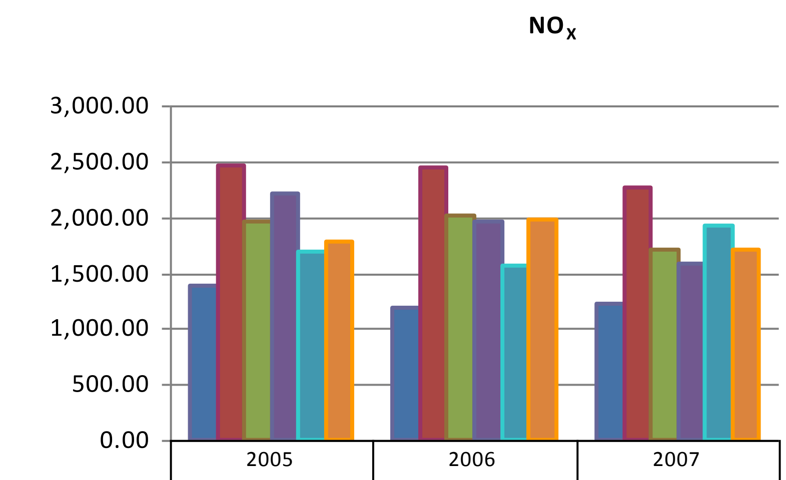


	2005	2006	2007
HOLCIM	75.20	73.60	72.60
LAFARGE	0.00	78.00	77.00
CEMEX	81.40	81.40	78.50
ITALCEMENTI	0.00	82.00	81.50
CRH, Irland	85.23	85.03	83.06
SECIL	78.30	75.60	78.10

Figure 4-3: The Clinker Factor, data collected from six international cement producers for their production during 2005-2007, Source: Author (2010)

Clinker factor represents the percentage of clinker used for cement production. In normal OPC production, 95% clinker plus 5% of gypsum are ground together. The cement manufacturing companies, that are working to reduce their CO_2 emissions per tonne of cement are utilising blast furnace slag and pozzolanic material to replace 6 to 70% of the clinker in their cement depending upon the market demand. The lower clinker factor in cement manufacturing is helpful to reduce net CO_2 emissions and helps in utilising waste or by-products of other industries to produce better classes of cement that result in more durable concrete. Use of blast furnace slag, which is a by-product of the steel industry to partially substitute for clinker in cement, gives a product that is of higher durability and is chlorine resistant in comparison to normal Portland cement. Similarly, use of pozzolana, either natural or industrial waste fly ash in partial substitution of clinker, results in Portland pozzolana cement, which has better resistance to alkali and sulphate attack and also produces less heat of hydration as well as it is better suited for massive construction work like dams. So, for the cement manufacturing companies, it is very beneficial to substitute clinker with other materials to reduce their total CO_2 emissions and to produce different types of cement, which can help them to reap further economic benefits and to help society in reducing the burden of industrial by-products that are often considered to be wastes.

4.3.4 Emissions data on NO_X gram/tonne for six cement producing companies:

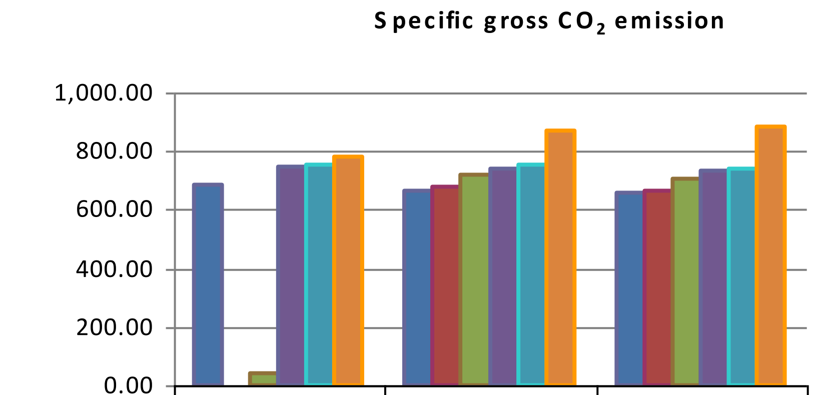


	2005	2006	2007
HOLCIM	1,375.00	1,190.00	1,220.00
LAFARGE	2,455.00	2,442.00	2,268.00
CEMEX	1,962.00	2,007.00	1,704.00
ITALCEMENTI	2,207.00	1,962.00	1,584.00
CRH, Irland	1,684.00	1,554.00	1,929.00
SECIL	1,772.00	1,971.00	1,702.00

Figure 4-4: Data collected from six international cement producers during 2005-2007 on emissions of NO_X, Source: Author (2010)

NOx is generated in the sintering-zone of rotary kiln due to presence of oxygen and nitrogen at high temperature (greater than 1200^0 C). NOx is harmful to humans as well as to flora and fauna. In developed countries, NOx emissions are regulated but many developing countries do not have regulations on NOx emissions. Some cement manufacturing companies have reduced their NOx emissions by modifying their kiln fuel firing burners and NH_3 injections in the pre-calciners. PCA (2010) recommended that a short flame and hot sintering zone could reduce the formation of NOx. Although, reduction techniques are quite expensive, the cement manufacturing companies are obliged to meet those emission limits. From Fig. 4-4, it can be inferred that the lowest emissions of NOx are from HOLCIM. This company is using low NOx burners for fuel firing and is also using Ammonia-solution atomisation in the process gases for lowering NOx emissions.

4.3.5 Specific gross CO_2 emissions, Kg/tonne:

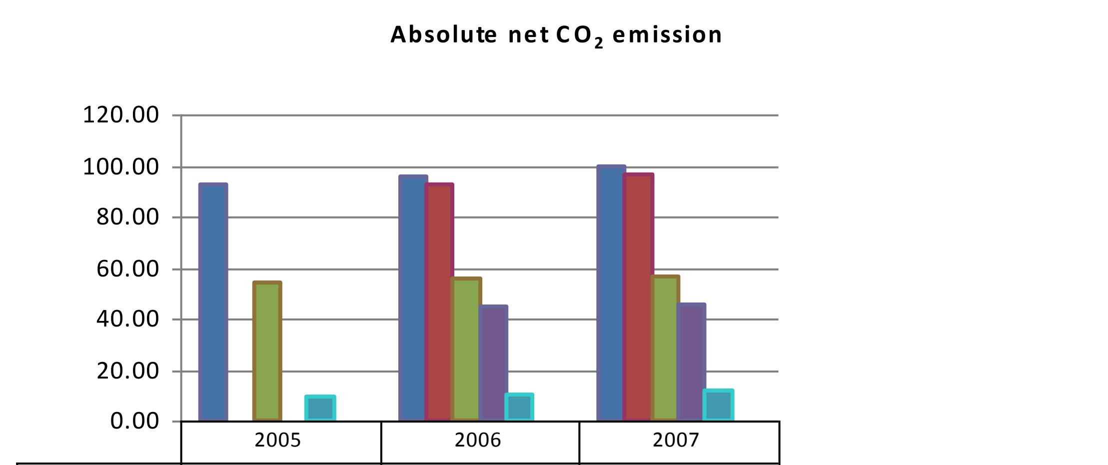


	2005	2006	2007
HOLCIM	683.00	664.00	660.00
LAFARGE	0.00	678.00	667.00
CEMEX	39.00	722.00	706.00
ITALCEMENTI	747.00	741.00	733.00
CRH, Irland	751.00	751.00	741.00
SECIL	781.00	869.00	885.00

Figure 4-5: Specific gross CO_2 emission data collected from six international cement producers, Source: Author (2010)

Specific gross CO_2 emissions is an indicator of emissions caused due to use of fossil fuels and thermal efficiency of the clinker production process, provided it is reported as per tonne of clinker production rather than per tonne of cement production. This provides better comparability with other cement manufacturing companies. From Fig. 4-5, it can be observed that HOLCIM has the least specific gross CO_2 emissions. Lower specific gross CO_2 emissions signify less consumption of fuel/ unit of clinker produced.

4.3.6 Absolute net CO_2 emissions in million tonnes per company:

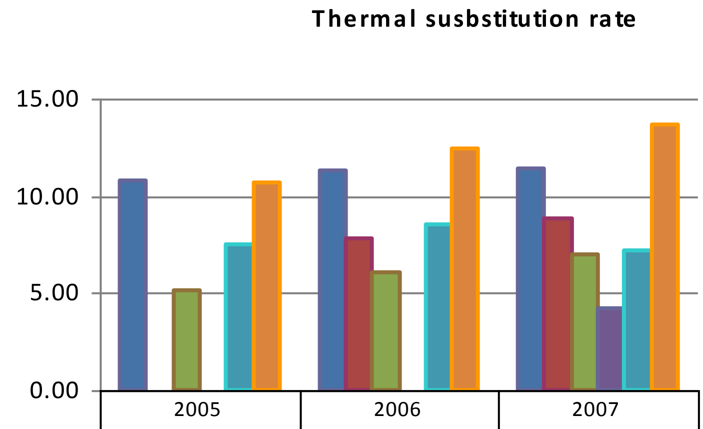


	2005	2006	2007
HOLCIM	92.80	95.30	99.70
LAFARGE	0.00	92.30	96.20
CEMEX	53.90	55.60	56.70
ITALCEMENTI	0.00	44.65	45.45
CRH, Irland	9.73	9.86	11.78
SECIL	0.00	0.00	0.00

Figure 4-6: The absolute net CO_2 emissions, data collected from six international cement producers during 2005-2007, Source: Author (2010)

Absolute net CO_2 emissions are the total quantity of CO_2 released from the cement manufacturing company after deducting the heat energy produced by the use of alternative fuels. However, this is also a function of total quantity of cement produced by the cement manufacturing company. It is meaningful to interpret this factor along with specific net CO_2 emissions. In the section 4.3.6 we can see that HOLCIM has substituted fossil fuel by alternative fuels by10.8 % in 2005, 11.3% in 2006 and 11.4% in 2007. SECIL has substituted fossil fuel by alternative fuels by 10.7% in 2005, 12.4% in 2006 and 13.7% in 2007. Efforts done by SECIL and HOLCIM in this regard are highly commendable and worth adopting by other cement companies. Substitution of fossil fuels by alternative fuels is the key factor to reduce net absolute emissions.

4.3.7 Percentage of substitution of fossil fuel with alternative fuels

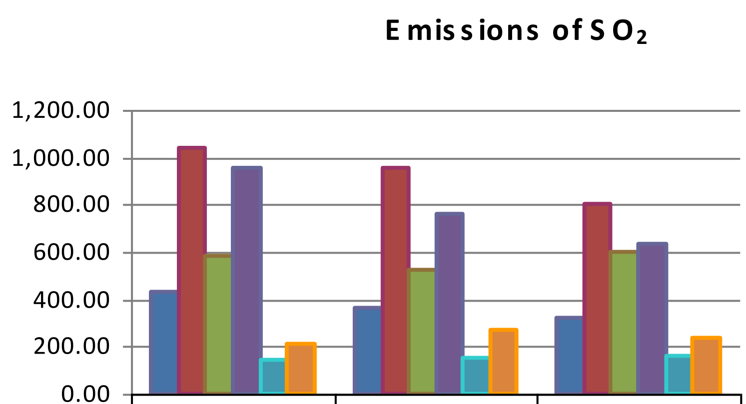


	2005	2006	2007
HOLCIM	10.80	11.30	11.40
LAFARGE	0.00	7.80	8.80
CEMEX	5.13	6.05	6.98
ITALCEMENTI	0.00	0.00	4.20
CRH, Irland	7.48	8.57	7.17
SECIL	10.70	12.40	13.70

Figure 4-7: Substitution of fossil fuels by alternative fuels %, Data collected from six international cement producers during 2005-2007, Source: Author (2010)

Thermal substitution rate indicates the percentage to which fossil fuel is replaced by alternative fuels. Substitution of fossil fuels with alternative fuels helps in reducing net CO_2 emissions in the cement-manufacturing sector. From Fig. 4-7, it is clear that thus far, SECIL has achieved the highest substitution of fossil fuels with alternative fuels of the cement companies studied. In the Middle East, where OCC is located, fossil fuels are available at low prices. Use of any alternative fuels is quite expensive; hence, no cement company in this area is using alternative fuels. However, OCC has started utilising “Oil Based Mud Cuttings”, which are produced during drilling of oil wells; these materials contain 6 to 10 % crude oil. This is a waste from oil well drilling and is treated as a hazardous waste. OCC obtained a permit from the Ministry of Environmental Affairs and Climate Change, Sultanate of Oman, and Civil Defence of Sultanate of Oman to utilise this material. Initial studies have shown that it can be used to substitute for 2% of traditional fossil fuel. Use of alternative fuels in cement manufacturing has to be done very cautiously as it affects product quality as well as the production process. The German Cement Industry (2000) reported that some of their companies have substituted as much as 70% of fossil fuels with alternative fuels in the manufacture of cement.

