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IDENTIFICATION OF THE CRITERIA AND SUB CRITERIA FOR THE GREEN SUPPLIER SELECTION IN INDIAN CEMENT INDUSTRIES

Deepesh Giri Sharma[1], A.M. Rawani[2]

[1]*Mechanical Engineering Department,*
Central college of Engineering and Management, Raipur, (India)
[2]*Mechanical Engineering Department,*
National Institute of Technology, Raipur,(India)

ABSTRACT

Green supplier selection (GSS) has emerged as an important activity of procurement function in supply chain. Green supplier selection is a multi criteria decision making problem which takes into consideration relevant green criteria in deciding which suppliers are the best. The criteria are essentially those which directly or indirectly affect the environment and society. Companies today's focus is to manage their activities in a more responsible manner. The industries are willing to pay back to the society by doing the sustainable business. Thus, to include the Corporate Social Responsibility (CSR) activities and Safety as the criteria in the green supplier selection process is the demand of the new age industries. Cement manufacturing involves the process which requires considering the environment concerns. There are many legal and social reasons due to which cement manufacturing companies are in search of environment friendly activities and process. The main objective of this research paper is to identify the criteria and sub criteria for Green Supplier Selection (GSS) including Safety, Corporate Social Responsibility criteria (if any) for Indian Cement manufacturing Industries. The criteria identified are the Quality, Cost, Services, green activities, safety and CSR activities of the suppliers.

Keywords: *CSR Activities, Green Activities, Green Supplier Selection (GSS), Safety.*

I. INTRODUCTION

Green Supplier Selection (GSS) plays an important role in any organization. The green supplier selection takes into consideration the environment related factors into supplier selection process. The Green Supplier Selection process requires various criteria and sub criteria to be considered. The identification of the criteria and the sub criteria is the first step in the Green Supplier Selection. In this research paper the criteria and subsequent sub criteria are identified for Green Supplier Selection (GSS) for Indian Cement Manufacturing Industries. Indian cement manufacturing involves the process which requires considering the environment concerns. There are many legal and society related reasons due to which cement manufacturing companies are in search of environment friendly activities and process. These industries are doing sustainable business and adopting safety as an important parameter in their business activities. As discussed with the procurement experts in Indian

cement manufacturing industry the availability of the raw materials has become a big challenge due to increased competition and limited resources. The Granulated Blast Furnace Slag (GBFS) is one of such raw material and very important constituents for making cement. The steel manufacturing industries of the country are the suppliers of Granulated Blast Furnace Slag (GBFS) to Indian cement industries.

II. LITERATURE REVIEW:

One of the reasons behind the success of any supply chain is in selection of good suppliers. The suppliers are selected based on certain criteria and sub criteria which vary organization to organization. Dickson in his study has identified twenty three criteria which he indicated should be considered for selecting the suppliers [1]. There is a need to include sustainability related factors in the analysis of the supply chain [2].The environmental issues have become important factors for the manufacturing industries for managing its supply chain. Organizations are now at the advanced stage of managing their supply chain; in which environmentally conscious firms, mainly larger companies, are developing environmental programs aimed at organizing their supply chains [3]. Integrating environmental management techniques along the supply chain is an appropriate method of improving the environmental performance of an industry. Over the last few years, organizations have responded to this challenge by implementing a number of programs [4]. The word environment at this advanced stage has changed and popularly accepted as 'Green', and hence the supplier selection considering the environment related factors has called Green Supplier Selection (GSS). The supplier selection is a multiple criteria decision-making problem affected by several conflicting factors [5]. In order to improve their relations with the environment, organizations must contribute towards a reduction in environmental impacts from their supply chains, by demanding improvements in their supplier's environmental performance [6]. Supplier selection and evaluation is the process of finding the appropriate suppliers who are able to provide the buyer with the right quality products and/or services at the right price, in the right quantities and at the right time [7]. Traditionally, companies have considered factors such as price, quality, flexibility, etc. while evaluating suppliers. However, environmental pressures urge them to consider green issues. Competitive advantages associated with supply chain management philosophy can be achieved by strategic collaboration with suppliers and service providers. The success of a supply chain is highly dependent on its suppliers and, thus, the supplier selection problem has been a major research area [8]. Perhaps the greatest significance of any good multi criteria procedure is that it provides a structural model to guide the decision maker through a complex decision process, such as supplier selection. Supplier selection criteria and methods will continue to be the focus in the research fields. However, there are various criteria for the supplier selection, some new criteria to reflect the whole supply chain performance should be included in the process of supplier selection [9]. The social dimension of sustainable supply chain management is frequently related with the concept of Corporate Social Responsibility (CSR), which tries to enhance the processes in supply chain by investing in employee safety and health, local impacts on land and communities, as well as infrastructure and utilities development [11]. Mani V et al [11], in their research have focused on socially sustainable supplier selection through social parameters. Further, the social sustainability parameters are highly contextual and vary from country to country. Recently, corporates have started incorporating green sustainability criteria by including some new criteria in addition to other

