

Emerging Environment Health And Safety Indicators And Criteria To Establish Sustainability Index For Cement Industry

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Abstract: Numerous researches have determined sustainability criteria for assessment of sustainability performance considering economic, environment and social indicators. To define sustainable EHS practices, industry must identify the criteria for sustainability to make choice and prioritizing the focus areas. For improving Environment health and safety (EHS) performance, it is required to emphasize criteria specific to EHS with consideration to nature of industry. The aim of this paper is to present an approach for identifying emerging sustainability criteria for environment, health and safety & community initiatives and proposing sustainability index for evaluating sustainability effectiveness. By studying in-depth EHS indicators specific to cement industry, indicators have been divided in sub indicators and total forty-six (46) criteria were established for study. Analytic Hierarchy Process (AHP) tool was employed to derive weights for prioritizing identified sustainability criteria for developing Sustainability Index. This work is an attempt to establish a linkage between sustainability and environment health and safety and indicate the requirement of integration of environmental management system, Occupational health and elements of sustainability and social responsibility.

Index Key Words : Cement Sustainability; EHS indicators; Environment Indicators for Cement Sustainability; Sustainable EHS practices; Sustainability criteria; Sustainability index

1. INTRODUCTION

In the last decade sustainability has emerged as an imperative for business across the globe considering the 3 Ps (Planet, people and profit). To survive in market the organizations must demonstrate the equilibrium in climate change, resource availability, impact of businesses on people, supply chain and making profits at the same time. Under the umbrella of Sustainability Environment, health and safety are the important aspects in gauging organization's business sustainability. Initially, most emphasis was placed on the environmental topics such as energy consumption, pollution from emissions, water usage and biodiversity. However, in recent years, with the development in Environment health and safety standards other aspects have also been undertaken: renewable energy, health and safety, community related EHS impacts etc. while considering sustainability [1]. Sustainable development and Environment, occupational health and safety (EHS) are the two allied concepts which are also considered as essential elements in running a successful business with the ability and competency to survive in the market [2]. There are several papers discussing the connection among sustainable development, economic performance, environment, people, supply chain, society, stakeholder engagement etc. but the role of occupational health, workplace safety, EHS focused community initiatives not widely considered for sustainable development. For this research the broad category of Environment, health & Safety and Community EHS initiatives have been divided into sub indicators which are as follows:

Consumption and conservation of Water and energy, conservation of raw material and recycling, GHG and other emissions, occupational health and occupational safety, Community projects on water and energy, green belt development and community health care. These sub indicators were ranged into set of criteria [12], [15].

2. METHOD USED FOR BUILDING SUSTAINABILITY INDEX FOR EVALUATING SUSTAINABILITY PERFORMANCE

The main procedures for building a sustainability index include selecting appropriate sustainability indicators, weighting the selected indicators, and aggregating those indicators into a composite index [3]. The set of sustainability criteria identified under the EHS Indicator and sub indicators by studying the emerging global sustainability practices through research papers [6],[7],[9], industry practices and available relevant literature [10],[17],[18].

3. IDENTIFICATION OF EHS INDICATORS AND CRITERIA FOR SUSTAINABILITY

Nowadays organizations have started using environmental and social indicators to determine the performance of business activities. Some of the largest companies are reporting their sustainable performance in their sustainability reports. These reports are largely based on the GRI framework, where the key aspects of social and environmental activities are covered. The World Business Council for Sustainable Development (WBCSD), the International Standards Organization (ISO), and the Global Reporting Initiative (GRI) were the key drivers for implementation of sustainability practices in industries [20], [21]. Although there are numerous sustainability indicators which are diverse in nature and have been developed voluntarily for the purpose of sustainable business practices [20]. For cement industry the most commonly used indicators for sustainable manufacturing is referred from the cement sustainability initiatives (CSI) under World Business