4.3.8 Emissions of SO_2 gram/tonne, per company:



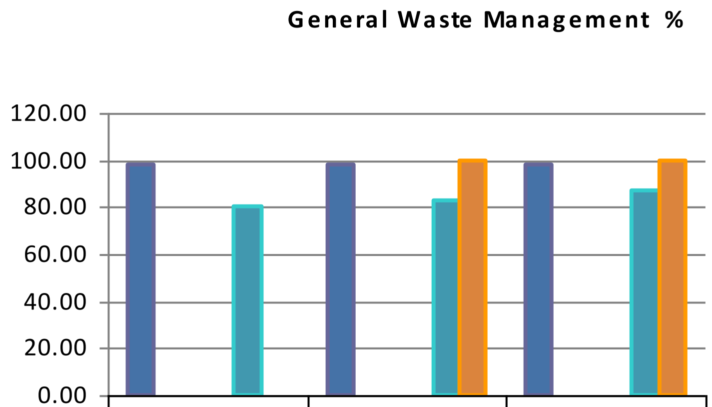
	2005	2006	2007
HOLCIM	435.00	365.00	320.00
LAFARGE	1,043.00	957.00	803.00
CEMEX	580.00	520.00	599.00
ITALCEMENTI	952.00	757.00	638.00
CRH, Irland	144.00	154.00	157.00
SECIL	210.00	267.00	238.00

Figure 4-8: Data from six international cement-manufacturing companies on emissions of $SO_{2,}$ Source: Author (2010)

Sulphur oxides, or SOx is formed as sulphur compounds are oxidised at temperatures of 300° C to 600°C. Limiting the source of sulphur in raw materials and fuels can help cement producers to limit the potential for SOx formation. Emissions of SOx were the lowest from CRH, Ireland.

In the Sultanate of Oman a regulation on SOx emission limits was implemented in 2009 with maximum permissible limit for cement kilns 50 mg/Nm^3. Different countries have limits on SOx emissions depending on the presence of sulphur in their raw materials and fuels.

4.3.9 General Waste Management (%)

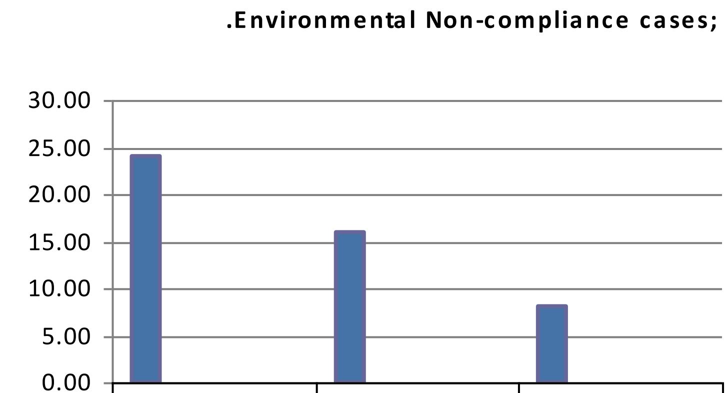


	2005	2006	2007
HOLCIM	98.00	98.00	98.00
LAFARGE	0.00	0.00	0.00
CEMEX	0.00	0.00	0.00
ITALCEMENTI	0.00	0.00	0.00
CRH, Irland	80.00	83.00	87.00
SECIL	0.00	100.00	100.00

Figure 4-9: General waste management data collected from six international cement producers, Source: Author (2010)

On this aspect, only three companies Viz. HOLCIM, CRH and SECIL have reported their performance. This information gives an idea about waste management at the manufacturing sites. Companies having large numbers of manufacturing units at multiple locations will need time to organise and measure their performance. SECIL has all its manufacturing facilities managing general waste. General wastes may contain some combustible materials. It may be useful to use them as alternative fuels after proper evaluation.

4.3.10 Number of cases of environmental non-compliance per company per year, No./year:

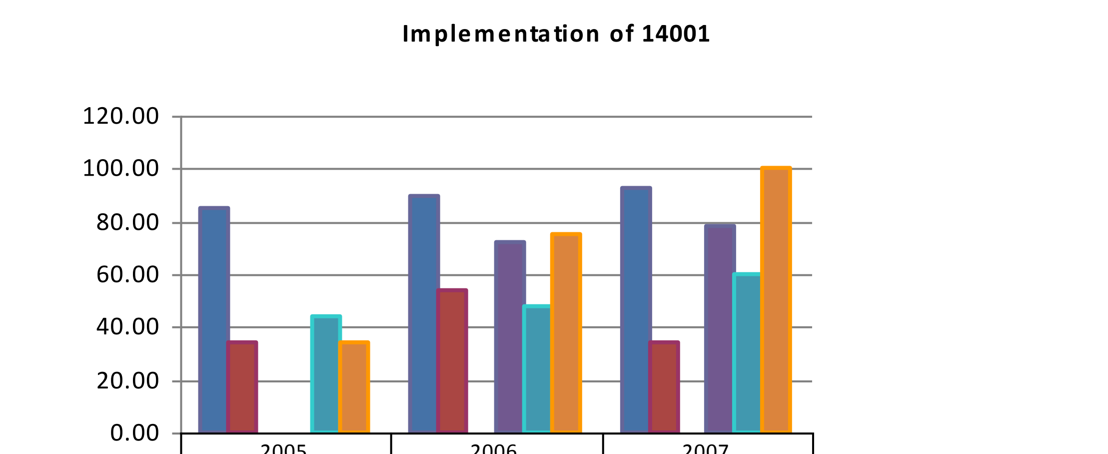


	2005	2006	2007
HOLCIM	24.00	16.00	8.00
LAFARGE	0.00	0.00	0.00
CEMEX	0.00	0.00	0.00
ITALCEMENTI	0.00	0.00	0.00
CRH, Irland	0.00	0.00	0.00
SECIL	0.00	0.00	0.00

Figure 4-10: The annual number of environmental non-compliance cases per company. (Only one company has revealed this information), Source: Author (2010)

From the CSR/ Sustainability report of various companies it is documented that some companies in pharmaceuticals, metals and chemicals are not complying with the regulatory requirements but report their performance, voluntarily. This practice is not prevalent among the cement manufacturing companies. From Fig. 4-10, it was found that only HOLCIM has reported in this regard.

4.3.11 Percentage of the cement plants of six international cement companies certified to ISO: 14001 during 2005 – 2007.

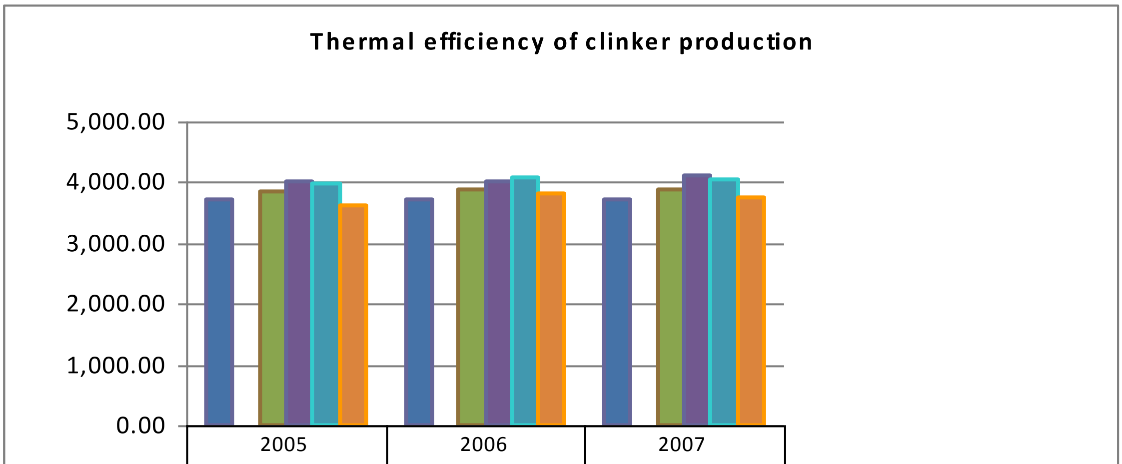


	2005	2006	2007
HOLCIM	85.00	90.00	93.00
LAFARGE	34.00	54.00	34.00
CEMEX	0.00	0.00	0.00
ITALCEMENTI	0.00	72.00	78.00
CRH, Irland	44.00	48.00	60.00
SECIL	34.00	75.00	100.00

Figure 4-11: Implementation of ISO: 14001, data collected from six international cement producers, Source: Author (2010)

Certification to ISO: 14001 are an indicator of successful implementation of Environmental Management System in the manufacturing facility. Certification implies that the facility is in compliance with the requirements of the standard specifications and with all the relevant environmental standards. In this case, multiple locations of manufacturing units of a particular group make the task more difficult. SECIL is certified for ISO: 14001 for all its cement-manufacturing units in Portugal as they have reported for plants located in Portugal only. However, HOLCIM has also worked to obtain this certification for 93% of its cement manufacturing plants, located worldwide in diverse countries. Oman Cement Company was certified to ISO: 14001 in 2001. It was the first cement company in the Gulf Cooperation Council Countries to obtain this distinction.

4.3.12 Thermal efficiency of clinker production, MJ/Kg clinker

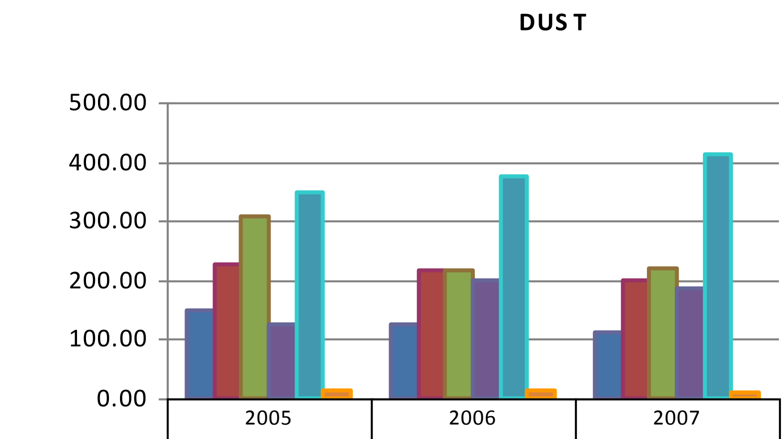


	2005	2006	2007
HOLCIM	3,710.00	3,704.00	3,703.00
LAFARGE	0.00	0.00	0.00
CEMEX	3,864.00	3,882.00	3,868.00
ITALCEMENTI	4,011.00	4,016.00	4,110.00
CRH, Irland	3,992.00	4,071.00	4,033.00
SECIL	3,627.50	3,811.60	3,749.00

Figure 4-12: Thermal efficiency of clinker production, data collected from six international cement producers, Source: Author (2010)

Fig. 4-12 provides data on the thermal energy efficiency of the manufacturing companies. SECIL used the lowest among of thermal energy in 2005 but their fuel consumption increased in 2006 and 2007. HOLCIM achieved improvements on a consistent manner and had the lowest thermal energy consumption in 2007, 3,703 MJ/Kg. These data indicate that 3,703 MJ were consumed to produce one kilogram of cement-clinker. Lower consumption of fossil fuels also lowers the specific CO_2 emissions. This is clarified by the data presented in Fig. 4-5.

