Abstract

Introduction
In the past, the concept of environmental quality was almost non-existent in the world’s business community. Gradually, environmental consciousness grew. Today, it encompasses issues like clean air, safe drinking water, healthy ecosystems, safe food, safe waste management, natural resource conservation and the restoration of contaminated sites. The most commonly perceived culprits to environmental protection are poor planning and implementation of manufacturing processes, poor production and operations management practices, poor disposal of end-of-use items, poor quality of raw material, improper product-design, improper use of transportation mode etc. In this sense, business operations are viewed as a potent threat to the environment, as they contribute to waste generation, ecosystem disruption, and depletion of natural resources. Our current production practices are believed to outstrip the earth’s ability to recover and rejuvenate itself and, thus are not sustainable by the earth’s ecosystem (Beamon, 1999). Also, with increasing consumerism, production of goods and services is ever increasing. Therefore, churning out goods for the consuming masses of the world, pose a serious threat to the environmental health of the globe (Rao, 2004).

The current state and trend of environmental degradation from regulatory, consumer, and moral standpoints indicates a need for change in approach to manufacturing (Beamon, 1999). There is a need for a fundamental shift in the way business processes are managed. This presents the industry with both challenges and opportunities in integrating environmental concerns in business processes. This can help in achieving sustainable development for human society.

Manufacturing Operations and Sustainability
Various organizational functions - be it engineering and design, purchasing, operations, human resources, etc. - in some form or the other impact environmental sustainability. However, manufacturing and operations are core functions that have a profound and direct impact on corporate environmental performance (Sarkis, 2001). A number of issues encompass this function such as product design, selection of raw
materials, manufacturing processes, re-use or recycling of used products (Jones and Klassen, 2001). These activities can potentially harm the environment, if environmental considerations are ignored in their development and deployment. This throws the integration challenge, i.e. challenge of blending environmental management into core business processes, tools, decision-making and accountability (Schaltegger et al., 2003).

Organizations, today, are sourcing raw materials and semi-finished and even finished components from numerous suppliers and sub-suppliers. Thus, many of today’s supply chains are longer and complex. Therefore, supply chain management has become vital in today’s globalized world (Welford, 2002). In such a situation, organizations need to take responsibility for the environmental performance of the entire supply chain. This presents a new challenge of balancing efforts to reduce costs and innovate while maintaining good environmental performance (Pagell et al., 2004). Thus, the management of supply chain is an important element for business to lower its environmental and social impacts (Wycherley, 1999), hence a potent area in achieving sustainability in manufacturing operations.

**Green Supply Chain Management (GSCM)**

Adding green component to supply-chain management involves addressing the influence and relationship between supply-chain management and natural environment (Srivastava, 2007). GSCM includes green purchasing, green manufacturing/ material management, green distribution/ marketing and reverse logistics (Hervani et al., 2005). It is also rooted in the idea of corporate social responsibility which calls for and facilitates organizations to make all operations and supply chain decisions within the context of environmental concerns. The aim of organizations adopting GSCM practices is to enhance their environmental and financial performance, investment recovery and eco-design or design for environmental practices (Zhu and Sarkis, 2004).

**Literature Review**

Literature was reviewed under the following broad themes:

- Governmental Role in Environmental Management
• Environmental Strategies
• Environmental Management System
• Environmental Technologies
• Key Business Processes

**Literature on Key Business Processes**

The following are the key business processes on which extensive literature review was carried out.

- Product development
- Purchasing
- Manufacturing
- Reverse logistics
- Environmental performance evaluation/measurement

Chen (2001) suggested that green product development, which aims to prevent pollution in the first place through product design and innovation, has emerged as an innovative and sustainable tool for solving today’s environmental problems. Simon (1992) argued that the green products emerge from the demand-pull of customers with new attitudes toward environmental values. Jain and Kaur (2004) reported that green product development is also stimulated by various forms of environmental standards imposed by governments around the world.

Porter & van der Linde (1995) and Carter & Ellram (1998) have reported that purchasing function is placed in an advantageous position to implement waste reduction strategies. Faith-Ell et al. (2006) reported that purchasers can improve the environmental performance of the products and services by expressing environmental preferences through green procurement. Lippmann (2001) highlighted the need for working collaboratively with suppliers on new product development, providing training, and/or mentoring, in order to increase their environmental management capacity. Rao (2002) observed that enhancing the environmental performance of suppliers lead to competitiveness and improved economic performance.

