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Status of Green Supply Chain Management Practices in Power Companies

[1]Sheetal Soda [2] Anish Sachdeva [3] R K Garg
[1][2][3]Department of Industrial and Production Engineering,
Dr B R Ambedkar National Institute of Technology Jalandhar

Abstract: **Green Supply Chain Management (GSCM) finds its extensive application in power industry, and has the potential to deliver cleaner energy, coupled with economic gains for the practicing organization. The research study is focused on the power companies of Punjab (India) to examine the deployment of green practices in the implementation of GSCM. This study presents one of the earliest efforts to undertake a survey on the subject of GSCM implementation in Indian power companies. Six factors considered for examining the status of GSCM in power industry. The result of study shows that the Green Organizational Culture and Government Regulations are the most important factors in propagating GSCM culture in the power companies and Green Energy Promotion and Green Awareness are the least important factors.**

I. INTRODUCTION

In recent years there has been phenomenal rise in global concern towards curbing the ill effects of human actions on environment. The evil of environmental degradation is manifesting itself in the shape of Global warming, aberrations in balance of eco-systems and an escalation in health ailments attributed to pollution. All over the world, concern for ecology and environment is increasing day by day. As a result, companies are being bound to adopt environmental friendly practices in their supply chain [1]. With avid desire for power; all economies across the world are gearing up to enhance their power generation capacities, which are going to cause danger to global environment. Power industry has been identified as one of the largest polluting industry. In contrast to developed nations, the developing nations are relatively lagging when it comes to greening supply chain of power industry. The Indian Power industry is in transition phase, as it is undergoing from traditional operations to modern practices; but still there is a long way to go.

The significance of the study manifests itself in the fact that the power utilities of the state need to have a consolidated analysis of their supply chains, which can throw opportunities of prospective gains. A study on Green Supply Chain Management (GSCM) practices prevalent in State Owned Power Companies (SOPCs), along with the areas where improvisation can be done, will help the SOPCs' managements indecisively dealing with the problems of losses and inefficiencies in a number of operational domains, simultaneously attending to environmental concerns, as well. This study deals with SOPCs of Punjab a state in North India, and tries to find status of GSCM practices implementation by power companies.

II. LITERATURE REVIEW

Over the last two decades, environmental issues have mainstreamed into the public sphere [2], [3]. GSCM is attracting increased attention from researchers working in the field of operations and SCM [4], [5], [6]. Apart from being environment-friendly, GSCM also promises economic gains for the practicing firm. It needs to be absorbed throughout the constituents of the conventional supply chain, to deliver its gains. A supply chain can truly become green when it is integrated throughout every aspect of the value chain [7]. GSCM drew its evolution and advancement from SCM. As competition intensified in 1990s, increased awareness of green practices triggered firms to act in an ethically and socially responsible manner concerning their supply chains [8]. By 1995, GSCM had attracted considerable scholarly interest; and the concept received highest attention of scholars in 2010 [9].

Electricity generation is by far one of the biggest global warming culprits. Electricity generating plants account for one-quarter of all carbon emissions for which human activity is responsible – and their harmful emissions have shot up by 60% over the past two decades, especially as China and India have experienced rapid economic growth [10]. Environmental issues in the electricity sector have been addressed directly through laws and governmental orders, and indirectly through policies on alternative technologies and efficiency improvement. Solutions to these problems lie in combinations of cleaner and more efficient generation,

appropriate control equipment, and more efficient end-use devices [11].

The success of power reforms and subsequent modernization and increase in efficiencies of SOPCs of Punjab will be led by deployment of GSCM initiatives. But greening power sector of state is not the sole responsibility of SOPCs; rather it calls for contribution from various non govt. organizations, public interest groups and consumers. The success of power reforms in Punjab will depend upon the sincerity of state government and the vigilance of Non-Government Organizations and public interest groups [12]. This calls for concerted efforts by all the stake holders of power sector – not only those involving in Generation Transmission and Distribution (GTD); but users and social activists as well.

The study as mentioned in this paper investigated the status of various green attributes as inherent to the implementation of GSCM. The study has been carried out in the field of power sector with focus on six green factors viz. Green Awareness, Government Regulations, Green Procurement, Green Technology, Green Energy Promotion and Green organizational Culture.