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Council for Sustainable Development (WBCSD). CSI guidelines include parameters like GHG emissions and other emissions from cement manufacturing, co-processing of fuels and materials, safety and water consumption. Energy consumption has been identified as one of the key drivers for CO₂ emissions in the cement sector. It also defines emissions of dust, NO_x, SO₂, VOC, heavy metals and dioxins/ furans, water withdrawal, discharge and consumption, improvement in water balancing, work-related fatalities and injuries etc. as the Key Performance Indicators (KPIs). Besides, there are number of indicators proposed by Global Reporting Initiative (GRI) which focus on the organization's significant economic, environmental and social impacts. It talks about labour practices, decent work, human rights, product responsibility, society, energy, water, emission, waste, effluent, conservation mechanism etc. under Social and environment section. UN Global Compact is another voluntary initiative to implement universal sustainability principles to take steps to support UN goals for sustainability which are also known as sustainable development goal (SDG). UN framework

considers equity, health, education, security, population, atmosphere, land, ocean, fresh water and biodiversity under social and environment section. Apart from sustainability frameworks, Environmental Management System (EMS) and Occupational Health and safety management system are structured systems which help an organization to identify the environmental and OH&S impacts resulting from its business activities [22]. Under EMS standard talks about Prevention of pollution, which considers all the environment aspects (Air, water, Noise, land, emission, waste etc.) with respect to all the activities, product and services of the company. Whereas OH&S system covers Hazard identification and risk assessment process which evaluates all the activities, product and services of the company against Health and safety performance. It requires to form control procedures and management systems for improved EHS performance [23], [24]. The list of criteria is given in the table which was used for developing the index for evaluating the sustainability maturity and effectiveness.

EHS Sub indicators	Sr No.	Key Criteria	
Water Consumption and Conservation	1	ISO 14001 management system certification	
	2	Fresh water consumption pattern (YOY)	
	3	Ground water resource extraction pattern (YOY)	
	4	Water Metering and management	
	5	Waste Water Treatment and Reuse (reused percentage of fresh water consumption)	
	6	Water Quality of effluent water	
	7	Zero discharge plants	
	8	Rainwater Harvesting (YOY)	
	9	Ground water recharge	
Energy Consumption and Conservation	10	ISO 50001/SS 564 management system certification	
	11	Energy consumption pattern- Direct Energy (fuel) (YOY)	
	12	Energy consumption pattern- Indirect Energy (grid electricity) (YOY)	
	13	Energy consumption pattern for supply chain/ employee commute not under direct control of company (YOY)	
	14	Company conducts Environment and Energy Audit	
	15	Energy Efficiency Initiatives	
	16	Alternate fuels Usage as a percentage of total energy (YOY)	
	17	Renewable energy usage as a percentage of total energy (in a given year)	
	18	PAT implementation and status	
	19	Renewable purchase obligation status	
	Raw material Consumption and recycling	20	Use of recycled materials as a percentage of total Raw material used
21		Sustainable procurement Initiatives	
22		Company reporting Emissions in CDP/ as per ISO 14064	
23		Direct Emission Pattern	
24		Indirect emission pattern	
GHG and other Emission reduction	25	Emission pattern for supply chain/ employee commute not under direct control of company	
	26	Commitment to reduce CHG emissions with timelines.	
	27	AAQ -PM, Sox, Nox	
	28	Availability of latest technologies	
Occupational Health	29	emission offset programs	
	30	OHSAS 18001 management system Certification	
	31	Health and wellness programs in 1 year	
Workplace Safety	32	Health and safety programs- Hygiene, ergonomics	
	33	Frequency Rate (FR) – Number of recordable incidents per 1 million man-hours worked/year less than the national average	
	34	Severity rate (SR) – Number of man days lost per 1million man-hours worked/year - less than the national average	
	35	Loss time injury rate	
	36	Program on Behavior based safety	
	37	EHS Trainings	
	38	Safe work place initiatives to boost employee morale	
	39	EHS committee and meetings	
	Community project-Water and Energy Resources conservation	40	Projects on providing basic amenities
		41	Projects on promoting sustainable agriculture and forestry
42		Access to improved drinking	

		water source
Community project-Green Belt development	43	Projects on watershed protection
	44	Projects on Biodiversity
	45	Projects to improve forest cover
Community project-Community Healthcare	46	Community wellness program