Azzone and Bertele (1994) have pointed out that the production processes effect the environment by affecting both the production of pollutants and the consumption of
natural resources. Bhat (1996) opined that pollution reduces efficiencies and increases costs because discharged wastes contain expensive materials, energy inputs, labour and overheads. Hui et al. (2001) and Tan et al. (2002) described green manufacturing as a mode that encompasses all the methods of manufacturing that are designed to minimize the environmental impact, reduce waste & pollution and conserve resources. Rao (2004) has suggested that the internal supply chain’s performance can best be managed within this function and reported four frameworks (i) Cleaner Production, (ii) Lean Production, (iii) Eco-efficiency and (iv) TQEM, as commonly used by the industry while implementing green manufacturing in their firms.

Reverse logistics stands for all the operations related to the reuse of used products. Martin (2001) described reverse logistics as a way to maximize the value of residual assets. Dowlatshahi (2000) termed reverse logistics as the process in which a manufacturer systematically accepts previously shipped products or parts from the point of consumption for possible recycling, remanufacturing or disposal. Wu & Dunn (1995); Carter & Ellram (1998) observed that reverse logistics has important environmental dimensions. Daugherty et al. (2001) have stated that reverse logistics is fast becoming a competitive necessity. They identified some of the potential benefits that may accrue to firms with an effective reverse logistics program such as better customer satisfaction, increased control on inventory, reduced costs, higher profitability, and enhancement of corporate image. Another dimension of reverse logistics is Product Life Extension. Roy (2000) reported that product life extension aims at decreasing the environmental impact while increasing the economic value of the product at different stage in its life cycle.

There is a wide variety of criteria that can be used to evaluate a firm’s environmental performance. James (1994) has proposed a set of criteria including the quantification of environmental costs, and environmental protection activities, satisfaction of consumer needs, evaluation of the impact on the environment as a result of the activities of the company, consumption and efficiency in the use of resources, and wastes generated and risk assessment. Sarkis and Rasheed (1995) presented a list of environmental performance measures such as recycled content, recyclability, reusability, degradability, hazardous/toxic waste content, resource/energy usage, and air, water & soil pollution issues related to product, process and technology.
The key gaps identified as a result of extensive literature review are as follows:

- Majority of the studies reported in the literature are carried out in context of the developed countries. The researcher could not locate any empirical study in Indian context.

- In most of the studies, only large firms are focused upon and there is general lack of studies on small and medium enterprises (SMEs).

- In the available literature, barriers and enablers impacting integration of environmental concerns in key business processes have been reported. However, that listing is far from comprehensive. Moreover, their relative importance and mutual relationships are also not yet identified and analyzed in the available literature.

- Generally, there are a large number of vendors supplying various components to OEM. A significant portion of these vendors fall in SME category. Till date, suitable integrating methods for the suppliers have not been devised for improving the overall environmental performance of supply chains.

- Available literature records issues related to implementation of some of the GSCM practices. However, there is lack of enough understanding on similarity and dissimilarities across the different industrial sectors and categories.

- Companies could have different alternatives for the conduct of GSCM program and practices. These alternatives have been individually discussed in the existing literature on environmental management. Yet, not many analytical models can be found, which guides practitioners in selection of the best alternative for the conduct of GSCM operations. Also, a holistic framework, incorporating both tangible and intangible variables in evolving an environmental friendly approach, has not been developed, as yet.
The Study
This research aims to integrate environmental concerns in business processes, primarily the supply chain processes. This is expected to ensure productivity and welfare of the society, contributing to sustainable development. Integration is the main theme of this research. From the interdisciplinary perspective, the research bridges Operations and Supply Chain Management and Environment Management in order to balance a variety of corporate objectives such as profitability, productivity and waste management. From cross functional perspective, the research attempts to bring together different functional fields like product design, procurement, manufacturing and reverse logistics. It is believed that an interdisciplinary, cross-functional perspective can help develop effective strategies that balance, economic and environmental costs. It shall contribute to long term betterment of industry and society as a well.