III. RESEARCH METHODOLOGY

The questionnaire in this study was derived from the literature, either through adoption or slight modification to make it relevant to this study. The quantitative questionnaire survey method is used in this study. Surveys are a fairly popular research strategy within business and management research [13]. Questionnaires were used to collect the required data from power companies of Punjab. The pilot test was conducted to improve the overall quality of the questionnaire. 40 questions were asked for GSCM practices. A 5-point rating scale, ranging from "1= Very Poor "to "5= Excellent," was adopted to measure GSCM practices parameters in the study. Items analysis was conducted for each of the 40 statements through a mean score.

IV. RESULT AND DISCUSSION

Table: 2 to 7 explains about the analysis in terms of mean values for effectiveness of green supply chain practices with 40 underlying items for power industry. Six green supply chain factors are considered for this study with 40 underlying items. Importance of these factors for an industry for effective GSCM implementation has been measured by computing the mean score. Cronbach's alpha is used to evaluate construct reliability, with the threshold value of 0.60 recommended by [14] Nunnally (1978) and [15] Flynn et al. (1990). All constructs in this study are higher than the recommended threshold value, and reliability of these constructs is ensured (**Table 1**). Since Cronbach's alpha values for all the factors are well above the critical value and ranged from 0.770 to 0.936.These results suggest that the theoretical constructs exhibit good psychometric properties.

Table 1: Reliability analysis of constructs

Construct	**Number of items**	**Cronbach's alpha**
Green Awareness	11	0.936
Government Regulations	8	0.909
Green Procurement	10	0.916
Green Technology	5	0.876
Green Organizational Culture	3	0.770
Green Energy Promotion	3	0.792

Table-2: Performance of Green Awareness [Factor 1] (Average Mean score: 3.02)

Item	Mean Score
In-House research to augment eco-friendly initiatives within the organization	3.04
Funding of research projects undertaken by external parties on the subject of green operations	2.97
Joint researches with other organizations on various issues of GSCM	3.06
Level of awareness on environment based issues among the consumers	3.08
Number of eco-friendly projects, other than attached with core operations	3.05
Status of ready database for reference, on the subject of eco-friendly operations	3.05
Volume of literature published/circulated by organization to generate environmental awareness	2.93
Advertisement channels used by the organization to promote awareness amongst consumer to cut down wastage	3.13
Number of seminars/conferences organized on green measures	3.01
Suggestions/Corrective actions proposed before the suppliers for making their operations greener	2.92
Participation of staff members in	3.07

developing eco-friendly policies	

Green Awareness: It is the concern as well as well-informed interest, on the part of stake holders, in matters pertaining to protection and conservation of environment. It represents consciousness and possible desire to preserve natural resources. Generally, it is characterized by environment-friendliness and a tendency to cut down on actions and behaviour that lead to wastages, pollution and destruction to ecology. Green Awareness has 11 underlying item. In power industry the most important item is Level of awareness on environment based issues among the consumers (3.08) followed by Participation of staff members in developing eco-friendly policies (3.07), and the least important item is Suggestions/Corrective actions proposed before the suppliers for making their operations greener (2.92) followed by Suggestions/Corrective actions proposed before the suppliers for making their operations greener (2.93).

Table-3: Performance of Government Regulations [Factor 2] (Average Mean score: 3.16)

Item	Mean Score
Effect of Government regulations on economic gains secured	3.16
Effect of Government regulations in the ease of carrying out business	3.12
Correlation between Government regulations and productive efficiency	3.13
Level of alignment between Government policies and organizational objectives	3.18
Extent to which regulations are complied with	3.15
Sensitivity of Government towards business objectives while formulating environment based regulations	3.18
Level of cooperation with other Government and Non-Government Organizations to promote eco-friendly operations	3.20
Relative percentage of total budget spent on green measures	3.22

Government Regulations: Last few decades have witnessed an increased participation from Governments at various levels, and through their agencies in addressing the cause of environmental conservation. This has led to emergence of various laws/ordinances/regulations aimed at curbing devastation of environment at the hands of industrial/manufacturing entities. Government Regulations has 8 underlying item. In power industry the most important item is Relative percentage of total budget spent on green measures (3.22) followed by Level of cooperation with other Government and Non-Government Organizations to promote eco-friendly operations (3.20), and the least important item is Correlation between Government regulations and productive efficiency (3.13) followed by Effect of Government regulations in the ease of carrying out business (3.12).