4.3.13 Emissions of Dust (SPM), gram/tonne cement



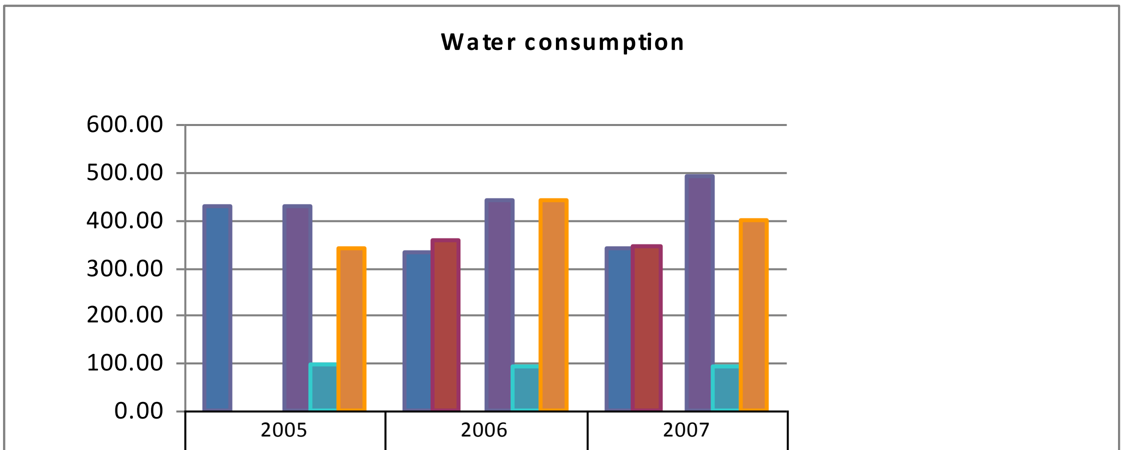
	2005	2006	2007
HOLCIM	150.00	125.00	110.00
LAFARGE	227.00	217.00	199.00
CEMEX	307.00	215.00	219.00
ITALCEMENTI	126.00	199.00	187.00
CRH, Irland	349.00	375.00	412.00
SECIL	13.80	15.03	9.87

Figure 4-13: Emissions of Dust (SPM), data collected from six international cement producers, Source: Author (2010)

It may be observed from Fig. 4-13, that data reported by SECIL are exceptionally low. Hence, clarification was sought from the company and they clarified that the dust emission was 42.33gm/tonne cement in 2007. The dust emissions data of HOLCIM for 2007 were 110 gm/tonne, which is the second lowest and CRH"s emissions of 412 gm/tonne were the highest.

SECIL installed high performance bag filters in all kilns and mills. Additionally, it has almost 200 bag filters installed in crushers, belt conveyors transfer points, silos and all hoppers. Emission of dust causes respiratory complications. Hence, most of the countries have a limit on the emissions level of dust. The Sultanate of Oman's environmental regulations permits a maximum of 100mg/Nm^3 discharge from stacks. In the EU, most of the member companies have a limit of dust emissions below 25 mg/Nm^3. Stack emissions are not the only sources of dust emissions, however, capturing or preventing the dust loses helps the cement companies in reducing their material's losses from the process thereby improving their efficiency and profitability while they reduce their worker's health and safety risks.

4.3.14 Water consumption per tonne cement produced:

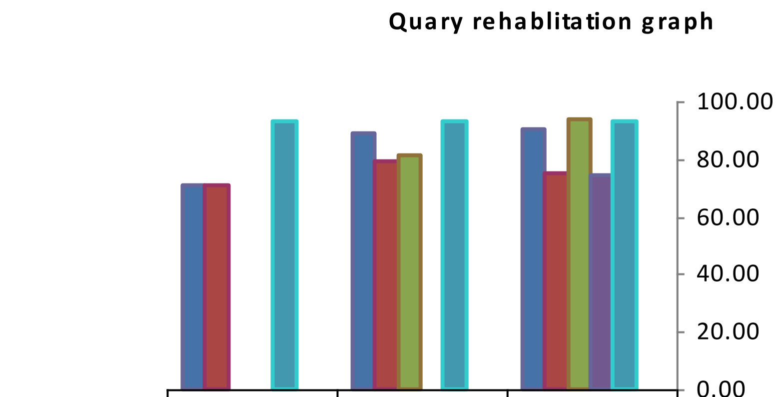


	2005	2006	2007
HOLCIM	430.00	330.00	340.00
LAFARGE		355.00	343.00
CEMEX	0.00	0.00	0.00
ITALCEMENTI	429.00	439.00	489.00
CRH, Irland	95.00	94.00	94.00
SECIL	339.00	440.00	399.00

Figure 4-14: Water consumption data collected from six international cement producers for the period 2005 – 2007, Source: Author (2010)

Fig. 4-14 shows that most companies maintain records of their consumption of water. Ideally, in a dry process cement plant using bag filters for collection of dust particles, water is only used for cooling of machines and domestic uses. Loss of water also occurs due to evaporation. Water is a scarce natural resource and is essential for life. The lowest consumption of water was reported by CRH and highest by ITALCEMENTI. The difference is more than four times the minimum consumption. Possibly, this difference is due to the fact that CRH has only dry process cement producing plants, where consumption is lower than the for the wet process.

4.3.15 Quarry rehabilitation (%)



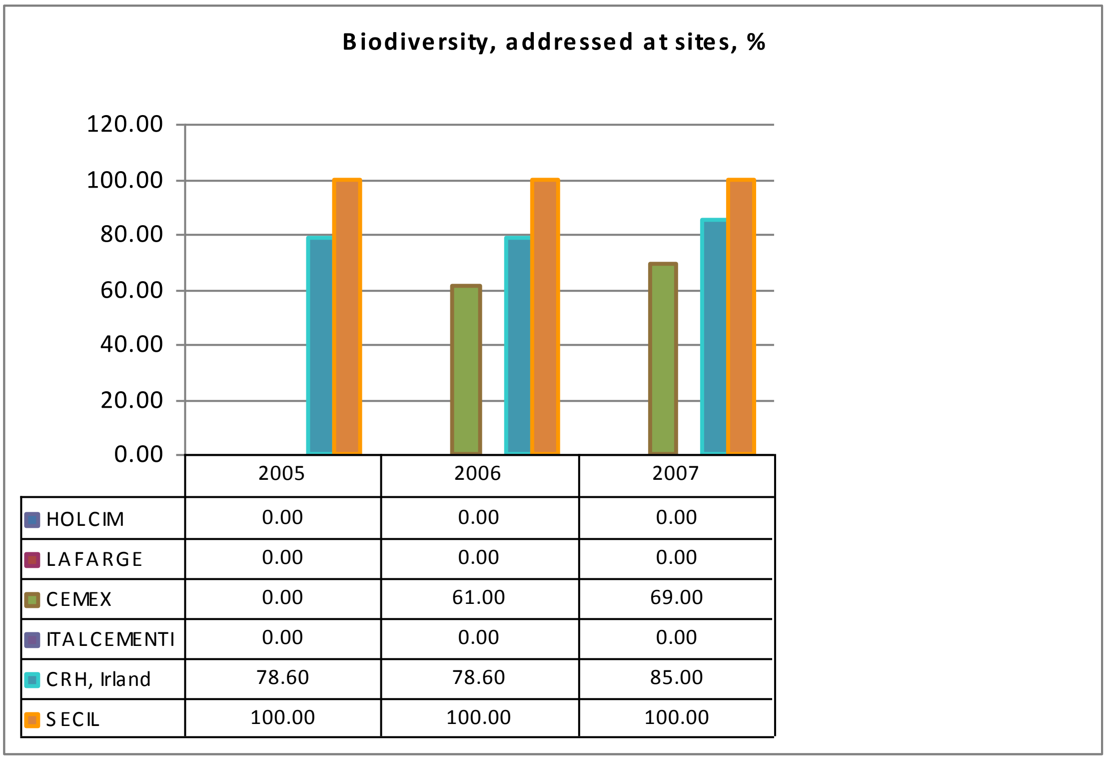
	2005	2006	2007
HOLCIM	71.00	89.00	90.00
LAFARGE	71.00	79.00	75.00
CEMEX	0.00	81.00	94.00
ITALCEMENTI	0.00	0.00	74.00
CRH, Irland	92.90	92.90	92.90
SECIL			

Figure 4-15: Quarry rehabilitation data collected from six international cement producers during 2005 – 2007, Source: Author (2010)

Quarry rehabilitation is an important aspect of reducing environmental impact in a mineral-based industry, such as the cement-manufacturing sector. Fig. 4-15 shows that SECIL has not reported in terms of percentage but stated in its Sustainability Report of 2007, that it was engaged in an integrated work for the landscape restoration of the areas already quarried. This restoration work was initiated in the quarries of the Outao plant in 1982. It is evident that all cement companies reviewed for this thesis research were fully aware of their responsibilities for rehabilitating the quarried sites.

Many countries have imposed quarry rehabilitation as a condition for the permit to quarry materials. In those countries, maintaining a license to operate requires strict control on quarry rehabilitation. CEMEX reported quarry rehabilitation at 94 % of their quarry sites, which is the highest percentage of any of the companies in this study. The ITALCEMENTI Company with 74% of quarry sites restored by 2007 is the lowest.

4.3.16 Biodiversity, addressed at plant sites (%)

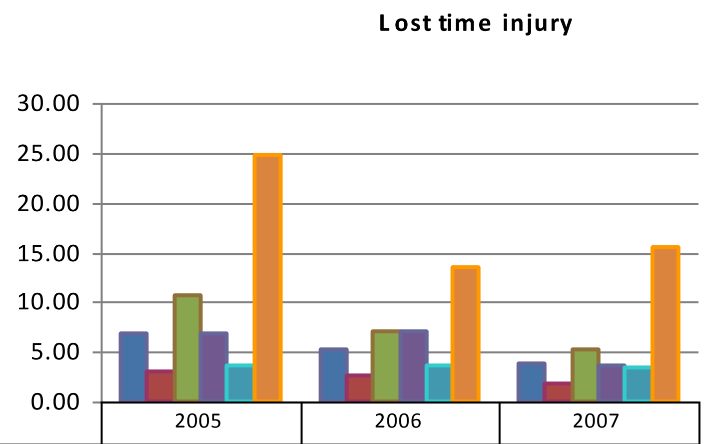


	2005	2006	2007
HOLCIM	0.00	0.00	0.00
LAFARGE	0.00	0.00	0.00
CEMEX	0.00	61.00	69.00
ITALCEMENTI	0.00	0.00	0.00
CRH, Irland	78.60	78.60	85.00
SECIL	100.00	100.00	100.00

Figure 4-16: The percentage of sites of six international cement producing companies that were reported to have addressed biodiversity issues during the period 2005 – 2007, Source: Author (2010)

The success of a restored ecosystem is dependent on maintaining the biodiversity of the surrounding areas. From Fig. 4-16, it may be noted that many companies have not reported on their biodiversity restoration efforts. But all the companies have initiated work on this important performance indicator and some of them have reported remarkable improvements. SECIL tops the list with addressing the biodiversity at all three manufacturing sites in Portugal. For large companies like HOLCIM, LAFARGE and ITALCEMENTI, it is a real challenge to measure and report on this aspect due to their presence in multiple countries. Lafarge is committed to make progress on biodiversity and has entered into a partnership deal with WWF. From this partnership, they expect that their business units can identify risks and opportunities; communicate with stakeholders, employees and other partners interested in biological diversity conservation; and participate in research, awareness and education programs. OCC can definitely learn from the experiences these companies in establishing initiatives to make progress on biodiversity.

4.3.17 The lost time incidents frequency rate of six international cement companies during the period 2005 - 2007



	2005	2006	2007
HOLCIM	6.90	5.20	3.90
LAFARGE	3.00	2.70	1.80
CEMEX	10.60	7.00	5.20
ITALCEMENTI	6.80	7.00	3.60
CRH, Irland	3.64	3.64	3.36
SECIL	24.80	13.50	15.60

Figure 4-17: The lost time incident frequency data of six international cement producing companies during the period 2005 – 2007, Source: Author (2010)

Lost time incidents frequency (LTIF) is an indicator of company performance on their safety management and accident prevention program. The higher the LTIF the more serious the matter is for the cement-manufacturing company. SECIL has the highest LTIF whereas LAFARGE has the lowest according to these data. Lafarge has implemented a group-wide safety policy and makes no compromise regarding safety. They fully integrated safety into human resources management during 2006. The group has a “Zero Accident” policy and has mobilised all the three levels of employees. They require the personal involvement of senior management in safety matters, and engage supervisory staff and strengthen interpersonal relationships so that each employee is aware of high-risk behaviour of his /her colleagues. Their efforts have resulted in marked reductions of their LTIF from 3.0 in 2005 to 1.8 in 2007. Lafarge has successfully implemented “Contractor H&S Management System” to monitor and control the performance of its suppliers and contractors. This provides an excellent learning opportunity for OCC and other cement companies on a way to improve their performance.

Summary

In this Chapter, data from six international cement manufacturing companies were compared for their absolute and specific CO_2 emissions, clinker factor, emissions of NOx and SOx, use of alternative fuels for replacing traditional fossil fuels, water consumption in cement production, quarry rehabilitation, ISO 14001 certification for manufacturing plants, general waste management, reporting of environmental non-compliance cases, addressing of biodiversity at plant sites, and thermal energy consumption in cement manufacturing.

The data analyses clearly highlighted the best performance achieved by the different companies on certain performance indicators. These data are being used for benchmarking OCC, the case study company. The author has tried to cover 100% of the performance indicators for environmental and social aspects but the data available for the analyses only covered about 80% of the requirements for TBL reporting according to the GRI G3 guidelines.

5 Chapter 5 - Answers to the Research Questions

This thesis researcher examined the evolving status of TBL/CSR implementation in some worldwide cement manufacturing companies with a focus on their similarities, differences vis-à-vis CSI guidelines as well as their progress and their future goals and needs.

