Study of Green Supply Chain Management Practices and its impact on Chemical Industries

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Abstract

Supply chain management is about minimizing or optimizing operation to maximize the efficiency of an organization. The effective Supply Chain Management delivers product or services quickly, at lower cost without any quality compromise. In Green Supply Chain Management, the word Green means greening the process of procurement, manufacturing, storage, distribution and reverse logistics (Source – Proceedings of the International Multi-Conference 2010, Hong Kong).The importance of green supply chain management is to optimize &reduce waste which could be in the form of solid waste, emissions, energy and chemical/hazardous liquids. These days the concerns to producers or manufacturer are coming from various issues relating to Environment like different directives or legislation from consumer or end user in many countries.

Purpose: The objective of this study is to understand Green Supply Chain Management practices implementation in Chemical Industries in India. The other objective is to study & understand the effect of Green Supply Chain Management Practices on Chemical Industry's performance. The third objective is to understand the impact of PESTEL (Political, Environmental, Social, Technological, and Economical & Legal) on implementation of GSCMP. The last objective for the study is to understand the role of Institutional pressure, Green Innovations on Organizations performance.

Methodology: Data will be collected through a survey method within Chemical Industries in India and would be based on structured questionnaire. Chemical industry in India will be taken for study. Total 80 Supply Chain personnel will be interviewed. The sample is adequate as it represents 10% of the total chemical industries as ten percent of the total industries sample is adequate as per Hair et al.(2005), Umasekaran (2006).

Expected Results: The importance of green supply chain management practices on Indian chemical industry's performancetaking into account the test method.The institutional pressure plays moderated effect between performance of an organization and Green supply chain management.It is also observed that the technology of greening has mediating outcome between performance of an organization and green supply chain management practices.

Key words: Green Supply Chain, Chemical Industries, Green Supply Chain management practices (GSCMP), Eco-Design, Green Purchasing, Green Innovations, Institutional Pressure.

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Introduction

Concept of Green Supply Chain

It is essential to understand the concept of green supply chain due to global warming and environmental concerns. These days' the customers are more focused on commodities they are procuring. Some organizations have been already focusing on improving the environmental performance and monetary improvements. For example, General Motors avoided disposal cost by $12M by launching a recyclable container platform with their vendors which not only helped in reducing cost but also improved environment. This concept helps in reducing transportation cost, less handling & disposing cost & reducing waste water and many more. So the purpose of Supply chain management is to optimize operations to maximize the efficiency of an organization. The effective green supply chain management delivers product or services rapidly, at lower cost without any quality compromise. The organizations can achieve cost benefits by reducing environmental effect in their business practices. So most of the firms these days understand and know that a green supply chain is mandatory to have for better business achievements. The organizations can motivate their suppliers by supporting them to quantify various benefits of a green supply chain. So it is essential to help vendors to recognizeand determining environmental matters and help them in connecting their own improvement initiatives.

Significance of Green Supply Chain in today's business

Before start thinking of implementing green supply chain, it is essential to understand the significance of it in today's business. The numerous significance which can be noticed by implementing green supply chain that could improve operations by engaging an environmental solution, improves agility by reducing risks and speed innovations, increase flexibility by evaluating advanced processes which results in better arrangement of guidelines and business processes. There are various areas to green the supply chain management and they are detailed as below.

Product design: An eco-friendly process of design helps to reduce material usage, reduce operation; proper use of tools can reduce the hazardous emissions at product design stage

Production: Following the approach of lean manufacturing to achieve benefits in operations, gasoline efficient tools and machines, choosing less carbon energy sources

Material Procurement: Applying green procurement controls, practical backing to vendors for emissions reduction, setting procedure for habit of using less harmful ingredients

Packaging: Lower toxicity, recyclability, mercury free, hazardous waste, durability or reusability and energy efficient

Storage: Tactically placing the store&delivery centers, improve store layout, developing fuel efficient machines and tools

Logistics and Reverse Logistics: Improved loading, dispatch shipment directly shipment to the consumers, pre-defining routes of supply to customers and reverse logistics.

