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An Empirical Analysis of Influential Factors of Green Supply Chain Management in the Context of Indian Mining Industries

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Abstract – With the growing public awareness regarding mining environmental issues, pressure is surmounting on mining industries to reduce their environmental impact. Mining industries also have responded to these pressures by adopting various environmental practices. However green supply chain management (GSCM) has been gaining popularity as it focuses on reduction of environmental impact of the entire supply chain instead of the individual organization. Though strong research evidence exists regarding positive relationship between GSCM practices and improved organizational performance, still most of Indian mining industries are standing on the cross roads of GSCM adoption. The reason is the insufficient knowledge regarding the influential factors of GSCM. It has been found that there is no difference among different mining sectors in perception regarding the barriers of GSCM implementation.

Keywords: Green supply chain management, Environmental issues, Mining industries

I. Introduction

Industries contributes significantly to the employment and wealth generation of any country. However, the downside to this is the adverse impacts of the mining activities on the environment. There is growing consensus that, poor environmental performance of the mining companies not only leads to substantial liabilities for the public but also impose costs on the mining and mineral processing industries by eroding share value, increasing the risks of temporary or permanent shutdown, incapable to eliminate pollutants and merely transforms them from one form to another, In contrast to this green supply chain management (GSCM) that focuses on reduction of sources of waste thought the entire supply chain is gaining importance among the companies as a proactive environmental management strategy. Indian mining industries are striving hard to implement such strategies in their operations, but struggling to get success due to many factors like poor governance, lack of knowledge regarding various issues of GSCM as well as the influencing factors (Kannan et al., 2014) and lack of industry specific guidelines.

II. Theory and Hypothesis Development

With increased public awareness of the need to protect the environment, organizations have started realizing the urgency to introduce and promote business practices that help ease the negative impacts of their actions on the environment (Wang et al., 2013). Moreover, governments of several countries including India have developed and instituted a number of environmental laws and policies. As a consequence organizations from almost every industrial sector have started transforming their supply chains into green supply chains by conducting their supply chain activities in more environmentally friendly way. There is strong literature evidence of environmental performance improvement through GSCM adoption (Lun, 2011; Chiou et al., 2011; Zhu et al., 2012; Eltayeb et al., 2010, 2011; Green et al., 2012). Though GSCM has evolved beyond a firm-specific or end-of-pipeline green solution, it is not widespread in the context of Indian mining industries despite its environmental benefits. This factor can be attributed to the absence of a clear picture of sector specific influential factors of GSCM.

Owing to the observed differences among the companies in different sectors in terms of competition faced, technology,

uncertainty etc. Most of the industries extracting coal in India are public sector units whereas a significant number of iron ore and manganese ore extracting industries are privately owned. Further, the operational policies of the organizations are influenced by the regulatory policies of the state in which they operate. These variation in ownership, properties and competitive environments influence the opinions of the organization regarding their perception of influential factors of GSCM in Indian mining industries (Mathiyazhagan et al., 2013; Diabat and Govindan, 2011). In addition to that regulative pressure on small scale mining industries in India is low when compared with that on the large scale industries (Ghose, 2003b). Based on the literature the following hypotheses are formulated:

Hypothesis 1: Different mining sectors differ according to their perception on GSCM barriers.

Hypothesis 2: Capacity constraint is perceived as a stronger barrier in comparison to information gap by small scale mining industries.

Hypothesis 3: The coal sector has a different perception regarding the behavioural factors of GSCM than the iron ore and manganese ore sectors.

III. Research Methodology

This study is based on empirical data collected through a survey of Indian mining industries.

A. *Structure and Content Validation of the Questionnaire*

Investigation on various green issues in Indian mining supply chains were conducted through a questionnaire-based survey. The design of the questionnaire is based upon previous literature (Quazi, 1999; Quazi et al, 2001; Zhu and Sarkis, 2004; Wee and Quazi, 2005; Ravi, 2005; Zhu et al., 2007; Daily et al., 2007; Walker et al., 2008; Tseng et al., 2009; Kaur, 2011a) and consultation with practising managers and academicians. The questionnaire was designed on a five-point Likert scale.

The developed questionnaire was tested for (i) Reliability, (ii) content validity, (iii) construct validity.