Answers to the thesis research questions are provided in the following paragraphs.

5.1 *A Long Journey on TBL/CSR*

This thesis author conducted a detailed literature review with a focus on the environmental and social problems associated within the cement-manufacturing sector. The literature review provided a foundation for the thesis author pertaining to the past and current practices followed by manufacturing companies, in general, and more specifically those followed by the cement-manufacturing sector. Various guidelines given by the GRI, the UNGC, Environmental management systems and the voluntary standard ISO: 26000 on performance monitoring based upon relevant indicators and on reporting, enhanced the author's understanding of the relevance of the data collected from the worldwide cement manufacturing companies. Analyses and evaluations of the collected data served as inputs to answer the research questions of this thesis.

The first research question for this thesis was "How are the TBL/CSR concepts implemented in the cement manufacturing organisations throughout the world?"

By visiting the websites and accessing the annual and sustainability reports of the cement manufacturing companies data related to the economic, environmental, and social indicators were collected. Although, the CSI published their progress report on achievements of the sustainability initiative, which was based upon participation of 18 cement companies, it failed to address the shortcomings in the data collection of participating cement companies. This thesis author's critical examination of the sustainability reports published by the individual companies revealed that the method of data collection and the results of the key values were reported in different units, which made it difficult or impossible, to make meaningful comparisons of performance of different companies on some performance indicators for some companies.

For example, emissions data were reported by some companies in mg/Nm^3 and other in parts per million (ppm). Throughout the world, including the Sultanate of Oman, the environmental regulations require that emissions be reported in mg/Nm^3. Additionally, many companies did not report on some key indicators so it was impossible to compare their progress towards achieving their sustainability goals, at least on those indicators

The methodology utilised in this research was considered to be a sound way for a self-funded researcher to access the data, due to the worldwide distribution of cement companies that were studied. Even the CSI partnership covered only about 50% of the world's cement producers. Almost half of the world's cement production takes place in China, but it was not covered by the CSI. This thesis writer collected and analysed data from responsible cement producing companies of China, Pakistan and India also. (Appendix7).

Contextually, it is appropriate to note that most of the international major cement producers have defined their TBL/CSR policies and have embarked on the journey of integrating their environmental, economic and social commitments. The collected data helped the researcher to better understand how the studied companies are implementing their TBL/CSR program. It also helped him to ascertain the current status of their programmes, and provided some details pertaining to their monitoring and reporting of economic, environmental and social dimension of their business. More interestingly, he obtained longitudinal insights into the company's trends and progress towards making improvements.

By collecting data and analysing them, as presented in Chapter 3, it is evident that there is a wide variation in the level of ISO14001 certification among the cement manufacturing companies studied. The data also revealed that wide variations exist among companies with regard to relative energy consumption, water consumption, water recycling, uses of alternative raw materials and alternative fuels, frequency of lost time accidents and severity rates of such accidents. Table 5-1, presents summary of the performance ranges as well as the best practices in the worldwide cement industry.

Parameters	Minimum	Maximum	Average	Best performing company	Best result
Specific gross CO_2 Kg/tonne of cement	660.0	885.0	772.5	HOLCIM	660.0
Specific net CO_2 Kg/tonne of cement	648.0	744.0	696.0	LAFARGE	648.0
Clinker factor	72.6	85.23	78.9	HOLCIM	72.6
ISO 14001 certification %	0.0	93.0	46.5	HOLCIM	93.0
Dust Emissions, gram/tonne	42.33	412.0	261.0	SECIL	42.33
NOx emissions, Gm/tonne of cement	1190.0	2455.0	1822.5	HOLCIM	1190.0
SOx emissions, gm/tonne of cement	144.0	1043.0	593.5	CRH	144.0
Thermal substitution (Fossil fuel substitution by alternative fuel), %	4.2	13.7	8.95	SECIL	13.7
Thermal efficiency of clinker Production (Specific heat Consumption), MJ/Kg clinker	3627.5	4110.0	3868.75	SECIL	3627.5
General Waste Management, % of sites.	0.0	100.0	50.0	SECIL	100.0

Parameters	**Minimum**	**Maximum**	**Average**	**Best performing company**	**Best result**
Water Consumption, Litre/tonne of cement	94.0	489.0	291.5	CRH	94.0
Quarry rehabilitation, %	0.0	94.0	47.0	CEMEX	94.0
Biodiversity addressed, %	0.0	100.0	50.0	SECIL	100.0
Environmental Non-compliances, Nos.	8.0	24.0	16.0	HOLCIM	8.0
LTI	1.8	24.8	13.3	Lafarge	1.8

Table 5-1: Summary of data collected from six leading international cement companies on their performance and the best results for benchmarking, Source: Author (2010)

From Table 5-1, it can be observed that some companies are much better than others, out of 15 performance-indicators, HOLCIM outperformed on five indicators. Similarly, LAFARGE's performance in achieving the lowest specific net CO_2 emissions in the cement-manufacturing sector indicated that the company has made good progress in reducing its net CO_2 emissions. This is due to the fact that the company is using increasing quantities of alternative fuels, thereby, making it possible for them to lower its corporate net CO_2 emissions, although, its specific gross CO_2 emissions are higher than those of HOLCIM. This thesis author for benchmarking the targets of the case study company used the average and the best performance data.

However, it is important to note that regulatory requirements in the EU and Japan are forcing the cement manufacturing companies to control and reduce their emissions of CO_2 and other pollutants. Presently in the Sultanate of Oman there are no restrictions on CO_2 emissions, NOx emissions, quarry rehabilitation, addressing biodiversity and substitution of fossil fuels by alternative fuels.

Emissions levels of dust, SO_x and NO_x also vary greatly among the worldwide cement producing companies but a good trend is that most of the companies are trying to improve on their environmental performance and are investing human and financial resources to reap the benefits of reducing their environmental pollution. As a result they are reducing there per ton consumption of energy, water, labour and raw materials. Technological improvements in the manufacturing processes are helping to reduce dust, SOx and NOx.

This thesis researcher found that the cement companies have identified a key factor for reducing the clinker to cement ratio by maximising the use of pozzolanic materials and blast furnace slag to produce blended cement products. Some cement companies are recycling municipal sewage sludge to produce eco-cement. One among them is Taiheiyo cement. OCC used Blast Furnace Slag and Pozzolana in 2000 and 2009 respectively to produce Portland Blast Furnace Slag Cement (PBFC) and Portland Pozzolana Cement (PPC), but due to very poor demand for these products within the Sultanate of Oman, the company discontinued production of these two types of cement. These approaches reduce fossil fuel based CO_2 emissions/tonne of cement produced. They also reduce the utilisation of clinker/tonne of cement.

Based upon detailed analysis of 12 cement companies and on the in-depth analyses of six worldwide cement companies, the status of reporting for United Nations Global Compact (UNGC) principles covering economic, environmental and social dimensions are presented in Table No. 5-2.

Summary of Cement manufacturing company’s actions relative to the ten principles of the United Nations Global Compact;

Global Compact Principles	Cement Companies Actions
Human Rights	
Principle 1: Business should support and respect the protection of internationally proclaimed human rights.	• All cement companies studied, worldwide have code of Employee and Business Conduct (training/ e-learning, reporting mechanisms, disciplinary actions, and audit functions.)
Principle 2: Make sure that they are not complicit in human rights abuses.	• 9 cement companies out of 12 support the Universal Declaration of Human Rights. In most cases it also applies to their employees, contractors and suppliers. • 8 cement companies out of 12 undertake extensive stakeholder engagement at their operations and with new projects.
Labour Standards	
Principle 3: Business should uphold the freedom of association and the effective recognition of the right to collective bargaining.	• All cement companies' Code of Conduct requires that they respect these rights.
Principle 4: The elimination of all forms of forced and	• All cement companies have unequivocal opposition to such practises.

Global Compact Principles	Cement Companies Actions
compulsory labour.	
Principle 5: The effective abolition of child labour.	• All cement companies have unequivocal opposition to such practises.
Principle 6: The elimination of discrimination in respect of employment and occupation.	• All cement companies have a prohibition against such discrimination. • Anonymous and voluntary HIV testing and antiretroviral therapies are provided for employees. • There is prohibition of discrimination against HIV/ AIDS- infected employees in the workplace.
Environment	
Principle 7: Business should support a precautionary approach to environmental challenges.	• Almost all have EHS Policies • LTI and accident reporting is not standardised. • Requirement for Environmental management is clearly understood and most of them are working towards ISO 14001 certification. • Cement companies use the precautionary approach to climate change and PAH emissions reduction.

Global Compact Principles	Cement Companies Actions
	• Strong initiatives for conservation of water are present in many companies.
Principle 8: Undertake initiatives to promote greater environmental responsibility.	• Specific directives on greenhouse gases, resource management, soil and ground water management, environmental releases management, waste management and spills containment measures are in place but reporting on the monitored results are not clear, consistent or transparent. • Stakeholder engagement and joint environmental projects are in progress. • Research on environmental issues is supported. • Biodiversity issues are still at a nascent stage.
Principle 9: Encourage the development and diffusion of environmentally friendly technologies.	• Some cement companies have developed very environmentally friendly products but more should/can be done. • Location of a cement plant plays a very important role with regard to the policies and products that are developed to fulfil the local regulations. There are marked differences in the regulatory standards and laws in developing market- countries and matured markets- countries.

Global Compact Principles	Cement Companies Actions
	• Only a few initiatives were documented on recycling of concrete. Such recycling can dramatically help in conserving natural resources for aggregates.
Anti-corruption	
Principle 10: Business should work against all forms of corruption, including extortion and bribery.	• Although most of the companies have a clear understanding of these problems, only one company reported on this issue. • None of the cement manufacturing companies is signatory to/or a working partner in the World Economic Forum's Partnering Against Corruption Initiative (PACII).

Table 5-2: Summary of actions documented according to the CSR/Sustainability report of the cement companies relative to the ten principles of United Nations Global Compact, Source: Author (2010)

The literature review prepared by this thesis author clearly documented that the ethical business units need to break the threshold of fulfilling the legal requirements and leap into the world of concern and care for life on this planet by becoming truly responsible corporate citizens. The UN Global Compact Principals show the way to proceed on the path of responsible corporate citizen. Principles 1 to 6 provide guidance on protecting Human Rights (social issues), principals 7 to 9 on protection of environment and principle 10 directs the companies to discourage any activity, which encourages corruption. Table 5.2 highlights the work done by the cement industry worldwide on each of the principles. UNGC principles, in general, focus on social and environmental leadership. The GRI guidelines help companies to monitor and to report on the key performance indicators against each of the activities as they proceed on their individual corporate TBL/CSR journey.

After carefully analysing the CSR/Sustainability reports of various cement companies throughout the world, this thesis writer prepared a summary of their reporting status. The GRI G3 reporting guidelines have lower to higher, level applications for reporting. G3 denotes the third version of the sustainability reporting guidelines. Reporting application level starts from C and goes up to level A+ with increasing disclosures on profile, approach and performance indicators in the following order:

$C > C^{+} > B > B^{+} > A > A^{+}$

To locate the elements and information contained in the GRI guidelines, including disclosures on management approach to economic, environmental and social aspects reference can be made to section 5.8.2 in this thesis or refer to the GRI website: www.globalreporting.org/OS.

In the data collection, for the period of 2006 to 2008, this thesis author found that there were cement companies that reported on the C+ application level to the A+ level. It was observed that the companies starting on their TBL/CSR journey begin with reporting application level C and gradually they progress towards higher levels of reporting to A+ during four to five years. Due to this fact there are many differences in the level of disclosure of performance indicators.