Statement of Problems & Need for the Study

The chemical or many other industries these days prevent themselves to adapt to green supply chain management guidelines because of lack of generic structure. The generic structures in Green Supply Chain Management could be MBNQA (Malcom Baldrige National Quality Award), EFQM

(European Foundation for Quality Management), RGNQA (Rajiv Gandhi National Quality Award) and CII (Confederation of Indian Industry's Centre of Excellence for Quality) are the business structures for TQM (Total Quality Management) implementation. To be successful in implementing any green supply chain project mainly bank on the support they receive from top management as the approval of money and other sources needed to endorsed by them. The management endorsement will give assurance to the program or the project due to higher significance inside the organization and will obtain required attentiveness. The commercial backing and desired resources are really required to make the projects successful and lack of these will mostly lead to failure. Not only the primary support but the personal backing is quite significantin smoothing the execution of green supply chain projects, mainly if it can notice resistance from the workforce involved in carrying out the projects (Ngai et al., 2004). The above statements evidently express the necessity for 'gauging or benchmarking' GSCM across many industries and firms.

Green Supply Chain in Chemical Industry

With highly diversified chemicals, currently the Indian Chemical Industry is worth $147B. It contributes to 15% of India's manufacturing GDP and this industry is important to the country's financial growth and has a possibility to grow up to $226B by 2020. Presently, the Indian Chemical Industry is accounted for 3% of global chemical market and 6th largest by value in the world. In India, the specialty chemicals sector is driving a double-digit growth and it is also an integral segment of manufacturing, automobile, pharmaceuticals and textile. To meet global quality standards and support related sectors these days the chemical industry is adopting sustainable practices. There have been many initiatives like "Make in India", reforming labour laws, easing the land acquisition rules and GST, India is at the edge of becoming a manufacturing hub for the globe. Due to its diverse production base, Indian Chemical Industry has massive possibility to become a global supplier. Therefore, a sustainable supply chain for the sector has become vital. The producers in Indian have started spending in R&D and executing green approaches to manufacture non-hazardous chemicals. The Indian textile chemical manufacturers have also understood the importance of moving towards biodegradable options and they are utilizing resources into the improvement of bio-auxiliaries and applications of probiotics to produce alternative bio-chemicals.The Petroleum, Chemicals and Petrochemicals Investment Region (PCPIR) is a planned investment region spread across 250 Sq. KM for the manufacture of chemicals, petroleum and petrochemicals for national and trade purpose. The Government of India has already enrolled strategies respectively in order to build PCPIRs in the country. The Government also introduced the essential scheme for research in the chemical industry, which mainly focuses on green and sustainable tools to decrease the dangerous effect of chemicals on the environment. The GST implementation will also help in benefitting the Chemical Industry by decreasing the logistics cost and evading the effects on Governmental taxes. The Chemical Industry in India is quite huge and shields more than 8,000 commercial commodities. The green initiatives by the Chemical Industry and the help from Indian Government are guiding India to be the next huge production hub and global supplier of chemical of worldwide sustainable quality.

Relevance of Green Supply Chain in Chemical Industry

The boost in demand & consumption for energy, increase in greenhouse/conservatory emissions, and compulsion on demanding natural resources

such as water, oil and earth have impacted the environment and bionomics or ecology very hard. Addressing these concerns should be taken on priority basis without losing any time. The customers in Indian market have this growing curiosity about protecting the environment. Technology has a critical aspect in today's age in customers mind as these customers are well informed about the ecological issues and hence it is important to change their though process so as to shelter a socially active lifestyle. The organizations which are active in going green are not only achieving profits in the long run but will also support in maintaining the ecology system and lower the impact on environment. These days' media also plays an important role by highlighting those organizations which implement green concepts and it creates a valuable marketing for the firms. Green Concept marketing for organizations can do a world of good for their corporate model. And hence the organizations which are actively involved in implementing green concept will achieve more visibility and reap credibility. The green concept implementation also ensures firms to achieve present and future environmental legislation. *Green Supply Chain Management is thus attaining sense due to declining raw materials, degradation of environment, pullulating waste lands and increasing pollution levels. Today the world has become so competitive that it is not only about being having improved trade or business sense and benefits but also about environment kindness.*

Literature Review

The Green supply chain management practices established upon firms to layout implement & generate products which are friendly to the environment and are suited in sustaining the environment. The green approach is revolved all through the phases of a product life cycle. To apply these practices of environment in the full process of supply chain and shift the conventional supply chain to greening supply chain practices as the major focus of the study is to sustain environmental factor (Jabbour et al. 2014).

The study advocates that if firm's approaches the green supply chain, then it could attain better commercial benefits through wastage reduction. To protect the environment it is important to lower the wastages which have lower impact or harm to the environment. Hence green supply chain will account for more economic & environmental performances in comparison with conventional GSCM practices enforced in industries (Zhu, Sarkis 2004).By implementing eco design during production, the environmental performance can be enhanced (Diabat, Govindan 2011).

