Assessment of Environmental Performances of Small and Medium Scale Indian Industries in the context of Green Supply Chain Management (GSCM)

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Abstract:
GSCM is extremely important for recent manufacturing systems. In an environmentally awaken atmosphere GSCM has an indispensable role to play to reduce the carbon footprint of different manufacturing operations. In the Indian context, the small and medium scale enterprises are unaware of environment friendly supply chain operations. Therefore there is an urgent need to develop a scale for implementing GSCM practices in those manufacturing domain. The objective of this paper is to investigate in formulating a widely acceptable scale for evaluation of green supply chain (GSC) system practices among those manufacturers. On the basis of the data collected from 119 Indian enterprises, measurement models of GSCM practices were evaluated. The assessments are done through the questionnaire from Small and Medium size enterprises (SMEs). Role of environmental performance in the green supply chain system for those enterprises is critically analyzed in this work. Conclusive strategies of this attempt will enable those manufacturers to perform effectively in dealing with GSCM issues.

Key words: Green Supply Chain Management, Survey, Environmental performance.

1. Objective:
Principal objective of the study is to do a comparative analysis of environmental performance between small and medium scale Indian industries in the viewpoint of GSC system. This critical comparison will empower the India SMEs to do the needful.

2. Literature review:
There are only a few attempts to critically analyze the environmental performance in GSCM. Various approaches to GSCM practice have been identified by various researches; yet they are very brief and have limited scope. One of them is by Quinghu Zhu et al (2008) [16] where the researchers conceptualize GSCM practices implementation.
A supply chain environmental performance assessment for telecommunication sectors was developed by Horvath, 1999 [8]. The assessment was based on a life-cycle assessment. Relationships between Green Supply Chain Management practices implementation and performance with a focus on the moderating effects of quality and lean practices were investigated by Zhu and Sarkis (2004) [23]. A number of GSCM practices implemented by Chinese enterprises to improve their performance were described by Zhu et al. (2005) [24].
3. The green supply chain:
Small and medium scale enterprises generate substantial value addition in the manufacturing sector, but their performance for implementing environmental regulations is not at all acceptable. In most of the cases they are the main culprit for polluting the environment. Due to this fact the implementation of GSCM practices is absolutely crucial for environmental perspective. Therefore, there is a burning need to formulate a scale to evaluate the environmental performance of the SMEs. GSC involves three approaches namely: environment, strategy and logistics. Figure 1 suggested by. (Breno Torres Santiago Nunes, Sergio Marques Junior, Rubens Eugenio Barreto Ramos, 2004)[1]. In context to Gilbert, 2001[5], green supply chain initiative provide competitive advantages such as low costs. In addition to low cost, Gilbert (2001) [5] stated that GSC also opens up new markets for organization.

![Fig. 1 Approach of green supply chain](image)

With the inception of the concept of GSC, manufacturers have started stressing upon the greener products design. For changing product design and for improving the recycling of the products, the manufacturer has to work in close proximity with recycled parts suppliers.

4. Research methodology:
Best Practices questionnaire have been developed. These questionnaire consist 10 underlying statements. Countries like China and Spanish industries are also critically investigated to set a benchmark of performance of Indian SMEs in the domain of implementing GSCM practices. To analyze the scores of Indian SMEs in different modules are being develop to comprehensively express its real performance.

The target respondents for this survey were requested to indicate through a five-point Linkert scale (Excellent/Completely agree-5 , Very good/ Rather agree-4, Good/ Partly agree-3, Average/ Rarely agree-2, Below average/Completely disagree-1.), the extent to which it perceived its enterprises implementing each of the dimensions of environmental performance and green supply chain management practices. The number of Indian SMEs is very large and analyzing the performance of each of them is quite cumbersome task. So some representative industries are selected for a gross performance trend in terms of environment friendly manufacturing. The 119 SMEs are sufficient to comprehend the overall performance towards GSCM.