The status on reporting with regard to various indices of the GRI by the cement companies is presented in Table 5-3:

GRI Indicator	Description	Status	GRI Indicator	Description	Status
EC1	Net sales	F	LA1	Breakdown of workplace (by country and type)	P
EC2	Geographic breakdown Of markets	P	LA2	Net employment creation and average turnover	N
EC3	Costs of all goods, materials, and services	N	LA3	Percentage if unionized employees	N
EC4	Percentage of contracts that were paid	N	LA4	Consultations/ negotiation re. Restructuring	P
EC5	Total payroll and benefits	P	LA5	Occupational accidents and diseases	P
EC6	Distributions to providers of capital	P	LA6	Description of health and safety committees	P
EC7	Increase/ decrease on retained earnings	F	LA7	Injuries, lost days, absenteeism & fatalities	F
EC8	Total sum of taxes of all types paid (by country)	P	LA8	HIV/ AIDS policies or programs	P
EC9	Subsides received (by country)	N	LA9	Average hours of training per year per employee	N
EC10	Donation to community, civil society, etc.	P	LA10	Equal opportunity policies or programs	P
-	-	-	LA11	Composition of senior management/ board	P
EN1	Total materials used other than water, by type	P	-	-	-
EN2	Percentage of materials used that are waste	N	HR1	Human rights policies, guidelines, structure	P

GRI Indicator	Description	Status	GRI Indicator	Description	Status
EN3	Direct energy (by primary source)	P	HR2	Consideration of human rights impacts	P
EN4	Indirect energy use from purchases	P	HR3	Human rights performance (suppliers)	P
EN5	Total water use	F	HR4	Anti-discrimination policy/ procedures/ programs	P
EN6	Lands located in biodiversity-rich habitats	N	HR5	Freedom of association policy and application	P
EN7	Description of major impacts on biodiversity	P	HR6	Policy excluding child labour	P
EN8	Greenhouse gas emissions	F	HR7	Policy to prevent forced and compulsory labour	P
EN9	Use/ emissions of ozone- depleting substances	P	-	-	-
EN10	NOx, SOx, and other significant air emissions	P	SO1	Policies to manage impact on communities	P
EN11	Total amount of waste by type and destination	P	SO2	Policy/ procedures addressing bribery and corruption	P
EN12	Significant discharges to water by type	N	SO3	Policy/ procedures- political lobbying/ contributions	F
EN13	Significant spills of chemical, oils and fuels	N	-	-	-
EN14	Significant environmental impacts	F	PR1	Policy for preserving customer health and safety	P
EN15	Reclaimable portion of products sold	P	PR2	Policy/ procedures- product info, and labelling	N

GRI Indicator	Description	Status	GRI Indicator	Description	Status
EN16	Environmental non-compliance	N	PR3	Policy/ procedures – consumer privacy	N

Table 5-3: Disclosure reporting status of cement companies in general on the GRI Index, Source: Author (2010)
(**Legend**: F= Full disclosure; P= Partial Disclosure; N= Not Reported)

It is significant that for seven indices there was full disclosure, for thirty indices there was partial disclosure and on twelve indices none of the companies reported. Hence considerable additional effort in GRI reporting is needed among the cement producing companies.

In conclusion, this thesis author found that the GRI guidelines, the principles of the UNGC and the new ISO 26000:2010 standard serve as significant reference frameworks for identification of performance indicators and for developing a reporting mechanism for the cement manufacturing companies. Data compiled from 12 international leading cement companies demonstrated the value of monitoring and reporting upon their performance and progress on their individual corporate TBL/CSR journey.

The longitudinal study of six leading cement companies documented the best performance results on each performance indicator. Subsequently, this thesis author developed and presented minimum, maximum and average values for each indicator in Table 5-1. He also identified the best performing company on the various performance indicators. Table 5-2 summarises the actions taken by the cement manufacturing companies on the ten principals of the UNGC. The results revealed that most of the leading cement companies are concerned with and are engaged in seeking to perform according to these principles as they proceed on their TBL/CSR journey. However, compilation of disclosures on the reporting status of cement companies as shown in Table 5-3 clearly showed that full disclosure was available on only seven indices, partial disclosure was present for thirty indices and there was no disclosure on thirteen indices. These deficiencies can be understood as many of the cement manufacturing companies have just begun their journey on TBL/CSR within the last seven years. Most of them are making progress that was documented from the longitudinal study. Some indices were not reported on in 2005 and 2006 but were reported on in 2007. This journey has to continue for the benefit of the cement manufacturers, for society for the eco-system upon which we are all interdependent.

The second research question was "What were the drivers for the companies to make improvements?

Consolidation in the industry by acquisition and mergers has worked as a driver. Big names in the industry like HOLCIM, LAFARGE, CEMEX, ITALCEMENTI, CRH and HEIDELBERG are consolidating their position in emerging markets and the need for transparency and increasing energy prices are also working as drivers for implementation of TBL/CSR in the cement industry. Analyses of the data from the TBL/sustainability reports and from the feedback received from the cement manufacturing companies, on the questionnaire sent to them (See Appendix 4), directly revealed that the main drivers were legal considerations, ethical issues, stake holder's concerns, and concerns to maintain the corporate 'license-to –operate'. Information from the literature review very clearly identified the drivers, which were confirmed by this study. The list of drivers of TBL/CSR along with respondent's response in percentage is tabulated in Table 5-4:

Drivers of TBL/CSR identified by the literature review	**Did the empirical study support the literature review findings?**
Stakeholders Demand	100% Yes
Customer Needs	89% Yes
Emerging Economies	67% Yes
Environmental Concerns	100% Yes

Drivers of TBL/CSR identified by the literature review	Did the empirical study support the literature review findings?
Regulatory Policies	89% Yes
Innovation	67% Yes
Transparency	100% Yes
Energy Prices	89% Yes
Global Consolidation	67% Yes

Table 5-4: List of drivers for TBL/CSR in the worldwide cement manufacturing companies, Source: Author (2010)

Almost all the questionnaire respondents agreed with the list of drivers for TBL accountability, found during the literature review. Another driver for the TBL/CSR accountability was climate change and 100% of respondents agreed to it. Feedback received from the cement companies is compiled and presented in Appendix 6.

Like two faces of a coin, drivers are always associated with barriers. Implementation of TBL/CSR in the cement-manufacturing sector has encountered many barriers.

The third research question was: "What were the barriers to make the changes and how were the barriers being overcome by the cement manufacturing companies?"

The barriers to the changes were mainly company inertia, market pressures on the cost of the energy and other raw materials and of their products. There was also the realisation that the cement industry is a mature market that demands a certain type of cement product. Consequently, there are few opportunities for making improvements. But that myth is breaking down and some improvements are being made as seen in the results of the vertical and longitudinal analyses of companies reporting on various indicators, some of them reported for the first time in 2007. OCC has not yet reported on its progress on its TBL/CSR indicators. But OCC intends to make its first TBL/CSR report in 2012.

Based on the feedback to the questionnaire sent to the international cement companies (See Appendix-6) the barriers are summarised in Table No. 5-5:

Barriers of TBL/CSR Implementation identified by the literature review.	**Did the empirical study support the findings?**
Cement is a matured product and customers resist change in quality parameters.	**89% responded Yes**
Manufacturing Companies have inertia to change	**67 % responded Yes**
Stiff competition leads to market pressure	**78% responded Yes**
As cement is a commodity product, in most places, the government regulates prices and the product is traded in a narrow price band.	**78% responded Yes**
Conventional costing practice	Yes

Table 5-5: **Barriers of TBL/CSR implementation in the cement-manufacturing sector, Source: Author (2010)**

The majority of the questionnaire respondents agreed with the barriers found during the literature review. Three respondents mentioned conventional costing practices as barriers to their usages of TBL/CSR accountability.

Information received from the responses to the questionnaire, highlights some of the following **other barriers** during implementation of the TBL/CSR approach:

a. Governmental authorisation or permits for the use of alternative fuels and alternative raw materials require very long processing times and are very cumbersome processes;

b. Transparency in sharing crucial information with the community is difficult due to the fact that the information is politicised and is used by vested interests for different purposes and groups in the society;

c. Harnessing alternative energy is more expensive than conventional energy so it is difficult to justify its use;

d. Lack of skills within the company to implement TBL/CSR.

Based upon the data collected from the cement manufacturing companies, it was found that some of them did not report on:

- The status of their ISO 14001 certification;
- Their compliance with governmental regulations;
- Their screening of suppliers;
- Their environmental investments;
- Their environmental non-compliance cases;
- The thermal efficiency of their clinker production;
- The clinker factor;
- The substitution of alternative fuels for fossil fuels.

The fact that some companies reported on these aspects indicates that they have overcome the barriers via their way by persuasion, training, taking innovative approaches of data collection and also by improving their organisational culture.

The fourth research question was: "Did implementation of TBL/CSR help the cement companies to become more socially responsible?"

The reporting of environmental and social indices by the cement companies clearly revealed that they are becoming more socially responsible as their engagement and transparency are increasing their compliance to human rights and social justice is improving. Feedback information on the questionnaire sent to the international cement manufacturing companies and the published information regarding confidence of the stakeholders in the companies also revealed that the companies are becoming more socially responsible after adopting the TBL/CSR concepts and approaches. Seven of the nine feedback responses to the questionnaire, clearly substantiated that their organisation has become more socially responsible and more profitable after implementation of the TBL/CSR program in their company. However, two respondents expressed some apprehension but stated that generally, good TBL/CSR implementation leads to improved operational excellence, which in turn enhances business performance and profitability.

The fifth research question was: "How can this author's company build upon these lessons as it progresses on its TBL/CSR journey?"

This thesis author's company, OCC has just begun on its TBL/ CSR journey. This thesis author started a campaign in August 2006 to discuss with the company's site management team, in order to seek to convince them about the potential advantages of TBL and of preparing CSR reports based on the data he had gathered from responsible international cement companies. This thesis author works in OCC as the Senior Manager. He is responsible for quality, environment and safety, in this joint stock company, which commands great respect from stakeholders and government regulators. The company's shares are traded on the Muscat Stock Exchange and the company is certified for ISO 9001: 2008, ISO 14001:2004 and API Quality monogram. Since the company was certified for its Environmental Management System and most of its environmental indicators were being monitored on a regular basis, it was not difficult to obtain the management's commitment for proceeding on its TBL/CSR journey.

A corporate policy was developed for safety, health and environment as a first step to begin to progress on its TBL/CSR journey. This policy was discussed with the departmental managers, sectional heads, first line supervisors and workers. By keeping the top management commitment in mind all employees were invited to support the company in its endeavours to become more environmentally and socially responsible.

Environmental impact assessment was carried out by OCC with the help of a third party. Baseline information on environmental indicators was collected, as recommended by the GRI and UNGC. A roadmap for OCC was recommended, to proceed on TBL/CSR journey, which may be useful for other cement companies and mineral based industries to progress on their TBL/CSR journey. A specific action plan for this thesis author's company was proposed. It is presented in the following section.

5.2 *Roadmap for Implementing TBL/CSR in the Oman Cement Company (SAOG)*

(In general this road map is being used as a guide for the senior decision-makers to help the company to make progress on its corporate TBL/CSR journey).

Having gone through the TBL/CSR sustainability reports of various leading cement companies and manufacturing companies in the pharmaceuticals and chemical sectors, the author of this thesis developed and used the roadmap to help OCC to align its policies, procedures, monitoring and reporting efforts with the GRI G3 guidelines, presented in Fig. 5-1:

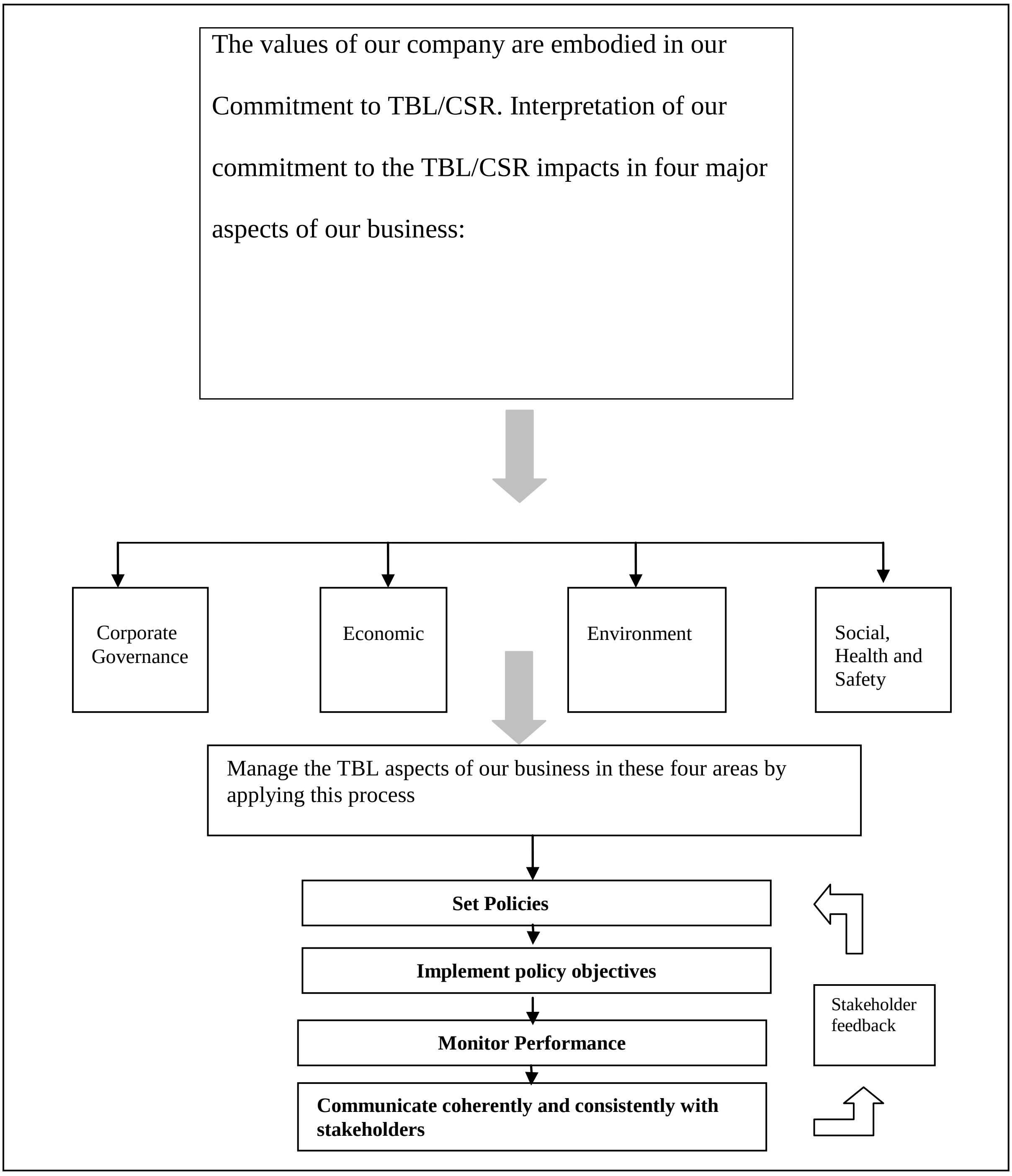


Figure 5-1: A Roadmap for proceeding on the TBL/CSR Journey at Oman Cement Company (SAOG), Source: Author (2010)