The main objective of eco-design is to investment recovery by reusing of products many times and that will not only directly lower remanufacturing cost but will also lower the overall wastage. Hence eco-design has a direct effect on environmental and economic performances. The study has proven that GSC practices have direct impacts on economic performances. The reduction in wastage should provide lower cost, and it is directly connected with financial performance. The firms which manufacture at low cost these can better their economic performance (Sun et al. 2017). IP which also referred as Institutional pressure is the activity of moderating firm characters to enhance their planning to protect the environment. The large institutional actors those are social, political, religious, local communities, competitors, consumers, foreign society, market and administrative firms (Wu et al. 2012). All firms' stakeholders push the firms to do forceful actions in specific conditions to protect sustainability of the environmental. Firms anticipated that they have to come across the institutional pressure, which will have effect on their strategic decisions (Tingey-Ho-lyoak 2014).

The political parties & regulatory authorities in many countries is applying force on firms to approach towards greening SCM to conserve environment. Many countries have defined some governance for firms to develop their environmental guidelines (Li et al. 2017). Moreover, many firms know that the local Government is the main stakeholder. Hence, these firms have to follow the policies set by accredited firms. Political power and local regulations are the also important institutional pressures for organizational processes (Majundar, Marcus 2001).

These days the firms respond according to consumers need as they have analyzed that if they did not meet consumers requirements, then the competitors can get benefit and approach their customers (He et al. 2016). To measure the green product innovation there are mainly four factors. The 1stfactor in innovation of green product is that firms establish the strategies for lower consumption of unprocessed material during designing & development process of the product(Fei et al. 2016). The energy consumption is the second main factor of green product innovation. The third major factor of green production innovation is that firms to have strategy to produce the finished goods with lesser amounts of raw material. The most important and fourth factor of product innovation is to produce products which can be recycled (Chiou et al. 2011). This helps firms to plan the dissolve/discompose them without much problem and then producers use them again.

The design of product should be friendly to environment (Sun et al. 2017).The implementation of process related to green inginnovation is very modern &inventive processes in firms to accomplish industry goals. To save and deliver energy savings during manufacturing and other processes, it is very critical to focus on green process innovations (Dai, Zhang 2017). The implementation and practice of greening innovation will motivate to reduce harmful materials and decrease waste materials. When firms destroy lower waste then it will have an impact on reduction of performance related to environment (Geffen, Rothenberg 2000). So, the process of green innovation is directly affecting the economic and environmental performance as the lower or reduce waste &production cost (Jakobsen, Clausen 2016).Table 1 gives the summary of the same.

Research so far on Green Supply Chain Management

Table 1: Summary of studies on Green Supply Chain Management

Author / Year	Area of Study	Gap Analysis
Miroshnychenko et al. 2017	Eco-Friendly Designs, customers to buy and use products	Internal Environmental Management (IEM)
Sun et al. 2017	Product Design, Environmental Friendly, Low Cost, Economic Performance, Green product Innovation	Cooperation with customers (CC)
Li et al. 2017	Rules & regulations, Environment Policies	Investment Recovery (IR)
Dai, Zhang et al. 2017	Save Energy during production and other organization processes	Cooperation with customers (CC), Internal Environmental Management (IEM)
Seles et al. 2016	Strategies Environmental friendly, organization performance	Green Purchasing (GP)
He et al. 2016	Customer's requirements, competitive advantage	Institutional Pressure (IP)