Table-A [5,8,11.13]

4. DETERMINING THE IMPORTANCE OF INDICATORS AND SUB INDICATORS USING THE AHP APPROACH

Indicators were divided in sub indicators to study the detailed criteria of each sub indicator for defining sustainability [14]. After defining the sub indicators, the weights of importance of the parameters are determined. Often the weights are determined basis the shared opinion of stakeholders the interest party [19]. The group usually consists of stakeholders who are impacting or getting impacted by the industrial operations. Here, the three aspects of EHS were compared by using AHP considering the global trend on reporting on sustainability. The analytic hierarchy process (AHP) is frequently used to determine the shared opinion of the group as one of the most frequently used methods for multiple-criteria decision-making. AHP allows to make decisions concerning complex content by simplifying the natural decision-making basis pairwise comparisons between parameters. To obtain weights for sub indicators, a survey was carried out through online mode, in which a link of questionnaire was shared with industry people. The questionnaire comprised of pairwise comparisons of the sub indicators. Basis received Responses the AHP online module was used to allocate the response in pairwise comparisons which used the scale of 1-9. Tables below show the list of sub indicators used for comparison. Pair-wise comparison scale and Numerical Rating for AHP preferences were as follows: 1- Equal Importance, 3- Moderate importance, 5- Strong importance, 7- Very strong importance, 9- Extreme importance (2,4,6,8 values in-between) [4]. Once responses are allocated, it is necessary to check that they are consistent. Since the numeric values are derived from the subjective preferences of stakeholders which results in some inconsistencies in the final matrix of judgment. AHP calculates a consistency ratio (CR) and compares the consistency index (CI) of the matrix in question and the consistency index of a random-like matrix (RI) which is expected to be highly inconsistent [3]. AHP defines the consistency ratio as CR where $CR = CI/RI$. A consistency ratio (CR) of 10% or less is acceptable to continue the AHP analysis [4]. If the consistency ratio is greater than 10% it is necessary to revise the judgments. Although here the AHP calculation has been done using the AHU software [16]. The results of indicator and sub indicator weights allocation using the AHP method are shown in the given below.

Category	Priority	Rank
1 Environment	59.4%	1
2 Occupational Health and Safety	24.9%	2
3 Community EHS Practices and initiative	15.7%	3

Number of comparisons = 3, Consistency Ratio CR = 5.6%
Priorities for Environment Sub indicators: Following are the resulting weights based on pairwise comparisons

Category	Priority	Rank
1 Water Consumption and Conservation	23.9%	3
2 Energy Consumption and Conservation	28.1%	2
3 Raw material consumption and recycling	14.0%	4
4 GHG and other Emission reduction	34.0%	1

Number of comparisons = 6, Consistency Ratio CR = 2.2%
Priorities for Occupational Health and Safety Sub indicators: Following are the resulting weights based on pairwise comparisons

Category	Priority	Rank
1 Occupational Health	66.7%	1
2 Occupational safety	33.3%	2

Number of comparisons = 1, Consistency Ratio CR = 0.0%
Priorities for community Projects and initiatives Sub indicators: Following are the resulting weights based on pairwise comparisons

Category	Priority	Rank
1 Community project-Water and Energy Resources	52.8%	1
2 Community project-Green Belt development	14.0%	3
3 Community project-Community Healthcare	33.3%	2

Number of comparisons = 3, Consistency Ratio CR = 5.6

5. RESULTS AND DISCUSSION

The results demonstrate the greatest importance to the quality of the environment (user aspect), whose weight is 59.4% followed by health and safety and community projects and initiatives with weight of 24.9 and 15.7 % respectively. For the sub indicators of environment GHG and other emissions scored highest priority (34%) followed by energy consumption and conservation (28.1), water consumption and conservation (23.9) and the lowest weight for raw material consumption and recycling (14%). In Occupational health and safety occupational health scored 66.7% and safety 33.3%. Under Community projects and initiatives, the water and energy scored the highest (52.8%) followed by community health care (33.3%) and green belt development (14%). Although the sub indicator scored lowest does not mean that they are the least important. In fact, it interprets that the lowest scored sub indicators have least impact on stakeholders in comparison to the highest scored sub indicators with the current practices and approaches towards EHS. The resulted index was presented in the form as shown in the table B.