Boxes shown in Figure 5-1 include specific KPIs, which need to be addressed in-depth. In Chapter 5 the KPIs for each of the economic, environmental and social aspects that are required to be addressed and integrated, are clearly identified and defined. For identifying the expenditure and savings due to certain proactive procedures, it is essential to classify costs and to tabulate them under proper headings. As presented earlier in this thesis, looking specifically at environmental aspects, the classification of costs in the environmental management literature is not well developed; however, fortunately, the IFAC International Guidance Document on environmental management accounting has resolved this ambiguity to a great extent. For OCC, it is recommended that they follow the classification of environmental costs that are suggested by IFAC. This recommendation is given in Table No. 5-6:

1. Material Costs of Product Outputs Includes the purchase costs of natural resources such as water and other materials that are converted into products, by-products and packaging.
2. Materials Costs of Non-Product Outputs Includes the purchase (and sometimes processing) costs of energy, water, and other materials that become non-product outputs (waste and emissions)
3. Waste and Emission Control Costs Includes costs for handling, treatment, and disposal of waste and emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs.
4. Prevention and Other Environmental Management Costs Includes the costs of preventive environmental management activities such as

	cleaner production projects. It also includes costs for other environmental management activities such as environmental planning and systems, environmental measurement, environmental communication and any other relevant activities.	
5.	Research and Development Costs	
		Includes the cost for research and development projects related to environmental issues.
6.	Less Tangible Costs	
		Includes both internal and external costs related to less tangible issues. Examples include liability, future regulations, productivity, company image, stakeholder relations and externalities.

Table 5-6: Classification of Environmental costs; Source: IFAC (2005)

In summary, it is clear that this activity based accounting focuses on the accumulation of costs for a particular activity and provides a good opportunity to control costs and to reduce overhead expenses, which are otherwise allocated to diverse cost centres. Using accounting for sustainability (A4S) was also suggested by H. Anthony and others in the book, "Accounting for Sustainability: Practical Insights." Anthony and others (2010) stated that A4S is an attempt to encourage interconnectedness of sustainable practices and business decisions. Such integration or interconnectedness facilitates analysis of how environmental and social factors influence the business and how they impact the bottom line in the form of an investment with an ROI or a new business opportunity. By calculating the financial impacts of such TBL/CSR programs, they should not logically be excluded from financial reporting. Interconnectedness or the connected reporting framework (CRF) offers a tool for business to think and act holistically about their strategic material issues, to establish goals and targets and to establish financial evaluation processes of the social and environmental impacts of their business strategies. Anthony et al (2010) stated that many companies viz. British Telecom, HSBC, AVIVA, Novo Nordisk, and Sainsbury have adopted A4S in sustainability and annual reporting.

Targets and Performance for OCC:

Table 5-7 summarises the targets set and the progress made until November 2010 for the case study company to proceed on its TBL/CSR journey:

Area	Target	Year	Progress
Set Policies	Establish EHS Policy and win top management Support to proceed with TBL/CSR integration throughout all corporate activities.	2010	Implemented
Orientation and training to the employees, customers and board members of the company on TBL/CSR	All new employees are trained on the TBL/CSR concepts and approaches. All employees were given orientation and a target of 100% training is set.	2010	Training is progressing well
Establish the environmental and social indicators on which data are to be collected	Initially to proceed with GRI G3 report application level C.	2010	Performance indicators have been identified including at least one from each of economic, social and environmental indicators of GRI.
Monitor and collect the data on	Data on environmental and social indicators to be	2010	Expected to be completed in the last

Area	Target	Year	Progress
performance indicators to define the baseline.	documented.		quarter of 2010.
Emissions Reduction	Reduce dust concentration per tonne of clinker 10% from 2006 levels.	2012	Pollution control equipments such as ESP and bag filters are planned to be replaced. Progress will be reported annually.
	Reduce NOx per tonne of clinker 5% from 2006 levels	2012	
CO_2 and Climate Change	Reduce thermal energy use by 5% per tonne of clinker and electrical energy consumption by 5%.	2012	Progress will be monitored and reported annually.
	Reduce CO_2 emissions per ton of cementitious material by 5%.	2012	
Reduction in water consumption.	Reduce water consumption by 20%.	2012	Replacement of ESPs by bag filters will make the gas-conditioning tower redundant. Gas conditioning tower uses large amounts of water. ESPs

Area	Target	Year	Progress
			replacement of production line I was approved by the company's board of directors and funds are allocated for use during 2010. Currently evaluation process of bids is on.
Use of Alternative Fuels.	The viability of using alternative fuels to partially substitute natural gas is being explored.	2012	Continued
Use of Alternative Raw Materials	The viability of using alternative raw materials is being explored	2012	Continued
Local Impact on Land and Communities	Establish community advisory committee.	2012	Continued
	Develop rehabilitation plan for our quarries	2012	

Table 5-7: Targets for the "Case study" company and actions under implementation for improvement, Source: Author (2010)

Based on Table 5-7, it is quite logical to examine the status of the targets with respect to the base year 2006. It is also important to know reasons for OCC to pursue this program. The status of the various parameters is given in Table 5-8:

Target	Deadline	2006 Performance	Why is OCC pursuing this programme? What will change?
MANAGEMENT			
On employee safety: reduce the lost time injury frequency rate by 50% in comparison to 2006.	2012	8.5	Achieving a company-wide LTI frequency rate of 1.0 (Currently the cement industry's best is 1.8) We will require our contractors to work to the same standard. Our ambition is to have zero fatalities and to join the "best in class" industrial companies. We will improve our safety practices so that nobody is killed on the job.
Ongoing monitoring of the implementation of our competition policy in functional departments.	2012		Free market, open competition always benefits, in the long term, the overall economy and population, and the viability of the companies. Although, we have governmental control on marketing our product outside the country, we are nurturing competition within our functional departments to prepare for

			the ‘free’ market and to become more competitive.
Design a training package on local stakeholder relationship management.	2012	N/A	Local stakeholders have increasing expectations from us on the way we operate our business and on the way they benefit from our presence/employment/products/services. Their expectations are becoming a requirement for us. We are striving to achieve best practices. We want to leverage this capital by embedding it in our organization. We aim to interact with local stakeholders in a timely, orderly, pro-active and transparent way to contribute to their well-being. We believe that this will result in economic and social development of the local communities surrounding our operations.
On customer relationships, by 2011, we will carry out an annual customer satisfaction survey. By	2010	N/A	Having customers satisfied today and tomorrow is absolutely necessary to achieve sustainability. This is an aspect of operations that has received insufficient attention within the

2010, the company will achieve US$ 27.4 million annual sales in new products.			cement industry. We have set ourselves tough targets for customer satisfaction and for product and service innovation. We invite/welcome feedback from our customers about their satisfaction with our products and services. We will also perform annual customer satisfaction surveys covering all aspects of our business transactions with them. Acting on what customers say and driven by a desire to achieve full customer satisfaction, we want to have completed the implementations of the OTIFIC programme (on time, in full and invoiced correctly). We intend to constantly innovate to meet customer's needs. This will help us to maintain viability and will support our sustainable corporate development. It will improve our understanding of our customer base and will create a platform for working with them on sustainability related issues.

SOCIAL			
Double the percentage of female employees between 2010 and 2012.	2012	2%	Currently, females in senior management in OCC are non-existent and therefore, we have set the target of 4.0% female employees.
Report on training; using the GRI (n3) guidelines.	2011	In Progress	Without a high skills base, a company is not sustainable in a competitive market. Our employees are skilled but currently we have no consolidated data on the training being done and so can not manage it properly. Therefore, we will collect and report average hours of training per year per employee as the first step in managing and increasing employee skills.
By 2010, establish a comprehensive occupational health programme including, at the minimum, regular medical examination.	2010	N/A	An effective workforce is a healthy workforce. OCC operates in the Sultanate of Oman where comprehensive health coverage is provided by the state to the citizens and with little public health provision to the majority of expatriates. Therefore, our ambition is to establish a comprehensive

			occupational health programme with regular medical examination by 2010. This will provide the foundation for better health for all our employees and will also benefit the company.
ENVIRONMENT			
Have 100% of our sites audited environmentally within the next four years	On-going	80%	Have 100% of our sites audited environmentally by skilled/ expert teams within the next five years. One of our challenges is disposal of bypass dust. Presently, we are disposing this dust in our exploited quarries. We have quarries located near to our plant site. We intend to rehabilitate our quarry sites based upon findings from the comprehensive environmental audits. Ready-mix concrete companies use a small portion of this dust as a raw material.
By 2010 reach a rate of 80% of quarries with a rehabilitation plan complying with local standards.	2012	40%	OCC puts as much effort into planning for the quarry after it ceases its active life as it does in putting a new quarry into

			operation. This involves engagement with local stakeholders in order to find the best options. In some cases this will mean a new activity in the site and in others a return to nature. Because of the complexity and the diverse roles of the parties in the decision-making process, it is unlikely that we will achieve 100% rehabilitation of our sites in the near future but we intend to strive to do so.
By 2012 we intent to screen all our quarries according to criteria validated by WWF International and those with realisable potential will have developed a site biodiversity program by 2012.	2012	N/A	Biodiversity has been on the OCC agenda for some time. We have been working on the biodiversity of selected quarry sites. Now we need to move forward so that it is being addressed at quarries that have a real potential for biodiversity enhancement.
By 2010:	2010		The increased concentration of CO_2 and other greenhouse

Reduce our net CO_2 emissions per tonne of cement by 5% as compared to 2006. Reduce our absolute gross emission by 10%			gases in the atmosphere is driving climate change. It is the biggest environment challenge of our time. Our overall ambition is to cut our net CO_2 emissions per tonne of cement by 5% by 2010 compared to 2000. By the end of 2007, we had achieved 14.2% reduction due to a large import of cement clinker. Net emissions are the gross emission less the emission that comes from burning waste. In addition, over the same period we had the ambition to cut our absolute gross emissions by 10%. In light of the realisation of the increased challenges from the climate change scenario, we recognise that new targets will be necessary for the period after 2010.
Reduce our dust emission in our cement plants by 10% *over the period 2008- 2012	2012	Varies between 125 mg/m_3 to	Our activities generate dust. Beyond local regulations, our voluntary undertaking is to reduce our dust emissions by 20% by 2012 compared to 2006. This will considerably reduce our

		150mg/m^3	nuisance for our neighbours. Achieving this objective will necessarily involve capital investments. The budget has been allotted for upgrading production line I pollution control equipment.
Reduce our NOx emissions in our cement plant by 5% over the period 2008- 2012	2012		With regard to combustion releases of NOx into the atmosphere, in addition to local regulations, OCC is voluntarily committing itself to a 5% reduction of NOx generated per tonne of clinker over the period 2008- 2012. Operating expenses are planned to mitigate the impact of these emissions.
Reduce our SOx emissions in our cement plants by 5% over the period 2008- 2012	2012		SOx results from the clinker burning process; the sulphur mainly comes from raw materials, like limestone. Consequently the level of SOx emitted by plants can vary considerably. Beyond local regulations, OCC is voluntarily committing itself to an additional 5% reduction of SOx

			generated per tonne of clinker over the period of 2008- 2012. Significant capital investments and operating expenses are being made to mitigate the impact of these emissions.
By 2011 have a baseline for persistent pollutants in our cement plant for 100% of kilns and reinforce our Best Manufacturing Practices to limit emission.	2011	N/A	Persistent pollutants can be found in inputs and at the kiln stack. In line with the methodology of CSI, OCC is voluntarily undertaking: 1. To have completed the measurements of the persistent pollutants for all its kilns by 2011. 2. To develop and use suitable KPIs and to report on progress made. 3. To implement Best Manufacturing Practices to reduce emissions by 2011. 4. To integrate, into standard management practices, the lessons learned that contribute to limit emissions of persistent pollutants.

