“An in-depth study of Green Supply Chain Management (GSCM) Practices in selected Chemical Industries in Gujarat”

A Thesis Abstract Submitted for the Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

In

MANAGEMENT

Submitted By:
Rinki Rola
(Registration Number: 10E0227)

Under Guidance of
Dr. S. O. Junare
Director, SJPIBMCA (NICM) Gandhinagar

Submitted To

Kadi Sarva Vishwavidyalaya
Gandhinagar

November 2014
Abstract:

Green supply chain management was emerging in the last few years. The GSCM concept covers every stage in manufacturing from the first to the last stage of life cycle, i.e. from product design to recycle. GSCM not only can be implemented in manufacturing organizations instead GSCM can also be used to other organizations such as government, education and services. But most importantly it is very crucial for the chemical industries to implement the green supply chain management practices to reduce their continuously increasing effect on the environment. The chemical industry in India is fragmented and dispersed. It is multi product and multifaceted – which really makes it complex and a challenging task to address sustainability issues. The industries have been labeled to be the most polluting industries, still the sustainability issues are yet to come in widespread manner. This calls for the research in chemical industries for GSCM practices and is being undertaken as the topic for the research study with a special focus on chemical industries in Gujarat state.

The study used exploratory research design to study the macro environment of chemical industries for the GSCM implementation followed by the descriptive research to determine the relationships among various components of green supply chain management practices and interrelationships among them. The non-probability convenience sampling method was used for data collection out of the chemical industries list provided by iNDEXTb published in 2010. All three segments namely, basic chemicals, Specialty Chemicals and Knowledge Chemicals of Chemical Industries are selected for the primary research and data collection. The data has been collected from the all eight Chemical Clusters declared by GIDC Jamnagar, Mehsana, Anand, Vadodara, Bharuch, Bhavnagar, Ahmedabad and Valsad. The study combines issues related to the environment with others supply chain management functions. The appropriate person from which the required data could be obtained should ideally have knowledge about both aspects. Managers of Environment Management Systems (EMS) departments or managers of Environment, Health and Safety (EHS) departments at various Chemical Industries were considered as sample universe for sampling procedure. Sample size calculation performed with consideration of Finite Population correction factor with $N = 2052$, $n = 384$, $p = 0.5$, $q = 0.5$, Confidence level = 95%, $\alpha = + or - 5\%$ gives $n = 324$ as sample size.
A total of 1000 chemical industries in Gujarat were approached for the survey and were administered with the research questionnaire, and only 331 respondents completed and returned the instrument. This is a 33.1 per cent response rate. Questionnaire was divided into three major sections containing 14 questions. All the 331 respondent’s entries were done in SPSS. For the analysis of data statistical methods are applied with the aid of Statistical Package for Social Science (SPSS) software, version 16.0 and excel.

The data shows that most of the chemical industries surveyed are at the beginning Stage of green supply chain activities followed by the few large scale chemical industries which are at intermediate stage of green activities implementation. It is found that only very few players are implementing green activities entirely along the every activity and are at advanced stage of green activities implementation and there are almost practically no medium sized and large scaled chemical industries without green activities strategy. It also shows that there is an association between the state of green supply chain management process and ISO 14000 certification achieved by an organization. The stages of green management activities differ among organizations having ISO 14000 certification and not having ISO 14000 certification. There is also an association between the state of green supply chain management process and adoption of environmental management system. The stages of green management activities differ among organizations having adopted EMS and not adopted EMS. There is an association between the state of green supply chain management process and the size of an organization. The stages of green management activities differ among medium and large size of organizations.

The top three influencing factors are environmental commitment of Top management followed by gain legitimacy and at the third rank are employee’s values. The preferences of organizations to work with various external parties/ stakeholders namely Competitors, Suppliers, Consultants, 3PL providers, Governmental Agencies and Customers differ.

An exploratory factor analysis was conducted to derive groupings of Green Supply Chain Management (GSCM) Drivers/Pressures; they were extracted using maximum likelihood method, followed by varimax rotation. The eight factors on GSCM Drivers/
Pressures are labeled as Vertical Channel Partners, Environmental Regulations, Society, Expected Business Benefits, Top Management Support and Corporate Values, Competitors’ Practices, Organizational Factors and International Environmental Agreements. An exploratory factor analysis was conducted to derive groupings of Green Supply Chain Management (GSCM) Practices. Seven factors of GSCM Practices are labeled as Green Manufacturing, Green Procurement, Green Designing, Green Supplier Development, Green Management, Green Logistics and Green Marketing.