supplier selection criteria. Similarly, very few companies emphasize social criteria by mandating health and safety mechanisms [11]. Based on above researchers comments in the literatures it is evident that relevant green, safety and corporate social responsibility criteria should be considered in the Supplier Selection process.

III. METHODOLOGY AND RESULT

The criteria and sub criteria were identified by taking inputs from literature reviews and executives of cement manufacturing plants. For this purpose, extensive literature review was first carried out. Thereafter, executives of the procurement department of two Indian cement manufacturing organizations namely ACC Limited and Ambuja Cement Limited were approached. Unstructured interviews of eleven executives were arranged. The demography of the respondents is given in TABLE (1a) and (1b).

Table 1 (a): Respondent's Designation and Numbers

Designation	Numbers
General Manager	1
Deputy General Manager	2
Manager	3
Deputy /Asst. Manager	5
Total	**11**

Table 1 (b): Respondent's Experience and Numbers

Total Experience	Numbers
Above 21 Years	1
11 to 20 Years	5
Below 10 years	5
Total	**11**

Finding of the literature survey is supplemented by the feedback given by the respondent. This has resulted in twenty six criteria, and their corresponding sub criteria which are listed in TABLE (2).

Table 2: The list of Criteria and Sub Criteria

S. No.	Criteria	Sub Criteria
1	Quality	Quality of incoming lots, Consistency, Quality of service, Return rate, Complaints on quality, Product durability, Product reliability, Quality systems
2	Delivery	Compliance with due time, Idle rate, Lead time, Compliance with quality, Shorter order cycle time, Modes of transportation facility
3	Performance history	Reputation and position in the market, Past business experience, Demand

		fulfilment in urgent orders
4	Warranties &claim policies	Policies on warranties & claim, Claim settlement system & procedure, Warranty period, After sales services,
5	Production facilities & capacity	Plant capacity, Machinery & equipments availability, types of production system, Scope for future expansion
6	Cost	Competitive pricing, Unit cost, Warranty cost, Delivery cost, Total cost, Quantity discount, Cost of quality, Measurement and assessment cost, Payment terms, Payment procedures understanding
7	Technical capability	Technical knowhow, research & Development, Innovation & adoptability, Data & resources, Technical collaborations
8	Finance position	Assets & liability, Annual turnover, Profit after tax, EBITA
9	Procedural compliance	Process & system compliance, Environment compliance, Safety compliance, ISO certifications
10	Communication system	Communication methods, Speed of communication, clarity, uniformity, Systems & guidelines
11	Reputation & position in industry	Brand image, Ranking of the business, Reputation in market, Competitive products, position among customers mind
12	Desire of business	Competitiveness, Willingness
13	Management & organization	Management systems, Types of organization, Authority & responsibility
14	Operating controls	Operations strategy, Control & measures
15	Services	Spare parts availability, Handling of complaints, Ability to maintain product/service, Timeliness, Personnel services, Customer complaints, Training aids, Flexibility (Payment, Freight, Price reduction, Order frequency & amount)
16	Attitude	Customer handling, Willingness to provide extra, Integrity, politeness
17	Impression	Image in customer's mind, Adoptability in market
18	Packaging ability	Authenticity, Packaging design, Packaging cost, Environment friendly packaging materials
19	Labor related records	Labor laws & bylaws, Labor union records, Labor norms & system, Handling of dispute procedure & records, Attendance & leave records, Medical benefits to labor registers
20	Geographical locations	Location of the plant, Distance from raw materials, Distance from market, Availability of services & facilities, Power & water availability, Land availability, Nearby residential facilities
21	Amount of past business	Quantity sold, Annual goods dispatched, Total amount of sell, Percentage margin
22	Training aids	Training facilities, Qualified faculty & instructors, Availability of books &