Fei et al. 2016	Green product Innovation, Develop Strategies	Eco-Design (ED)
Jakobsen, Clausen et al. 2016	Environmental & Economic Performance, lower consumption of energy, coal, oil resources or water	Cooperation with customers (CC)
Lee, Min et al. 2015	Reduce emission of toxic materials during production	Institutional Pressure (IP)
Zailani et al. 2015	Adopting Green innovations	Eco-Design (ED)
Jabbour et al. 2014	Environmental Sustainability, Management Practices	Green Purchasing (GP)
Tingey-Ho-Iyoak et al. 2014	Institutional Pressure	Eco-Design (ED), Cooperation with customers (CC)
Wu et al. 2012	Political, Social, Consumer, competitors, social, religious, local communities, foreign society, market and regulatory firms	Cooperation with customers (CC)
Diabat, Govindan et al. 2011	Implementation of Eco-Design	Institutional Pressure (IP)
Chiou et al. 2011	Commodity recycling, green innovation process, green production innovation, industry performance	Cooperation with customers (CC)
Chen et al. 2006	Green Technology, protecting environment, recycling energy savings, green procurement, eco-design, reduce waste, hazard's emissions	Eco-Design (ED), Institutional Pressure (IP)
Rao, Holt et al. 2005	Competitive Advantages, Green Supply Chain Management approaches	Eco-Design (ED), Cooperation with customers (CC)
Zhu, Sarkis et al. 2004	Environmental & Economic Performance, Traditional Supply Chain Management practices	Green Purchasing (GP), Institutional Pressure (IP)
Khanna, Anton et al. 2002	Environmental & economic performance, institutional pressure on organization	Cooperation with customers (CC)
Christmann, Taylor et al. 2001	Environmental Management	Institutional Pressure (IP), Cooperation with customers (CC)
Geffen, Rothenberg et al. 2000	Environmental Performance	Institutional Pressure (IP), Green Purchasing (GP)
McIntyre et al. 1998	Environmental assessment, product life cycle stages	Institutional Pressure (IP)
Green et al. 1998	Policies and green purchasing, Environmental performance	Cooperation with customers (CC)
	Environmental assessment, product life cycle stages	Institutional Pressure (IP)
Green et al. 1998	Policies and green purchasing, Environmental performance	Cooperation with customers (CC)

Identification of Variables and Developing Theoretical Model for Research

Based on Literature Review and Gap Analysis variables are identified for the proposed study.

Dependent Variables

Green Supply Chain Management Practices (GSCMP):

Over the last 5 decades, supply chains have

emerged from consumer–vendor communications through intelligence allocation to strategic association among supply chainally and, in last 10 years, the target is on the issues related to environment notonly for single firms butals of or the complete supply chains (Centobelli, P.; Cerchione, R.; Esposito Energies 2018,11,275). The management of green supply chain may also be divided in to observing and association based set of approaches to accomplish economic and environmental targets (M.; Park, Chu, S.H.; Yang, H.; Lee, S2017). The other studies from various parts of the globe have also been taken into consideration for the sesets of approaches (A.; Deshmukh, Chandra Shukla, S.; Kanda2009).

IR (Investment Recovery): This is approach which considers the business of surplus used materials, scraps, inventories, and surplus capital equipment as a strategic agreement to achieve the maximum advantage from its assets (Chan, H.K.; Chan, R.Y.; He, H.;Wang, W.Y2012).

GSCM (Green Supply Chain Management) Performance:

Generally, the performance of the SCM is measured by quality, time, cost and flexible dimensions with few deviations as per the requirements of the business and establishments (Beamon, B.M. 1999.). According to GSCM, the measurement of performance requires some additional and specified methods depending upon economic and environmental dimensions (Mansouri, S.A.; Geng, R.; Aktas, E.2017). Production factories should to decrease harmful emissions, reduce solid waste and water usage while reducing the use of harmful and dangerous raw materials to demonstrate improvement in environmental performance (Bhadauria, V.S., Meacham, J.; Green, K.W., Jr.; Zelbst, P.J.; 2012).

Moderating Variables

IEM (Internal Environmental Management):

IEM is the method of consolidating GSCM into a firm's strategy and display the engagement through higher management's view, middle management involvement, and growing beyond all firms associates through the foundation of cross-functional units (Zhu, Q.; Sarkis, J.; Lai, 2008).

ECO (Eco-Design):

This design approach is aggressive way to manage degradation of environment and it establishes conformity with pollution avoidance at the beginning point of a commodity lifecycle (D.;Kannan, Mathivathanan, D.; Haq, A.N.2018). These approaches considers environment from the concept generation to the commodity design that has benefit of low consumption of energy and lesser raw materials, and reducing harmful emissions, which can have better impact both on economic as well as environmental performance (Bhadauria, V.S., Green, K.W., P.J.; Meacham, J.2012).

GP (Green Purchasing):

The green procurement approach targets on collaborating with various vendors to manufacture products which are sustainable and environmental friendly (Zhu,Q.;Sarkis,J.; Lai, K. 2008). Green Procurement can also be seen as strategic plan for procurement having environment awareness concerns which are reducing waste and have the opportunity of recycling and reusing commodities (de Oliveira Frascareli, F.C.; DeSousa Jabbour, A.B.L.; Jabbour, C.J.C.2015).

CC (Cooperation with Customers):

In modern world, this process of CC involves them from eco-design to circulations, handling packaging and the approaches of returning back the commodities (Govindan, K.; Bouzon, M.; Rodriguez 2018). It is important to build upon a long relationship with mutual trust to discuss actual information and accurately achieve all processes as discussed above(McGrath, P., L.; Heavey, C.; Marshall, D.;McCarthy, 2015).