SUMMARY AND CONCLUSIONS

The sustainability maturity rating for the given criteria and the allocated weightage of indicator and sub indicator establishes the index which helps in evaluating sustainability effectiveness. The maturity ratings and

weights were multiplied to identify EHS indicator rating for sustainability and defining overall effectiveness. Sustainability maturity ratings were defined with three stages- Highly sustainable, moderately sustainable, evolving towards sustainable. The study has established a significant linkage between EHS and Sustainability. Integration of EHS and sustainability management programs have created comprehensive and extensive framework for the cement companies focusing on sustainable development encompassing social and environment indicators.

50 - 59	Evolving towards sustainable	low
60 - 74	Moderately Sustainable	Medium
75 - 100	Highly Sustainable	High

The sustainability performance evaluation can be done through index which comprises set of EHS indicators. The ratings resulting from the established index plays major role in decision making for company's sustainability performance and future actions. There is future scope of work in this research as the similar index can be established for other industries by setting criteria specific to the nature of industry.

EHS Index for Sustainability

EHS Indicator Rating for sustainability	Sustainability maturity Level	Sustainability Effectiveness
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Table-B

EHS Indicators	EHS Sub indicators	Sr No.	Key Criteria	1	0.5	0.1	Maturity level rating	weights	
				Highly Sustainable	Moderately Sustainable	Evolving towards sustainable			
Identify Emerging sustainability criteria	Environment	Water Consumption and Conservation	1	ISO 14001 management system certification	certified	under certification	no certification		0.239
			2	Fresh water consumption pattern (YOY)	Consp. less than 10%-20%	Consp. less than 5%-10%	Consp. less than 5%		0.239
			3	Ground water resource extraction pattern (YOY)	exact. less than 10%-20%	exact. less than 5%-10%	exact. less than 5%		0.239
			4	Water Metering and management	Well managed program	Initiated program	No program		0.239
			5	Waste Water Treatment and Recycle (recycle percentage of fresh water consumption)YOY	recycle more than 30%	recycle more than 20%	recycle more than 10%		0.239
			6	Water Quality of effluent water	Quality improved beyond regulatory limits	Quality meets regulatory limits	Tries to meet regulatory limits		0.239
			7	Zero discharge plants	Yes	Initiated program	No		0.239
			8	Rainwater Harvesting (YOY)	Harvested more than 10%	Harvested more than 5%	Harvested more than 1%		0.239
			9	Ground water recharge	Quantified	Initiated program	No data available		0.239
Identify Emerging sustainability criteria	Environment	Energy Consumption and Conservation	1	ISO 50001 management system certification	certified	under certification	no certification		0.281
			2	Energy consumption pattern- Direct Energy (fuel) (YOY)	Direct Energy consmp reduced more than 5%	Direct Energy consmp reduced more than 2%	Direct Energy consmp consistent		0.281
			3	Energy consumption pattern- Indirect Energy (grid electricity) (YOY)	Indirect Energy consmp reduced more than 10%	Indirect Energy consmp reduced more than 5%	Indirect Energy consmp consistent		0.281
			4	Energy consumption pattern for supplychain/ employee commute not under direct control of company (YOY)	Monitored	To be Monitored	No Monitoring		0.281
			5	Company conducts Environment and Energy Audit	once a year	Once in 2-3 years	Never conducted		0.281
			6	Energy Efficiency Initiatives	Well managed program	Initiated program	No program		0.281
			7	Alternate fuels Usage as a percentage of total energy (YOY)	AF used	AF to be used	No AF used		0.281
			8	Renewable energy usage (YOY)	RE used more than 50%	RE used up to 50%	RE use started		0.281
			9	PAT implementation and status	Achieved and traded	Achieved	Not achieved		0.281
			10	Renewable purchase obligation status	Complied beyond target	Complied	Not Complied		0.281
Identify Emerging sustainability criteria	Raw material Consumption and recycling	1	Use of recycled materials (percentage YOY)	Recycled mat. used more than 50%	Recycled mat. used up to 50%	Recycled mat. use started		0.14	
		2	Sustainable procurement Initiatives	Well managed program	Initiated program	No program		0.14	
	Environment	GHG and other Emission reduction	1	Company reporting Emissions in CDP/ as per ISO 14064	Disclosed with A rating	Disclosed with less than A rating	No disclosure		0.34
			2	Direct Emission Pattern	Direct Emission reduced more than 5%	Direct Emission reduced more than 2%	Direct Emission consistent		0.34
			3	Indirect emission pattern	Indirect Emission reduced more than 10%	Indirect Emission reduced more than 5%	Indirect Emission consistent		0.34
			4	Emission pattern for supplychain/ employee commute not under direct control of company	usage >25%	10-25%	0%-10%		0.34
			5	Commitment to reduce GHG emissions with timelines.	Monitored	To be Monitored	No Monitoring		0.34
			6	AAQ -PM, Sox, Nox	AAQ improved beyond regulatory limits	AAQ meets regulatory limits	Tries to meet AAQ regulatory limits		0.34
			7	Availability of latest technologies		technology upgradation in process	technology upgradation to be done		0.34
			8	emission offset programs	State of Art technology adopted	Well managed program	Initiated program	No program	