Table 5-8: Recommendations for OCC's steps on its TBL/CSR journey, Source: Author (2010)

The TBL/CSR process must be an on-going process with new targets established regularly and continuing efforts to make improvements made in a systematic manner.

6 Discussion and Conclusions

6.1 *Introduction*

This chapter is devoted to the latest developments in the cement manufacturing and how the adoption of these aspects can bring benefit to the cement manufacturing companies in general and for OCC in particular. After covering the specific recommendations to OCC, contribution of this research to the theory and practice are presented. Further, the research findings are summarised and the limitations of this research are clarified for the readers. This chapter is concluded with highlights of future research that is needed.

6.2 *Discussion and recommendations*

In this section the potential benefit of efficiency improvement in the cement manufacturing is discussed. Specific recommendations for OCC and the cement industry is made in line with the principle of conservation of environment to recycle, reuse, reduce waste and eliminate waste.

Based upon the data gathered from the cement industry companies, the current best practice for heat consumption is 700 x 4.18 kJ/ kg of clinker and for power consumption it is 68 kWh/t of cement. The industry's present average heat consumption for clinker production is 910 x 4.18 kJ/kg of clinker and the power consumption is 92 kWh/tonne of cement. Based on these data a general prediction for systematic energy efficiency improvement in the cement industry, for 2050 is:

1. The potential for improvement of the systematic heat consumption (910-700) x 4.18 x 5300 million mega joules. This means that 4.65 x 10^6 million mega joule of heat energy can be saved; (Based upon production of 5300 million tonnes of

cement per year. 700x 4.18 kJ/kg of clinker is the best achieved figure. However, with projected growth in annual production, the total energy consumption will increase in spite of reductions in energy consumption per tonne of cement produced).

2. The potential for improvement for power consumption: (92-68) x5300 million kWh. This means that 1.27×10^5 million kWh can be saved. (Based upon projected production of 5300 million tonnes by 2050) This projection is made on the basis of presently available technology and assuming that the efficiency improvements are made on 100% of estimated production capacity. There are possibilities of further savings due to improved technologies, better management, product innovations and TBL accountability in the cement manufacturing.

These forecasted savings are substantial; thus there is a great potential for improvement in carbon dioxide emission reduction by way of improvements in operating efficiencies. But the key question is how to motivate the companies to become motivated to invest in such energy efficiency improvements and at the same time to establish their practices based upon ethical principles rather than only by focussing upon the legal and financial dimensions. It is imperative that the investments in energy efficiency improvements will have a reasonable financial payback, especially as the cost of energy continues to increase and quite likely carbon surcharges may be implemented. Such improvements will also result into improved workers health and occupational safety.

Taking into considerations Kohlberg's moral development model (See section 2.4 Fig. 2-1) where the emphasis is on the ethical level of doing business, it is essential that the cement manufacturing sector should do a self-analysis and engage in honest soul searching of their operations in a holistic manner and rise to the occasion to meet the challenges of the TBL/CSR realities of the present and future. In this line, the recommendations for OCC include:

1. **1.** OCC should develop a social system (industrial clusters) responsible for improving material resources recycling. From a systems perspective OCC could make progress in optimising their materials cycle from raw materials to finished products, to obsolete products, to reuse of those used products. From a systems approach, resources, energy and capital should all be optimised. An example of best in class in such integrated systems is the Industrial Ecosystem at Kalundborg, Denmark. Ehrenfeld et al (2002) explained the legacy of Kalundborg in preserving the nature by industrial ecosystem. Although, it does not illustrate the recycling of cement or cement products, it provides an excellent example of one company utilising other's wastes and in helping each other in preserving the ecosystem (www.ecoearth.org/article/Kalundborg, accessed on 6th August, 2010). Recycling of concrete as a component of better business practice for SD is practiced in many German Companies and others worldwide. Additionally, the CSI has published a report on recycling of used cement (www.wbcsd.org, accessed on 4th July, 2010), which documented that approximately 900 million tonnes per year of demolished concrete is available in the Europe, the US and Japan and argues that recycling of concrete can reduce natural resource exploitation and waste going to land fill.
2. **2.** OCC should enhance its quality control to make more rapid progress towards product stewardship. They should implement better controls on their quarrying, pre-blending, kiln feed homogeneity, clinker feeding to the cement mills, reduce wastage of raw materials, decrease variations in product quality, reduce

operational disturbances and thereby improve worker's health and safety, the customer's confidence and the company's profitability.

3. OCC should invest in the generation of electricity by solar and wind power to replace conventionally generated electrical power. Today, based solely upon short-term economic considerations it may not seem to be economical but it will help to conserve natural resources and to reduce OCC's carbon footprint. In the long run, when the availability of fossil fuel from non-renewable sources will be constrained, OCC can make use of the fossil fuel for its critical activity in much better ways if they have also invested in energy efficiency improvements and in renewable energy generation. Presently, such activities can be funded, in part, by CDM. For example, Taiheiyo Cement has made a commitment to substitute 40% of its conventional power by utilising solar and wind power by 2012. This could become a very important initiative worldwide throughout the entire cement industry. Similarly, they could invest in reforestation as well, especially at the quarry sites or in other regions;

4. OCC should strive to eliminate the generation of hazardous wastes and continue to reduce other waste generation. In arid zones, as Oman where OCC operates, many cement companies have to by-pass some part of their kiln gases, to reduce alkali, sulphur and chloride recirculation in the process. This bypass gas carries fine dust particles with high alkali, sulphur and chlorides contents. Bypassing these gases from the main stream of the exhaust gases, which pass through the preheater-tower, minimises operational problems and also helps in reducing alkalis and chlorides in the product in order to comply with the maximum limits stipulated in the cement quality standard. Recycling of this bypass material could result in substantial savings for OCC and for the entire cement industry. It is estimated that annually, throughout the world, 80 million tonnes of such materials that could be incorporated into the products are currently wasted. The U. S. EPA (2008) estimated that 13 to 17 million tonnes of these materials are generated in USA alone. Also, there are hazardous and non-hazardous wastes such as lubricating oil, ferrous and nonferrous scrap, and wood, which, if they are segregated, could be utilised as sources of materials and energy for the cement production.

5. OCC should optimise its use of alternative raw materials. Heidelberg cement used 12% alternative raw materials in 2006 and is committed to further increase its usage of alternative raw materials. Using raw materials from sources other than quarries helps increase the sustainability of the product. However the extent to which one can use alternative raw materials varies from product to product and is also influenced by local regulations. OCC is using about 2% of drill cuttings generated from oil well drilling processes, as an alternative raw material. An analysis of this material (OBM) is given in Appendix 11. From these data, it is clear that OBM is similar to low grade limestone with the added bonus that it contains 7% oil. This material is a waste from oil well drilling and is treated as a hazardous waste. Use of this material in OCC's cement-making process required approval from the Ministry of Environment and Climate Affairs, Sultanate of Oman and Civil Defence, Sultanate of Oman. Similar actions by other cement manufacturing companies will help society manage hazardous wastes in a safe manner while saving energy and materials.

6. OCC should optimise its use of alternative fuels. By 2006, Heidelberg cement was already using up to 70% alternative fuels in some of their plants with an average use of 17%/ plant. OCC can make progress in this direction;

7. The use of biomass to replace traditional fossil fuels helps to reduce the long-cycle CO_2 releases. Siam Cement in Thailand, DG Khan Cement in Pakistan, and Cirebon plant of Heidelberg in Indonesia uses rice husk as an alternative fuel. Since 2006, Heidelberg plants in United States have replaced 6% of their total input energy by using previously wasted bio-solids. Availability of biomass is negligible in Oman and in neighbouring countries but OCC is actively considering the possibility of using municipal wastes and sewerage sludge as energy sources. OCC can make further progress in this regard;

8. Co-incineration of wastes in cement kilns is helping in reducing environmental burden and is saving energy. The Norwegian Foundation for Scientific Industrial Research (SINTEF) analysed more than 2,200 emissions data sets in order to examine the emissions of dioxins and furans from the co-incineration of waste and by-products in cement kilns. The study showed that the use of alternative fuels has no effect on the emissions of dioxins and furans. Detailed information on this issue can be found at www.sintef.no (accessed on 17.06.2010). In Oman, the governmental authorities have started working on segregation of solid wastes. OCC is negotiating with various companies for use of these wastes in its cement kilns.

9. OCC should safely manage its chemical substances such as PCBs. Such substances are used in cement plant laboratories and sometimes as grinding aids. PCBs are used in electrical transformers and the transformer oil is periodically replaced. These substances must be carefully stored, used under supervision and must be disposed in proper manner to eliminate possibilities of harm to human and animals.

10. OCC should reduce its water consumption. As a first step all leakages and overflows of water should be stopped. Cemex, Spain constructed a basin of 15.8 million gallons capacity to collect and treat storm water for use in their cooling system and to provide potable water for the community. This resulted in an improvement in the management of natural resources, less dependence on municipal water to the plant and community and enhanced availability of potable water to the community that often faced water shortages. It also reduced Cemex's water bill. Oman Cement is building a water tank to harvest storm water and to store it to reduce its dependence on municipal water.

11. OCC should increasingly work towards developing human resources through classroom and field training of its staff. Employees are key assets of any company and an efficient, empowered workforce is the key to organisational growth and prosperity. OCC is committed to provide adequate training to its staff and provides in-plant training to students studying in universities, colleges and schools thereby, contributing in development of the national human resources.

12. OCC should create a safer workplace and more fully empower its employees. Occupational Health and Safety (OH&S) rules and guideline should be practiced fully in all operations of the plant. All employees and contractors should be given safety training. This should result in creating a safety culture in the organisation where the employees are empowered to practice Safety First. Consequently, worker health and safety risks will be lowered and OCC will benefit from improved employee moral and loyalty. (OCC EHS Policy- Appendix 8)

13. OCC should make a commitment for improved the 'work- life' balance of its employees. 'Work-life' balance practices in the workplace are those that intentionally or otherwise, increase the flexibility and autonomy of the worker in negotiating their attention (time) and presence in the workplace.[5]

[5] Work-life Balance: A Matter of Choice; Gender, work & Organisation, Wiley online Library.

14. OCC should contribute to be a “Zero Emissions” company. Taiheiyo Cement has adopted the “Zero Emissions” concept aimed at eliminating waste emissions by promoting use of industrial wastes among companies in an industrial ecology approach. Taiheiyo takes calcium carbonate, fly ash and gypsum from power stations, which are their by-products (waste) and uses them in cement production. Taiheiyo also uses municipal solid waste to produce Eco-Cement and uses their cement kilns to destroy CFCs. In the vicinity of OCC, there are industrial units generating wastes such as copper slag, gypsum moulds, spent alumina catalysts and other wastes. Establishing a mechanism to explore the possible utilisation of these wastes can result in economic benefits for the companies currently generating these wastes as well as for OCC; consequently, the cluster of companies can improve their capacity to compete and collectively they can contribute to an improved, safer environment as well. In this way, the society can make progress, towards a goal of “zero waste”.
15. OCC should strive to promote stakeholder engagement. The goal of engaging stakeholders is to build strong, open relationships with them and to improve mutual understanding of their issues and concerns with the company. Lafarge, Holcim, Cemex, CRH, Italcementi, Taiheiyo, Titan, Heidelberg, Secil, Grasim and most of the socially responsible companies are actively engaged in such stakeholder engagement/empowerment.
16. OCC should actively promote biodiversity in order to promote ecological restoration of quarries, increasing the population of rare plants and animals in its areas of operation and thereby, help to conserve flora and fauna. Lafarge has entered into a partnership with World Wildlife Fund (WWF) to promote biodiversity worldwide. Through that partnership, they promote ecological

restoration of quarries, encourage ecologically sound re-establishment of forest ecosystems and have permission to also use WWF's logo in its communications.