For each of the 10 statements item analysis was conducted between the highest and lowest group through a “mean score”, “t-test” and “p” test.
5. Result and comparative analysis:

5.1 Comparative analysis of “Environmental Performance”:

Air emission control is important for reducing environmental pollution and subsequently implementing green supply chain management. Similarly, minimization of solid waste is crucial for green operations. Furthermore, recycling and recovery reduces environmental hazards and ensures cost reduction. Additionally, waste water treatment is also essential as per the rules and regulations of the ministry of environment. Table 1 and Graph 1 explains about the effectiveness and draws comparative analysis between Environmental Performance factors and 10 dimensions underlying for Indian small and medium sized enterprises. On the whole 119 industries have been considered (59 from medium scale industry and 60 from small scale industry).

Table: 1 Comparative analysis of mean score of Environmental Performance

| Sl. No. | Dimension                                                                 | SMALL SCALE Mean (S.D) | MEDIUM SCALE Mean (S.D) | MEAN DIFF. | RNK | t    | p     |
|--------|---------------------------------------------------------------------------|------------------------|-------------------------|------------|-----|------|-------|
| I      | Minimization of air emission                                              | 2.266 (0.756)          | 2.745 (0.842)           | 0.479      | 8   | 3.262| 0.001 |
| II     | Minimization of solid waste                                               | 2.400 (0.741)          | 2.762 (0.727)           | 0.362      | 3   | 2.695| 0.008 |
| III    | Improve production procedure/method for reducing waste/scrap              | 2.183 (0.624)          | 2.517 (0.731)           | 0.334      | 2   | 2.664| 0.009 |
| IV     | Recovery through sale of scrap and used/rejected material                 | 1.600 (0.785)          | 1.881 (1.068)           | 0.281      | 1   | 1.635| 0.105 |
| V      | Recovery through sale of excess capital equipment                         | 1.483 (0.650)          | 1.915 (1.193)           | 0.432      | 6   | 2.457| 0.015 |
| VI     | Recovery through sale of old/obsolete equipment                           | 1.474 (0.727)          | 1.898 (1.213)           | 0.424      | 5   | 2.300| 0.023 |
| VII    | Recycling of waste water                                                  | 1.466 (0.675)          | 1.949 (1.195)           | 0.483      | 9   | 2.717| 0.008 |
| VIII   | Optimization of manpower resources in production process                  | 2.483 (0.911)          | 2.898 (0.687)           | 0.415      | 4   | 2.801| 0.006 |
| IX     | Reduction of consumption for hazardous materials                          | 2.050 (0.768)          | 2.711 (0.910)           | 0.661      | 10  | 4.281| 0.000 |
| X      | Reduction in frequency of environmental accidents                          | 1.800 (0.859)          | 2.271 (0.961)           | 0.471      | 7   | 2.816| 0.006 |
Graph: 1- Comparative analysis of mean score of Environmental Performance

6. Comparative result analysis of different country:

It is very much necessary for analyzing the comparative assessment of these Indian SMEs with respect to some foreign counter parts. Air emission control, waste water management, recycling and recovering are the important modules of activities in all form of manufacturing plants. The comparative assessment of these modules is to be carried out to comprehend the gravity of the situation. The scores related to the performance of Chinese and Spanish industries are collected from the existing literature. United nations have set some pollution and emission norms for all the countries in the world. So a comparative assessment scale is very much important for analyzing the pollution related performance of these SMEs of the different parts of the world and bare minimum standard has to be implemented of every country without paying heed to their geographical locations, financial status and the overall discipline of the countries. The researchers have worked on various modules of GSCM practices implementation in different countries, for different time periods, for different classes of industries. The mean scores (percentage arrived with linkert scale adopted by researchers) of the some modules studied are tabulated below:
Table 2: Analysis of comparative result of different country for GSC.