Table-4: Performance of Green Procurement [Factor 3] (Average Mean score: 3.06)

Item	Mean Score
Responsiveness on the part of suppliers regarding suggestions put forward by your organization	2.97
Joint programs/meetings/discussion with suppliers on the issue of environmental responsibility	3.00
Adoption of management concepts like JIT (Just in Time), TQM (Total Quality Management) and QFD(Quality Function Deployment) in daily working of organization	3.15
Periodic review of technologies, processes and procedures to ensure greener operations	2.96
Importance given by suppliers to concepts like eco-friendly operations and GSCM.	2.98
Feedback given to government on effect of regulations	3.24
Monitoring of staff regarding compliance of environmental standards	3.12
Share of budget spent on upgrading green technologies and processes	3.20
Extent of inclusion of environmental related clauses in the agreement signed with suppliers	2.90
Checks and balances to ensure that eco-friendly policies deployed are delivering to the best of their potential	3.08

Green Procurement: When purchase decisions, programs and procedures are hinged on the concerns of environment protection, then the ensuing sourcing of raw/intermediate material is termed as "Green Procurement." In power industry the most important item is Feedback given to government on effect of regulations (3.24) followed by Share of budget spent on upgrading green technologies and processes (3.20), and the least important item is Responsiveness on the part of suppliers regarding suggestions put forward by your organization (3.13) followed by Effect of Government regulations in the ease of carrying out business (3.12).

Table-5: Performance of Green Technology [Factor 4] (Average Mean score: 3.10)

Item	Mean Score
Development of instruments/equipment which reduce wastage of power	3.06
Deployment of IT tools as an instrument for cleaner and greener operations	2.97
Induction of new technologies to curb down pollution and wastage	3.12
Complying with stipulations of Electricity Regulatory Commissions with respect to eco-friendly operation	3.19
Quantum of eco-friendly measures planned by top management	3.17

Green Technology: The term "Green Technology" subsumes within itself the development and usage of products, machinery and systems that aim at conservation of natural environment and its inherent resources. Green Technology helps in curbing the potential ill effects of human activities on environment, to a substantial extent. In power industry the most important item is Complying with stipulations of Electricity Regulatory Commissions with respect to eco-friendly operation (3.19) and the least important item is Deployment of IT tools as an instrument for cleaner and greener operations (2.97)

Table-6: Performance of Green Organizational Culture [Factor 5] (Average Mean score: 3.18)

Item	Mean Score
Status of awareness regarding environmental concerns, among the employees	3.10
Clarity of environmental consciousness in organizational vision/mission	3.20
Adherence to the environment policy of the organization by the employees	3.23

Green organizational Culture: Green organizational Culture practice includes various different factors that help in increasing consciousness in employees apropos environment conservation; promotion of inter-departmental actions and information exchange on subjects like environment, output, effectiveness etc. In power industry the most important item is Adherence to the environment policy of the organization by the employees (3.23) and the least important item is Status of awareness regarding environmental concerns, among the employees (3.10)

Table-7: Performance of Green Energy Promotion [Factor 6] (Average Mean score: 2.98)

Item	Mean Score
Providing subsidies to consumers on products which consume lesser energy and are more energy efficient	2.96
Offering incentives to consumers who save/ judiciously use energy	2.91
Information/Feedback channels on the official website of the organization to promote GSCM	3.06

***Green Energy Promotion*:** Green Energy Promotion consists of the measures used to popularize, stimulate and increase the adoption of products, processes, systems etc. related with energy usage that are environment friendly in nature; among stakeholders (esp. consumers) . In power industry the most important item is Information/Feedback channels on the official website of the organization to promote GSCM (3.06) and the least important item is offering incentives to consumers who save/ judiciously use energy (2.91)

Graph: 1 Comparative analysis of effectiveness of green supply chain factors.

While analyzing the green supply chain factors in power industry it has been observed that the most important factor is Green Organizational Culture [Factor 5] (3.18) followed by Government Regulations [Factor 2] (3.16) and Green Technology [Factor 4] (3.10) and the least important factor perceive is Green Energy Promotion [Factor 6] (2.98) followed by Green Awareness [Factor 1] (3.02) & Green Procurement [Factor 3] (3.06). From the study it can be concluded that power companies should focus more on Green Energy Promotion, Green Awareness and Green Procurement for making their supply chain greener.