IP (Institutional Pressure):

The firm's assessments are mainly constructed upon a set design of norms, behaviors and ethnic principles due to the impact of an external environment (Kalchschmidt, Gualandris, J.; 2014). Institutional theory focuses 3 types of isomorphic pressures, where coercive pressures are a set of formal or informal pressures from influential firms, on which the principal firm is reliant on due to explicit as sets, surviving by the law, or even societal opportunities. The pressure can take the form of invitations by manufacturing firms to associate them to secure a source of fear or benefits to be comefined or expelled for non-compliance of specific government laws or regulations (DiMaggio, P.; Powell,W. 1983). The normative pressures are an outcome of definite standard and norms formalized by environment from ethnic beliefs of the environment (Yang, H.;Lee,M.;Chu,S.H.; 2017).

GI (Green Innovations):

Eco Innovation or green innovation is the progress of processes and commodities that add to sustainable development, relating the marketable solicitation of information to produce direct or indirect biological enhancements.

Independent Variables

Political (Government Policies) – It regulates the range to which a Government can affect a certain industry or any economy.

Economics – This causes on the performance of the economy which directly impacts many industries.

Social– It determines the societal environment of the marketplace, and measures population analytics & cultural trends.

Technological– This refers to the technology innovations which can affect the industry operations.

Legal - In certain country, there could be certain laws which affect the environment of the business due to which the industry need to maintain few Governmental policies.

Environmental– This contains that can influence or are determined by the adjacent environment.

The above mentioned variables are classified under Independent, Dependent & Moderating Variable which is given in the following

Table 2.

Independent Variables	Moderating Variables	Dependent Variables
Political	Green Purchasing	Investment Recovery
Economic	Eco-Design	GSCM Performance
Social	Internal Environmental Management	Green Supply Chain Practices
Technological	Cooperation with Customer	
Legal	Institutional pressure	
Environmental	Green Innovations	

Keeping these variables, the following theoretical framework is suggested for the present study.

Proposed Theoretical Framework

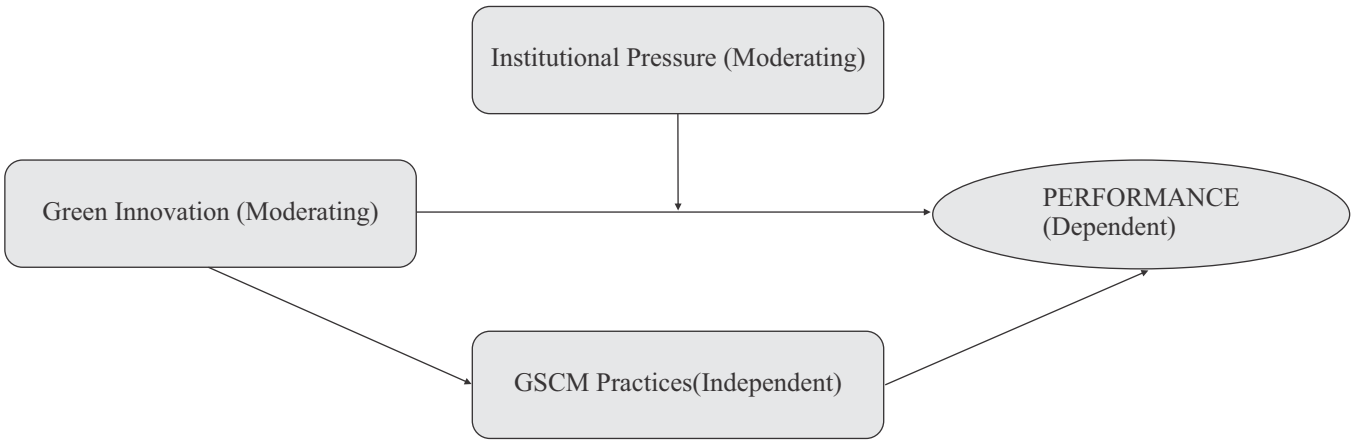

Figure 1: Conceptual Model

Objectives:

Keeping the theoretical framework in mind and different variables, the following objectives are taken for the study.

To study the trends of GSCM practices implementation in Indian Chemical Industries.

To measure the influence of GSCM practices on Chemical Industry's performance

To understand the impact of PESTEL (Political, Economic, Social, Technological, Legal and Environmental) on implementation of green supply chain management practices.