| Modules/Equivalent modules | Maximum recommended score by ISO 14001/Certification body for implementing an environmental management system | Javier et al, 2008[9] (Operations management practices linked to adoption of ISO 14001: An empirical analysis of Spanish manufacturers [Spain]) | Qinghua et al, 2008,[15] Firm-level correlates of emergent green supply chain management practices in the Chinese context [China] | A Comparative Analysis of Environmental Performance between Small and Medium Scale Indian Industries for Implementation of Green Supply Chain System [India] |
|---------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Linkert Scale**         | **in %**                                                                                                         | **6 (in %)**                                                                                                                  | **5 (in %)**                                                                                                                  | **5 (in %)**                                                                                                                  |
| Minimization of air emission | 100                                                                                                              | 4.98 (83.0)                                                                                                                  | ---                                                                                                                               | 2.505 (50.1)                                                                                                                  |
| Minimization of solid waste | 100                                                                                                              | 5.34 (89.0)                                                                                                                  | ---                                                                                                                               | 2.581 (51.6)                                                                                                                  |
| Improve production procedure/method for reducing waste/scrap | 100                                                                                                              | 4.37 (72.8)                                                                                                                  | 3.670 (73.4)                                                                                                                  | 2.350 (47.0)                                                                                                                  |
| Recovery through sale of scrap and used/rejected material | 100                                                                                                              | 3.98 (66.3)                                                                                                                  | 3.480 (69.6)                                                                                                                  | 1.740 (34.8)                                                                                                                  |
| Recovery through sale of excess capital equipment | 100                                                                                                              | ---                                                                                                                             | 3.340 (66.8)                                                                                                                  | 1.699 (33.9)                                                                                                                  |
| Recovery through sale of old/obsolete equipment | 100                                                                                                              | 4.01 (66.8)                                                                                                                  | 3.430 (68.6)                                                                                                                  | 1.686 (33.7)                                                                                                                  |
| Recycling of waste water  | 100                                                                                                              | 3.81 (63.5)                                                                                                                  | 3.350 (67.0)                                                                                                                  | 1.707 (34.1)                                                                                                                  |
| Optimization of man power resources in production process | 100                                                                                                              | 3.99 (66.5)                                                                                                                  | ---                                                                                                                               | 2.690 (53.8)                                                                                                                  |
| Reduction of consumption for hazardous materials | 100                                                                                                              | 4.26 (71.0)                                                                                                                  | 3.570 (71.4)                                                                                                                  | 2.380 (47.6)                                                                                                                  |
| Reduction in frequency of environmental accidents | 100                                                                                                              | 4.58 (76.3)                                                                                                                  | 3.650 (73.0)                                                                                                                  | 2.035 (40.7)                                                                                                                  |
It is observed that in above foreign industries, the impact of GSCM practices and implementation is higher. It is also observed that for all the modules, Indian industries score significantly less compared to the industries of the other countries. In India, the awareness regarding the implementation of GSCM practices is far from satisfactory. It is suggested that more emphasis should be given for GSCM practices for effective recognition and satisfactory implementations. The management of Indian industries, especially small and medium sized industries, should be more focused to the above modules for better implementation of GSCM practices.

7. CONCLUSION

A detailed study about the performance of the Indian SMEs is carried out and the scores of the Indian industries are compared with Spanish and Chinese counterparts. It is revealed from the comparison that most of the Indian enterprises are operating at a very low level in terms of implementing GSCM. In most of the modules, the scores of Indian enterprises are the least. It is evident from this analysis that the awareness regarding GSCM is exceptionally poor for the manufacturing operations in India. Therefore, a uphill task is ahead of the Indian SMEs to come to the international level. Pollutions due to the manufacturing processes mainly in the urban and suburban areas are mostly done by Indian SMEs. In different sectors, the SMEs has to incorporate the awareness programs related to the green procurement, green processing, green waste management at various levels. These lower level performances of the Indian SMEs have to be audited on regular basis under a common platform for alleviating them from the bottom most level. This paper identifies the pragmatic situations of Indian SMEs and their extreme level of non-performance towards GSCM implementation.

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