1. Content Validity: The development of the measuring items in this research is based on exhaustive review of pertinent literature and thorough assessment by a group of experts both from industry as well as from academics. The content validity was further tested during pilot survey. A total of fifteen experts were chosen for pilot survey. These respondents have experience varying between five to twelve years. The other two members of the expert team were selected from directorate of mines, government of Odisha, and include a mining officer and a mining engineer. The members from the directorate of mines were engaged in reviewing license renewal criteria of various mining industries operating in Odisha. The content validity was further tested during pilot survey as per the guidelines prescribed by Froza (2002). The questionnaire was further improved either by deleting some questions or by modifying a few questions to convey their intended meaning through a care full review of the responses received during pilot study.

II. Construct Validity

The items, having a factor loading of 0.5 or higher and a cross loading of 0.35 or lower are used for the further improvement of the questionnaire.

A total of 500 survey questionnaire were sent either to the environmental officers or to the quality control officers of the mining industries operating in India. In return 163 responses were received. Out of the 163 responses 144 were accepted for further analysis. Hence an overall response rate of 28.8 percent is obtained. This response rate is higher than the that obtained by Wee and Quazi (2005) (21.9 percent) and Ravi (2005) (21 percent) in similar kind of research hence is considered reasonable. The profiles of the respondents are represented using figures 1, 2, 3, 4 & 5.

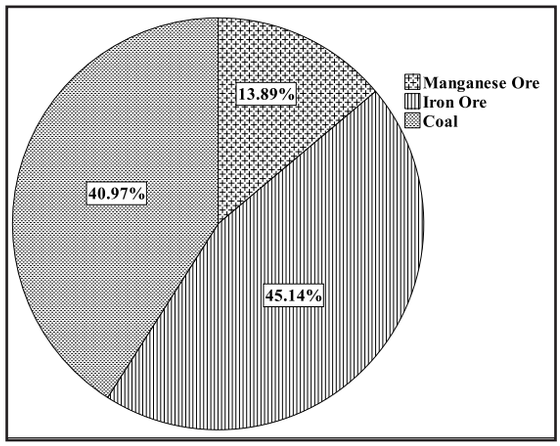

Fig. 1. Percent of respondents of the survey across different sectors

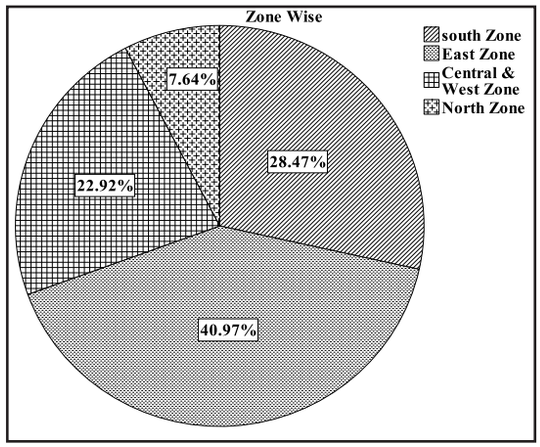

Fig. 2. Percent of respondents of the survey zone wise

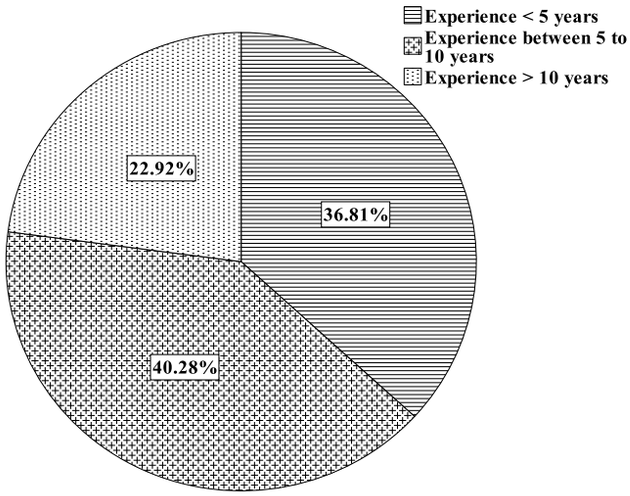

Fig. 3. Respondent profile based on number of years of experience

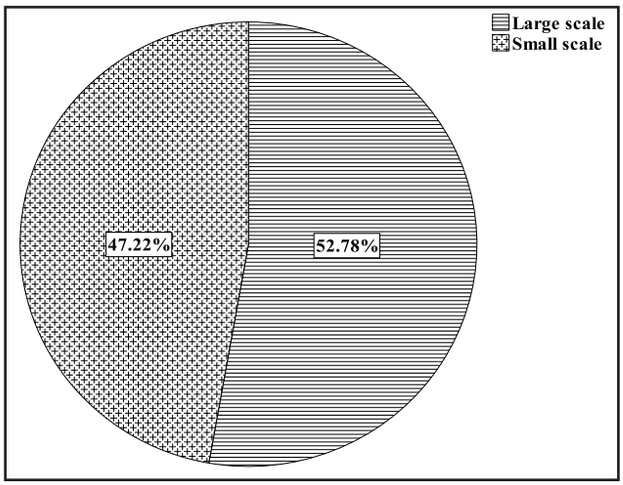

Fig. 4. Percent of respondents of the survey based on the production capacity of their organizations