IV. CONCLUSION

The essence of GSCM implementation is conservation of environment by cutting down on pollution and wastage; thereby minimizing the harmful impact of production processes on natural ecology. Nevertheless, the concept also subsumes gains in domains other than

environment viz. Economic gains, enhanced brand equity, operational efficiency etc. [16]. Power Industry is unique in the sense that it is most indispensable industry for economic growth, while being one of the most polluting as well. The findings from this study, which has been carried out in context of Punjab province of India clearly show the importance of Green Organizational Culture and Government Regulations in propagating GSCM culture in the power companies. Stringent enforcement of regulations by the law enforcing agencies is by far the biggest driver in popularizing the adoption of GSCM by power companies in the state. In contrast, the factor Green Energy Promotion and Green Awareness does not project themselves prominently This can be attributed to the fact that there is stunted dissemination of knowledge about GSCM practices amongst stake holders; most noticeable the consumers – a substantial chunk of which are from lower socio-economic strata which are more associated with unawareness on the discussed subject. Because of their profit motive orientation, economic gains are of immense interest to companies when they go for GSCM implementation.

REFERENCES

[1] Chien, M. K., and Li-Hsing Shih. "An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances." *International Journal of Environmental Science and Technology:(IJEST)* 4, no. 3 (2007): 383.

[2] Barkemeyer, Ralf. "Beyond compliance–below expectations? CSR in the context of international development." *Business Ethics: A European Review*18, no. 3 (2009): 273-289.

[3] Holt, Diane, and Ralf Barkemeyer. "Media coverage of sustainable development issues–attention cycles or punctuated equilibrium?."*Sustainable development* 20, no. 1 (2012): 1-17.

[4] Srivastava, Samir K. "Green supply-chain management: a state-of-the-art literature review." *International journal of management reviews* 9, no. 1 (2007): 53-80.

[5] Zhu, Qinghua, Joseph Sarkis, and Kee-hung Lai. "Green supply chain management innovation diffusion and its relationship to organizational improvement: An ecological modernization perspective." *Journal of Engineering and Technology Management* 29, no. 1 (2012): 168-185.

[6] Govindan, Kannan, Mathiyazhagan Kaliyan, Devika Kannan, and A. N. Haq. "Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process." *International Journal of Production Economics* 147 (2014): 555-568.

[7] Wang, Hsiao-Fan, and Surendra M. Gupta. *Green supply chain management: Product life cycle approach*. McGraw Hill Professional, 2011.

[8] Diabat, Ali, and Kannan Govindan. "An analysis of the drivers affecting the implementation of green supply chain management." *Resources, Conservation and Recycling* 55, no. 6 (2011): 659-667.

[9] Luthra, Sunil, Dixit Garg, and Abid Haleem. "Identifying and ranking of strategies to implement green supply chain management in Indian manufacturing industry using Analytical Hierarchy Process." *Journal of Industrial Engineering and Management* 6, no. 4 (2013): 930.

[10] Don Grant, Wesley Longhoferand Andrew K. Jorgenson. "Targeting Extreme Polluters to Reduce Carbon Emissions from the Electricity Sector", *Journal of Environmental Studies and Sciences* 3, no.4 (2013), 376-380.

[11] D'Sa, Antonette, and KV Narasimha Murthy. "Environmental Reform in the Electricity Sector China and India." *The Journal of Environment & Development* 15, no. 2 (2006): 158-183.

[12] Singh, Kulwant, Rajesh Kumar, and Surinder Kumar. "POWER SECTOR REFORMS." *Man & Development* 28 (2006): 39.

[13] Saunders, Mark NK. *Research methods for business students, 5/e*. Pearson Education India, 2011.

[14] Nunnally, J. "Psychometric Theory, 2nd. edMcGraw-Hill." *New York* (1978).

[15] Flynn, Barbara B., Roger G. Schroeder, and Sadao Sakakibara. "The impact of quality management practices on performance and competitive advantage."*Decision sciences* 26, no. 5 (1995): 659-691.

[16] Soda, Sheetal, Anish Sachdeva, and Rajiv Kumar Garg. "GSCM: practices, trends and prospects in Indian context." *Journal of Manufacturing Technology Management* 26, no. 6 (2015): 889-910.