17. OCC should optimise its business opportunities. As an illustration of an innovative new business opportunity, Heidelberg's initiative to develop TioCem, which is a photo-catalytically active cement with nano-particles of titanium dioxide. In sunlight, this cement actively breaks down air pollutants such as organic substances and nitrous oxides (a part of urban smog) into harmless compounds and also keeps the concrete surfaces clean. Development of Shortcrete, concrete eco-columns and eco-cement are further examples of creatively optimising business opportunities within the cement industry. OCC should continue to explore such opportunities as then move further on their TBL/CSR journey.

6.3 *Contribution of this research*

This thesis author brought together the theoretical and empirical knowledge of how diverse industrial sectors, worldwide have and are integrating the economic, environmental and social dimensions into the TBL/CSR emphases in their manufacturing sectors. The research methodology was designed to help the author to clarify and document the key factors that are challenging and driving industries to make improvements as they progress on their TBL/CSR journeys.

This thesis author performed in-depth, comparative analyses to compare and evaluate the policies, procedures and progress of diverse cement companies, worldwide. He also analysed how these cement companies are progressing in integrating the TBL/CSR concepts into their daily processes and procedures. This integration is a big challenge because, although some researchers have sought to transpose environmental and social welfare into monetary terms and some progress has been made in these efforts, we must admit that some parameters are qualitative and cannot be easily transformed into quantitative financial terms. That provides many important challenges in seeking to motivate industrialists and other stakeholders to move forward on CSR/TBL journey. Based upon the insights and lessons learned from the comparison of how other cement companies are progressing, this thesis author developed and implementing a road map for OCC to proceed on its TBL/CSR journey towards sustainable production.

The researcher with the top and middle level management of OCC discussed this proposal. They have made a firm commitment for them and their employees to support this research project. OCC has published its Health, Safety and Environment policy and this has been explained to all the employees of the company. OCC has prepared a manual for "Business Continuity Plan" and it has also duly clarified its understanding of its social responsibility. This manual was presented to the Board of Directors of the company for approval in December 2008. The approved Business Continuity plan was adopted for the day-to-day business of the company to pave the way for progressing on its TBL/CSR journey.

6.4 *Findings of this research*

In the cement, manufacturing sector, emissions per ton of cement produced from various cement plants differ because of the types of equipment, the process energy efficiencies and the product composition. Guiding factors for their control pertain to the technologies being used in the particular company, the quality of management, the local governmental regulations on emissions and the social liabilities. Management differences contribute to many facets of cement production that influence efficiencies, product quality, as well as workers health and safety and environmental quality.

In order to make more effective and consistent progress on their TBL/CSR, cement companies have installed and are increasingly implementing integrated EMS. Top management commitment was found to be essential for engaging the corporation's personnel in the process of identifying the significant environmental aspects, prioritising them according to their significance and in making serious and systematic efforts to make procedural, process, product and service improvements. Analyses of social perspectives in the manufacturing operations, which include community, concerns about plant operations, worker's health & safety, transportation and aesthetics, documented a wide diversity of responses among the cement companies.

Data presented in Table 4-3 indicated that sales per tonne of cement, production per employee, energy consumption per tonne cement, water consumption/ tonne of cement and degree of certification of companies to ISO 14001 that varies widely due to the fact of cultural, regulatory, management, and technological differences. These challenges are further complicated due to diverse climatic conditions and regional differences in market preferences. Net CO_2 emissions from cement-producing companies vary from 0.910 to 0.645tonne/tonne of cement produced respectively. Dust emissions vary from 15.7gms to 375gms/ tonne of cement produced. NO_X emissions vary from 1190 to 1971gms and SO_X emissions vary from 70 to 957gms/tonne of cement produced.

It is clear from these research findings that the cement-manufacturing companies can obtain substantial economic benefits by enhancing their materials and energy efficiencies, as we have seen from the collected data that heat energy vary from 3627 mega joule/kg clinker to 4,110 mega joule/kg clinker. This can help the entire cement industry to save billions of dollars per year and at the same time dramatically reduce their carbon footprint and other negative environmental impacts. Energy costs vary widely from country to country and sometimes within different regions in the same country. It is impossible to predict the precise savings in monetary terms but in terms of percentage savings, it is expected to be 23% on heat energy and 26% on electrical energy by 2050.

There is a clear need to manage energy and materials intelligently and professionally. This thesis author documented that there is a big gap in translating and implementing international initiatives into action at national and local levels. Ensuring that the initiatives are translated into action at the local level can help the cement manufacturing sector to become more environmentally and socially responsible.

It is important to note that the local laws regulating the economic, social and environmental activities of the companies play important roles in driving or in hindering the TBL/CSR initiatives in the cement-manufacturing sector. The environmental laws in Europe and North America are very stringent but they are relaxed to very-relaxed in Asia and Africa. In the Sultanate of Oman, the environmental laws are in the formative stage for many environmental aspects but enforcement is very strict. A royal decree (RD) No. 10/82 was issued in 1982, promulgated protection of the environment and the prevention of pollution. Presently, the cement industry in Oman is required to comply with nine standards that are listed in Appendix 10.

Many international companies in the cement manufacturing sector have taken advantage of the disparity among environmental laws of different regions; they therefore, prepare their monitoring reports for “Emerging markets” and for “Matured markets” separately. It must be understood that the world is like a sink and pollution created at any place on the earth leads to increases of that pollutant in the sink. Thus, it would be ideal for the companies to work with a three-pronged simultaneous approach:

a. Think broadly about issues and impacts beyond legal compliance.

b. Engage with a wide range of stakeholders to obtain and to build upon comprehensive inputs into their business opportunities, while reducing the risks. Thereby, the companies can make more consistent progress on their TBL/CSR journeys. Developing partnerships with a variety of stakeholders will help the companies with more effective approaches to address issues of mutual importance.

c. Cement company leaders should make connections across the cement manufacturing industry and thereby, learn from each other how to more effectively, work to increase sustainability in the cement industry.

In order to improve on the KPIs, the cement industry needs to work on individual action plans as well as to work jointly with cement industry members on action plans as outlined in Table 2-3. The cement industry must understand the positive and negative repercussions of their actions on environment and society; therefore, they should work sincerely and consistently to reduce their thermal and electrical energy uses, reduction of their emissions, promote recycling and uses of alternative fuels and raw materials. Transparency on environmental and safety investments is currently quite poor. This must be improved across the entire cement industry. Health and safety awareness information and approaches to make improvements are being disseminated among all manufacturing units but the occupational accident frequency rate is still very high, consequently accident prevention actions are urgently needed.

TBL/ CSR approaches require more than the current rules of corporate engagement. They must increasingly strive to operate within environmentally sustainable limits, in order to lower their ecological footprints, to enhance social equity and to develop a sense of futurity. In order to achieve these things McIntosh at el. (1998, 2003) stated that manufacturing enterprises should articulate their roles, scopes and purposes and they should understand their social environmental impacts as well as their financial performance. Therefore, they should be more transparent and accountable, and go beyond merely being in compliance with relevant laws and regulations.

In order to fulfil the demands of TBL/CSR, cement-manufacturing organizations need to seriously address the following:

- **a.** Environmental responsibilities;
- **b.** Worker Health and Safety responsibility;
- **c.** Fiscal and policy measures;
- **d.** Market preferences;
- **e.** Public image;
- **f.** Costs and benefits of waste and pollution prevention, abatement and treatment;
- **g.** Ethical responsibilities to present and future generations;
- **h.** Consumer product safety responsibilities;
- **i.** Stockholder value.

The TBL/CSR journey must be an on-going process based upon establishing new targets regularly and engaging consistently in efforts to make improvements in a systematic manner. The following management elements were found to be necessary for making progress on the TBL/CSR journey within the cement industry:

a. There must be top-level corporate commitment for getting started on the journey and for continuing to make on-going TBL/CSR improvements;

b. The company must develop a clear TBL/CSR policy through inputs from a wide array of stakeholders within and outside of the company. That policy must be used to guide implementation of its improvements;

c. The company's leadership must ensure proper allocation of human and financial resources to ensure that real progress will be accomplished on its TBL journey;

d. The company must develop and utilize a clear strategy and timetable for implementation of improvement activities for both the short and long-term;

e. The company must have indicators to monitor its progress towards its goals;

f. The company must report, internally and externally on its progress towards its goals;

g. The company must continue to update its strategy, timetable and specific activities to ensure that it continues to respond to the changing political, social, environmental and economic demands of society for seeking to make progress towards sustainability.

6.5 *Limitations of this research work*

Yuansheng (2009) reported that the cement industry is highly segmented and there are more than 5500 integrated cement plants operating worldwide. China has 4000 integrated plants and over 1000 cement grinding units. Over the last decades, rapid integration in the industry has taken place but it remains at a relatively low level, particularly in China. There is a substantial difference in the culture, management style, governing regulations, discipline and reporting performance of cement plants located in industrialised countries and developing countries. Apart from developed and developing economies, more than half of the world's population lives in countries, where they are barely surviving. In such countries like Bangladesh, Burundi, Cameron, Rwanda, Somalia, Sri Lanka, Sudan, and Myanmar the focus is on product quantity to satisfy day-to-day needs rather than on making efficiency improvements, waste reduction, recycling and fulfilment of societal responsibility. Data published by some cement companies are based on measured or metered physical quantities, or best estimates based on industry knowledge and established calculation factors and representative samples. While some of them have reported data based on actual measurements of CO_2 emissions, others have calculated and reported them based on the WBCSD protocol. Most of the companies have different mixes of activities for their production group hence group ratios are not directly comparable among company groups but most of the data reported for cement production activities are reported according to the agreed CSI Key Performance Indicators (KPIS), which are directly comparable across the sector. Data published by the cement-manufacturing sector on the environmental and social KPIS are still in early stages of utilisation.

While some of the cement companies have published their 3rd or 4th TBL/CSR/Sustainability reports and they are trying to improve on the accuracy and quality of their reports, many cement companies have not produced any TBL/ Sustainability reports. GRI reporting guidelines are based on voluntary disclosure and the disclosure level starts from beginners level C to full disclosure level A+. As cement companies have started moving on the TBL/CSR journey, more than 50% have reported at level C. Hence, for the purpose of comparison in the longitudinal study data was collected from the companies reporting on the same level and within the same perimeter. This is a major limitation for this thesis research.

Sincere efforts were made by this thesis author to collect data from the cement industry with the constraint of time and cost. The resultant data were analysed to identify and characterize the best practices adopted in the industry and in some cases normalisation of data was done to be able to perform comparative analysis. The thesis author is aware of the relative paucity of useful, comparative CSR data among the cement, manufacturing sector. This is primarily due to the fact that awareness about and engagement in TBL/ CSR issues has emerged very recently within this sector, although many of the large firms are now seriously addressing these vital issues. In the near future, it is anticipated that new studies will help to expand and enrich the data on environmental and social indicators in the cement industry.

6.6 *Scope of future research*

Awareness about the engagement in sustainability and CSR issues has emerged very recently within cement manufacturing sector, although many of the large firms are now seriously addressing these vital issues. Presently, the major cement producing companies have seriously engaged themselves with the TBL/CSR activities and likely to report on all the indicators, in the near future. Hence, it is anticipated that new studies will help to expand and to enrich data on environmental and social indicators and will provide opportunities for future researchers to improve upon this research work. As it was reported in this research that cost accounting practices are still following traditional methods, it may be desirable to bring out the practical benefits of reducing overhead costs in cement manufacturing, where activity based accounting practices are used, by performing new research in this area. Based upon similar studies in other manufacturing sectors on implementation of environmental and social dimensions can help the manufacturing sector to become more socially responsible and to also contribute more to the GDP.

6.7 *Conclusions*

The Cement manufacturing companies worldwide, started working on integration of the TBL from 2002 and addressed issues such as CO_2 and climate change, uses of alternative fuels and raw materials, emissions reduction, recycling and reuses, employee health and safety, and mitigating local impacts on land and communities. Some of them have taken their performance in the prevention and/or reduction of accidents and emissions in 1990 as their base year to reduce pollution and to improve upon employee safety, where-as others have taken 2002 or 2004 as their base years. On many environmental and social indicators, they have shown encouraging improvements, which have motivated them to continue to develop innovative processes, products and procedures to improve their economic profitability while also improving their environmental and social performance. These improvements have earned such cement companies laurels from the community. This thesis research identified drivers and barriers in implementation of TBL/CSR program in the cement manufacturing. Based on this research, this thesis author has prepared a plan for implementing the TBL/CSR integration in OCC, which has started its journey on TBL/CSR by establishing its policy, objectives and targets, its quality and its environmental management program. Implementation of the strategic improvement plan is progressing well. The company has scheduled to publish its first TBL/CSR report during 2012.

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