To understand the role of Institutional pressure, Green Innovations on Organization's performance.

Hypotheses:

Based on literature review and conceptual model mentioned in Figure 1, following hypotheses have been formulated.

H1 (Hypothesis 1): Green supply chain managementpractices have positively relation on performance of the environment.

H2 (Hypothesis 2): Green supply chain management has positively relation with performance of industry operations.

H3 (Hypothesis 3): The Operational & Environmental performance is positively related to the financial performance.

Research Methodology

In this study the focus would be on large scale, medium scale & SME scale chemical industries in Maharashtra, Gujarat & Noida in India. In this study, we will follow mail survey method to collect the data from professionals from supply chain in chemical industries. A detailed analysis will be done with the guidance of professors in Supply Chain field in Chetna College. A complete analysis will be used to categorize the literature and improve the research direction of the study. The research review is motivated on development of green supply chain management including all those previous scholars which is relevant to societal & environmental sustainability toward the supply chain and operation management.

Research Design: The process of methodology is constructed on the various set of events to complete the study. Research methodology is established on the data collected from literature review of many newsletters, articles, research papers, publications etc. A wide range of sustainability improvements across corporate types, trades and business functional areas were deliberated, and the types of profits produced were looked at. A detailed research on various establishments' initiatives towards green supply chain management has been done and relevant proposals and profits have been derived. The nature of research is quantifiable. In this particular research, empirical research method is used since in this study, based upon the theories and literature review, hypotheses have been established. The intangible method develops the correlation between variables. By using various statistical tests, the correlation has been verified. The effects of these statistical tests shows demonstrate the correlation and then apply these results to other trades.

Method of Data Collection: In this research, a survey method based on set of questionnaire will be used to collect data. The population of the research is Indian chemical industry. Sample is the subset of population. In this research cluster, random sampling methods will be used to gather data. The sampling size would be 80;the sample is adequate as it represents 10% of the total chemical industries as ten percent of the total industries sample is adequate as per Hair.et al (2005), UmaSekaran (2006).

Research Questionnaire Design: Questionnaire will be developed based on Zou & Sarkis 2008approach to measure Green Supply Chain Performance. They have taken variables like Green Purchasing, Integrating Green Management in product life cycle and green supplies to the suppliers & customers to the same of 1 to 5. Material requirements, pre-manufacturing, manufacturing, usage, supply and discarding as per Faruk et al. 2002 will be added in measuring the Green Supply Chain Management (GSCM). Internal Environment Management will be measured on Green Purchasing policy, training of the employee, middle management support regular supply evaluation process as per the scale developed by Carter et al. 1998. Eco-Design will

be measured on emission of toxic materials, energy consumption as per research of Green et al 2012. Green Purchasing will be measured based on recycling of the product, planned purchase awareness as per study of Dsouza et al 2015. All these 3 variables will be measure from the scale of 1 – 5.

Table 3 Research Questionnaires

Sr. No.	Set of Questions
RQ1	What will be the dimensions/factors which are significant for GSCM implementation?
RQ2	Is it possible to suggest a hypothetical model and test it empirically?
RQ3	Is it possible to provide references to Indian chemical industries on the basis of numerical output and offer additional research guidelines?

Expected Outcome & Contribution

The study aims to show:

- The effect of GSC Mapproaches on chemical industry's performance through the regression test.
- Institutional pressures have moderated effect between green supply chain management and industry's performance.
- And the greening innovation shows mediating affect between green supply chain management practices and industry's performance.

This research can be applied in chemical industries to reinforce the supply chain management channel applying better theories and methods to boost performance & innovation. Moreover, this study can be applied outside India and in various sectors such as health care and construction. From the research point of view, it can open new doors and dimensions to the arena of greening innovation, institutional pressure, green supply chain management and performance, for the new scholars to do further study and analysis. Hence, this study had practical implementation in both facets.

Limitations of the Study

The larger market of the chemical industry in India belongs to small scale firms and in the current highly competitive market, it would be tough to implement green supply chain practices. This study is an effort to improve a theoretical structure which is limited in knowledge based theory. This study helps to extent the previous studies which doesn't have theory motivated approach. The limitation or implication of this study is that the information of the research gap can be used to focus efforts on key areas so as to ensure quick and broad execution of green supply chain management practices.

Time Frame

Introduction	2 months
Literature Research Review	6 months
Writing of Questionnaire & Survey	8 months
Analysis	4 months
Writing Report / Synopsis	4 months

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