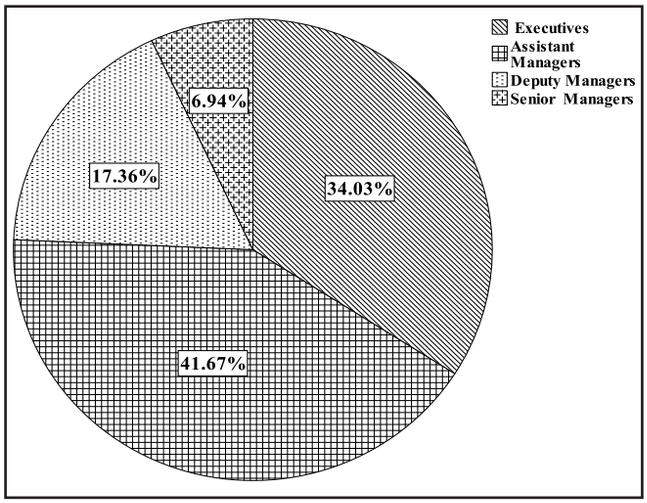

Fig. 5. Percent of respondents of the survey based on their designation

B. Measurement Instruments

Based on a detailed analysis of past literature on GSCM practices, GSCM in the context of mining industries and various categories of influential factors of GSCM, four sets of independent variables and two sets of dependent variables were compiled. These measurement items are discussed below in detail.

I. Independent Variables

The measurement items under this category asked the respondents to indicate the degree of influence they considered each item has on GSCM implementation using a five point Likert-type scale, with 1 being 'Least influence' and 5 being 'Most influence'.

a. GSCM Barriers

During adoption of GSCM in traditional SCM, some hurdles are experienced due to the expected transition; these hurdles are called barriers (Govindan et al., 2013). The barriers identified through scanning of literature and expert opinion are presented in table 1.

b. Behavioural Factors of GSCM

Behavioural factors represent those aspects that have the potential to affect the behaviour of a person to work for a certain objective (Grover et al., 2006). It has been advocated by several authors that success of any environmental strategy is influenced by the human resourcesthat execute it (Daily et al., 2007; Wee and Quazi, 2005; Govindarajulu and Daily, 2004), as shown in Table 2.

II. Dependent Variables

These variables were further categorized as 'Perceived GSCM Outcome' and 'GSCM Initiatives'. First category of variables were quantified using a 5-point Likert scale, with 1 being 'strongly disagree' and 5 being 'strongly agree' whereas the second category of variables were quantified using a five point Likert scale, with 1 being not implemented and 5 being completely implemented.

IV. Result Analysis

To test hypothesis 1, ANOVA test was conducted and differences among the sectors regarding the perceived barriers were analyzed. The test results presented in table 3, indicate that there is no significant difference (p values for all the factors are higher than 0.05) among the mining sectors regarding their perception about the barriers of GSCM. Thus hypothesis 1 is not supported.

To test hypothesis 2, paired sample t-test was conducted. Responses obtained from large scale industries were only used

to test this hypothesis. 'Capacity Constraints' and 'Information Gap' were used as the paired variables.

The test results shown in table 4, indicate that a difference between the mean values of the variables exists, which is significant (p<=0.000). Thus the hypothesis is accepted. To test hypothesis 3, ANOVA test was conducted. Opinions from the respondents were collected on a five point Likert scale about their perception regarding the impact of the soft factors 'Top Management Support', 'Employee Innovation', 'Work Culture', 'Team Work', 'Employee Motivation' and 'Minimizing Resistance to Change' on GSCM performance.

Results of the test presented in table 5, shows that there is no significant difference (p values for all the factors are higher than 0.05) among the three mining sectors regarding their perception about the soft factors of GSCM. Hence the hypothesis is not supported.