		reading materials, Latest training aids, Internets & computers in training
23	Reciprocal arrangements	Immediate planning, Risk management policies, Reaction time, Speed of recovery
24	Green activities	Environmental norms and policy, Environment friendly products, Green operations, Green manufacturing, Green packaging, ISO 140001 Certifications, Disposal of hazardous materials, Environmental protection campaigns, Plantation of trees, Use of biodegradable materials, Recyclable products, Non conventional energy usage, Alternate Fuels & raw materials usage
25	Safety	Safety norms and policy, OHSAS 180001 certification, Safe business practices, Safety of employees, Safety of machines & equipments, Safe operating procedure, Job safety analysis, Work permit systems, Response time to accidents, Medical facilities, Fire hazard safety, Claims & reimbursement
26	CSR activities	Social image, Mutual trust and ease of communication, Educational & health facilities, Self help groups, Community development programs

To understand the importance of the criteria a questionnaire was prepared in which respondents were requested to rate the given criteria on a likert scale of 1-10. The questionnaire was distributed personally and through mail to forty seven executives of the nine plants of ACC Limited and Ambuja Cement Limited working in different departments such as procurement, production, logistics, environment, safety etc. The Demography of the respondents is given in TABLE (3a) (3b) and (3c).

Table 3 (a) : Statistics of Obtained Responses

Category	No. of plants	Responses obtained	Percentage of Total Response obtained
ACC Limited	6	28	59.57 %
Ambuja Cement Limited	3	19	40.43 %
Total	**9**	**47**	**100 %**

Table 3 (b): Respondent's Designation and Numbers

Designation	ACC Limited	Ambuja Cement Limited
General Manager	2	1
Deputy General Manager	4	2
Chief Manager/Managers	6	5
Deputy /Asst. Manager	10	7
Executives	6	4
Total	**28**	**19**

Table 3 (c): Respondent's Experience and Numbers		
Total Experience	ACC Limited	Ambuja Cement Limited
Above 21 Years	05	4
15 to 20 Years	8	5
10 to 15 Years	11	7
Below 10 years	4	3
Total	**28**	**19**

This exercise was carried out in two stages. First stage deals with rating of all identified twenty six criteria whereas second stage deals with rating of the sub criteria of selected criteria. Selection of criteria is done on the basis of average score obtained in the first stage. The average scores of the criteria are given in TABLE (4). In order to select the most important criteria, it was intended to accept the criteria with average 9 and above. The criteria identified from this stage are Quality, Cost, Services, Green Activities, Safety and CSR Activities of the suppliers.