A similar factor analysis of the GSCM Performance items of also grouped the scale items as predicted. The five factors on Green Supply Chain Management (GSCM) performance are labeled as Environmental Performance, Financial Performance, Operational Performance, Competitive Performance and Reduction in Penalties. The regression analysis of GSCM Drivers on GSCM practices shows that there is a significant impact of various GSCM Drivers on the various GSCM Practices followed the Chemical Industries in Gujarat. Also there is a significant impact of GSCM Practices adopted by the chemical industries and the various organizational performance measures named as GSCM Performances.

After the both exploratory and primary research it was observed that the Indian Chemical Industries are feeling multiple pressures and drives to react to the environmental needs. They are also reacting with multiple and diverse set of actions of green supply chain initiatives. The large scales Industries are taking many innovative steps towards implementation of GSCM and practicing environmental sustainability. Most of the industries are at still at very beginning stage but the continuing pressures from all the major drivers will make them realize the need to implement and advanced the GSCM initiatives. The chemical industries are experiencing high regulatory and market pressures, pressures from their suppliers and other channel partners and at the same time from internal pressures from their organization, top management etc. Still they are lagging on external relationships such as green purchasing. Being a process oriented organizations they are more proactive towards environment needs of the manufacturing operations then their other parts of the operations like logistics, designing, supplier development and so on.
As initial survey had revealed that the Small Scale Industries (SSI) does not have much awareness about the green supply chain management practices. There is almost negligible implementation of GSCM in SSI Units because of unavailability of required funds for the initial investment for Green activities implementation in supply chain. Overall this study provided the additional insights into the growing field of the relationships between environmental drivers and practices and performances. Only the large and medium organizations have recognized the need of implementing the green supply chain management initiatives others have lagged in the implementation of these principles into practice.

Government should do campaigns to create awareness of green issues as customers are one of the major drivers of GSCM implementation. Governments should make some laws for GSCM implementation so as to motivate them as the one of the main drivers for GSCM implementation is to gain legitimacy. Further efforts by governments and industries are needed to promote GSCM implementation, from within manufacturer boundaries to broader product supply chain boundaries. Government of India agencies (Ministry of Environment and Forest, Central Pollution Control Board, Department of Chemicals and Petrochemicals) must work with state governments to ensure more rigorous and transparent enforcement of pollution and environment related regulations in chemical units. Government can give subsidies to motivate GSCM implementation and should aid the industrial association like chemical industry association of India to address barriers they may face internally or throughout the supply chains.

Providing greater autonomy to Pollution Control Boards (PCBs) for stricter enforcement could be considered as the regulations and enforcements from the pollution control board act a major driving force to for chemical Industries to implement GSCM Practices. Public will also be involved by introducing of ‘whistle-blower schemes’ with incentives to identify the defaulters. For the interest of development of chemical industry Government of India should consolidate multiple legislations governing the chemical industry into Integrated Chemical Legislation which should cover the entire life cycle of chemicals.
It is recommended to take up Life Cycle Analysis of toxic chemicals to help understand exposure potential to humans and identify population at risk. Life Cycle Assessment is a decision cum management tool which provides information on the environmental effects of various products and processes so as to arrive at necessary corrective measures to make the entire process efficient with optimal utilization of resources and minimal wastes generation.

Industry needs to develop and upgrade technologies and processes to produce chemicals starting from agro-wastes and non-edible agricultural products such as ethanol, glycerin, cellulosic materials, non edible oils, etc. to surfactants, polymers, specialty and fine chemicals, through fermentation, genetic engineering and bio-tech based processes and intermediates.

There are many ways in which Chemical Industries can reduce carbon footprint in manufacturing plant. A closer look at the power source is an excellent start. Looking beyond the source of energy, there are ample opportunities to reduce consumption. How water is consumed as a resource throughout the production stages? How efficient are your plant layout and production plans? Streamlining production steps and reducing toxic materials and harmful emissions can each have a significant impact on how green your supply chain.

Green initiatives are tied to the larger issue of corporate social responsibility (CSR), the idea that companies have obligations not just to their investors but also to their stakeholders, society, and the environment. Industries should consider these GSCM practices as a CSR activity and should work upon them as their responsibility towards the society and environment.

This study is only one of few efforts to investigate green supply chain management practices in chemical industries. Thus, the investigation and its findings are still relatively exploratory. It is expected that the as time progresses the relationships between the increasing pressures and nascent GSCM practices will become clearer. In arriving the results we must mention the presently the research is concentrated only to large and medium chemical industries and factory units in Gujarat state. It is expected that the as time progresses the relationships between the increasing
pressures and nascent GSCM Practices will become clearer. GSCM tends to have win-win relationships in terms of environmental performance and financial performance in log run.

**Keywords:**
Green Supply Chain Management (GSCM), Green Manufacturing, Green designing, Green Operations, Environment Management systems, GSCM Drivers, GSCM Practices, GSCM Performances, ISO 14000, Green Logistics, Green procurement, Green Supplier Development.