V. Conclusion

It can be thought of as an industrial philosophy that has evolved from the integration of environmental commitments and traditional supply chain activities. Its purpose is to either improve the environment or to preserve it, but not to allow its further depletion through the reduction of resources and energy. Although GSCM has been studied in detail for developed countries there has been little Further, the type of and strength of influence of these factors on GSCM adoption were investigated using various statistical methods. It was observed that industries from different mining sectors do not differ neither regarding their perception about GSCM barriers nor the behavioural factors. The study further finds that capacity constraints have higher inhibiting strength in comparison to the barrier information gap in case of small scale mining industries.

Though this research has been carried out in the context of Indian mining industries, yet it can be helpful for global mining industries. The measurement items used in this research can be used to study the GSCM practices in the context of global mining industries with little modification.

VI. Limitations and Future Scope

The amount of variation (R^2), accounted for all the proposed hypotheses in this research, is less than 100% which indicates that there are still other variables contributing to the variance. Future research may explore the possibility of identifying these.

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Anexure-1

Table 1
GSCM Barriers

GSCM Barriers	*References*
Capacity Constraints	Mudgal et al., 2010;Nikolaou and Evangelinos, 2010; Lee, 2008; Wu et al., 2012
Poor Legislative Measures	Ministry of Mines, 2010; Sharma et al., 2009; Deb et al., 2008;Ghose, 2003b;
Information Gap	Wu et al., 2012; Ghose, 2003b, Barve and Muduli, 2011; Ministry of Mines, 2010
Insufficient Pressure from Society	Testa and Iraldo, 2010; Hilson and Nayee, 2002;Ghose, 2003a; Barve and Muduli, 2011

Table 2
Behavioural Factors of GSCM

Behavioural Factors	*References*
Top Management Support (TMS)	Govindarajulu and Daily, 2004; Kaur, 2011a; Olugu et al., 2011; Mudgal et al., 2010
Green Innovation (GI)	Jabbour and Santos, 2008; Grover et al., 2006; Wee and Quazi, 2005; Zhu et al., 2012.
Green Motivation (GM)	Govindarajulu and Daily, 2004; Grover et al., 2006; Barve et al., 2009; Kaur, 2011b
Team work (TW)	Jabbour and Santos, 2008; Daily et al., 2007; Massoud et al., 2011
Work Culture(WC)	Jabbour and Santos, 2008; Govindarajulu and Daily, 2004;
Minimizing resistance to change(MRC)	Grover et al., 2006; Barve et al., 2009; Mudgal et al., 2010;Kaur, 2011b

Table 3
Results of ANOVA for GSCM Barriers

GSCM Barriers		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Capacity Constraints	Between Groups	49.516	2	24.758	1.068	.346
	Within Groups	3267.644	141	23.175		
	Total	3317.160	143			
Poor Legislative Measures	Between Groups	46.747	2	23.373	2.020	.136
	Within Groups	1631.246	141	11.569		
	Total	1677.993	143			
Information Gap	Between Groups	31.729	2	15.865	1.974	.143
	Within Groups	1132.930	141	8.035		
	Total	1164.660	143			
Insufficient Pressure from Society	Between Groups	60.942	2	30.471	2.838	.062
	Within Groups	1513.947	141	10.737		
	Total	1574.889	143			

TABLE 4
RESULTS OF PAIRED SAMPLE 'T' TEST

		Paired Differences							
			Std.	*Std. Error*	*95% Confidence Interval of the Difference*				*Sig.*
		Mean	*Deviation*	*Mean*	*Lower*	*Upper*	*t*	*df*	*(2-tailed)*
Pair 1	Capacity Constraints – Information Gap	4.289	5.899	.677	2.942	5.637	6.339	75	.000

TABLE 5
RESULTS OF ANOVA ANALYSIS OF BEHAVIOURAL FACTORS

		Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
Top management support	Between Groups	54.596	2	27.298	2.512	.085
	Within Groups	1532.341	141	10.868		
	Total	1586.937	143			
Employee Innovation	Between Groups	47.539	2	23.769	2.795	.064
	Within Groups	1198.899	141	8.503		
	Total	1246.437	143			
Work Culture	Between Groups	7.580	2	3.790	.463	.631
	Within Groups	1155.358	141	8.194		
	Total	1162.937	143			
Team Work	Between Groups	3.173	2	1.587	.189	.828
	Within Groups	1183.716	141	8.395		
	Total	1186.889	143			
Employee Motivation	Between Groups	3.251	2	1.625	.217	.805
	Within Groups	1055.909	141	7.489		
	Total	1059.160	143			
Minimizing Resistance to Change	Between Groups	25.239	2	12.620	1.105	.334
	Within Groups	1610.511	141	11.422		
	Total	1635.750	143			