Table 4: Average scores of the Criteria (on 1-10 scale)		
S. No.	**Criteria**	**Average Rating**
1	**Quality**	**9.66**
2	**Cost**	**9.57**
3	**Services**	**9.36**
4	**Green activities**	**9.23**
5	**Safety**	**9.17**
6	**CSR activities**	**9**
7	Delivery	8.87
8	Performance history	8.66
9	Technical capability	8.43
10	Finance position	8.34
11	Amount of past business	8.34
12	Geographical locations	8.15
13	Desire of business	7.98
14	Management & organization	7.98
15	Reputation & position in industry	7.72
16	Production facilities & capacity	7.57
17	Warranties &claim policies	7.21
18	Communication system	7.11
19	Procedural compliance	6.91
20	Attitude	6.83

21	Impression	6.74
22	Packaging ability	6.64
23	Operating controls	6.53
24	Labour related records	6.47
25	Training aids	6.26
26	Reciprocal arrangements	6.17

The average scores of sub criteria are given in TABLE (5).

Table 5: Average scores of the Sub Criteria (on 1-10 scale)

S. No.	Criteria	Sub-Criteria	Average rating
1	**Quality**	**Quality of incoming lots**	**9.62**
2		**Consistency**	**9.57**
3		Quality of service	8.96
4		Return rate	8.64
5		Complaints on quality	8.51
6		Product durability	8.11
7		Product reliability	7.96
8		Quality systems	7.74
9	**Cost**	**Delivery cost**	**9.40**
10		**Cost of quality**	**9.28**
11		**Measurement and assessment cost**	**9.00**
12		Competitive pricing	8.81
13		Unit cost	8.64
14		Total cost	8.51
15		Warranty cost	8.51
16		Quantity discount	8.43
17		Payment terms	8.11
18		Payment procedures understanding	7.96
19	**Services**	**Timeliness**	**9.53**
20		**Personnel services**	**9.34**
21		**Customer complaints**	**9.02**
22		Spare parts availability	8.64
23		Flexibility (Payment, Freight, Price reduction, Order frequency & amount)	8.51
24		Training aids	8.11
25		Handling of complaints	8.11

26		Ability to maintain product/service	7.96
27	**Green activities**	**Environmental norms and policy**	**9.34**
28		**Environment friendly products**	**9.28**
29		**ISO 140001 Certifications**	**9.02**
30		Green operations	8.96
31		Green manufacturing	8.64
32		Alternate Fuels & raw materials usage	8.51
33		Non conventional energy usage	8.43
34		Disposal of hazardous materials	8.43
35		Plantation of trees	8.11
36		Environmental protection campaigns	8.11
37		Use of biodegradable materials	7.96
38		Recyclable products	7.64
39		Green packaging	7.62
40	**Safety**	**Safety norms and policy**	**9.28**
41		**OHSAS 180001 certification**	**9.15**
42		**Safe business practices**	**9.06**
43		Safety of employees	8.96
44		Safe operating procedure	8.96
45		Safety of machines & equipments	8.81
46		Response time to accidents	8.64
47		Medical facilities	8.51
48		Fire hazard safety	8.43
49		Job safety analysis	8.30
50		Work permit systems	8.19
51		Claims & reimbursement	7.96
52	**CSR activities**	**Social image**	**9.15**
53		**Mutual trust and ease of communication**	**9.06**
54		Educational & health facilities	8.81
55		Community development programs	8.64
56		Self help groups	8.43

IV. CONCLUSION AND SCOPE OF FUTURE WORK

The main contribution of this research paper is in the identification of the important criteria and their corresponding sub criteria for Green Supplier Selection (GSS) for Indian Cement manufacturing industries. The criteria identified are the: Quality, Cost and Services, Green activities, Safety and CSR activities of the supplier.

The sub criteria under these criteria are: Quality of incoming lots, Consistency, Delivery Cost, Cost of Quality, Measurement and assessment Cost, Timeliness, Personnel services, Customer complaints, Environmental norms and policy, Environment friendly products, ISO 140001 Certifications, Safety norms and policy, OHSAS 180001 certification, Safe business practices, Social image and Mutual trust and ease of communication. Based on the identified criteria and sub criteria, a suitable model for the Green Supplier Selection (GSS) can be developed and the same can be used for selecting the suppliers for the Indian cement manufacturing industries.

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