Identify Emerging sustainability criteria	Occupational Health and Safety	Occupational Health	1	OHSAS 18001 management system Certification	certified	under certification	no certification	0.667
			2	Health and wellness programs in 1 year	1 or more program per month/ qtr	1 program per Six Month/ year	No program	0.667
			3	Health and safety programs- Hygiene, ergonomics	1 or more program per month/ qtr	1 program per Six Month/ year	No program	0.667
		Workplace Safety	1	Frequency Rate (FR) – Number of recordable incidents per 1 million man-hours worked/year (less than the industry average)	Zero FR	FR above 25% of the industrial average	FR above 50% of the industrial average	0.333
			2	Loss time injury	zero fatal incident	Minor Incident but no fatal incident	fatal incident	0.333
			3	Program on Behaviour based safety	Well managed program	Initiated program	No program	0.333
			4	EHS Trainings	Well managed program	Initiated program	No program	0.333
			5	Safe work place initiatives to boost employee morale	Well managed program	Initiated program	No program	0.333
			6	EHS committee and meetings	Well managed program	Initiated program	No program	0.333
			7	Community wellness program	Results monitored and quantified	Results monitored but not quantified	No program	0.33
Identify Emerging sustainability criteria	Community EHS Practices/ initiative	Environment Initiatives- Water conservation and forestry and basic amenities	1	Projects on providing basic amenities	Results monitored and quantified	Results monitored but not quantified	No program	0.528
			2	Projects on promoting sustainable agriculture and forestry	Results monitored and quantified	Results monitored but not quantified	No program	0.528
			3	Access to improved drinking water source	Results monitored and quantified	Results monitored but not quantified	No program	0.528
			4	Projects on watershed protection	Results monitored and quantified	Results monitored but not quantified	No program	0.528
		Community project-Green Belt development	5	Projects on Biodiversity	Results monitored and quantified	Results monitored but not quantified	No program	0.14
			6	Projects to improve forest cover	Results monitored and quantified	Results monitored but not quantified	No program	0.14
			7	Community wellness program	Results monitored and quantified	Results monitored but not quantified	No program	0.33

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