The Scope
This study aims to integrate environmental concerns in the key business processes of manufacturing sector in India. In this study, the following key business processes have been focused upon:

- Product development,
- Procurement/purchasing,
- Manufacturing,
- End-of-life management of product (Reverse logistics)
- Performance evaluation (from environmental perspective)
- Other miscellaneous/related management practices (like employee training, performance evaluation, goal setting etc.) that ensures environmental friendly enterprise.

For the purpose this study, *key business processes* would include major supply chain management processes mentioned above. As this study focuses on integrating environmental concerns in the key business processes of manufacturing sector in India, the primary focus would be to understand *green supply chain management* (GSCM) practices. Therefore, in this study ‘integrating environmental concerns in key business processes’ may be taken to mean GSCM practices. Also, the term *green* may
be taken to imply environmental friendliness wherever used in conjunction with business processes and/or practices.

The study primarily focused on three key industrial sectors, namely:

- Automobile including auto components
- Electrical and Electronics goods
- Chemical and Paint

Research Objectives

The broad objectives of the study are:

- To assess the current state of environmental concerns in Indian manufacturing sector.
- To gain an insight into the current state of GSCM practices in targeted companies.
- To explore differences, if any, with regard to GSCM practices across varied industrial sectors and nature of industrial enterprise.
- To identify barriers and enablers impacting implementation of GSCM.
- To propose a model by crystallizing relationships and driving power & dependence of the barriers and enablers.
- To ascertain validity of a conceptual model interlinking environmental concerns, barriers, enablers, GSCM practices and performance (environmental, competitive and economic).

Research Strategy

Following three research techniques have been employed in this research:

- Questionnaire-based Survey
- Interpretive Structural Modeling (ISM)
- Structural Equation Modeling (SEM)

Research Hypotheses

Based on the extensive review of the existing literature and discussions with experts, hypotheses were formulated and have been placed under three sets. The first set of hypotheses (hypothesis 1- hypothesis 8) was related to green practices. This set of hypotheses focused on establishing relationship among varied green practices. The
second set of hypotheses (hypothesis 9 - hypothesis 14) focused on similarities/dissimilarities with regard to select green practices across selected industrial sectors as also varied type of enterprises like, OEM & suppliers, listed and non-listed companies and their scale of operation (SMEs and Large enterprises). The third set of hypotheses (hypothesis 15 - hypothesis 24) sought to establish relationship between and among two factors that are expected to drive one another.

Multiple linear regression analysis has been carried out for testing the first eight hypotheses. For testing the validity of hypothesis number 9, 10 & 11 both independent-samples t-test and ANOVA have been conducted. Hypotheses 12 and 13 have been tested for validity with independent-samples t-test. Rests of hypotheses, from number 14 to 24, are tested using correlations. The evaluation uses a significance level of $p < 0.05$.

Specific hypotheses are being produced along with results on page 12 (Table 1)

The Conceptual Model

The conceptual model developed by the researcher for validation through SEM for the study is presented as Figure 1.

**Figure 1: Conceptual Model for SEM**

![Conceptual Model for SEM](image)
Pattern of Analysis

The study used the specifically developed research questionnaire (Appendix A1), as the basic research instrument to collect the data. The data was analyzed using MS-Excel 2002, SPSS (version 13.0) software and LISREL (version 8.5) Structural Equation Modeling software. The descriptive analysis of the data was undertaken using frequency distribution, mean, standard deviation, which are useful to identify differences among several data sets. Cronbach’s reliability test was carried out to test the reliability of the survey questionnaire. For testing the hypotheses, appropriate statistical tools like regression analysis, t-test, ANOVA, correlations test were used.

Key Findings from the Research

- Waste disposal, air emission, low level of eco-literacy and depleting natural resources are the major environmental concerns of the Indian manufacturing industry.
- Lack of commitment from the top management, inadequate adoption of reverse logistic practices, low level of eco-literacy among supply chain partners, lack of corporate social responsibility, and lack of market demand for green products emerged as the prominent barriers for the impacting integration of environmental concerns in business processes.
- Reverse logistics practices are not being widely adopted in Indian manufacturing organizations.
- Responding companies have implemented ISO: 9000 quality management system. However, only 50% of them had implemented ISO: 14001 EMS.
- Greening of suppliers is not a very common practice in Indian manufacturing sector.
- Modern environmental management techniques and practices such as benchmarking, carbon trading, eco-labeling, Life Cycle Assessment (LCA), balanced scorecard for performance management, public environmental reporting, environmental accounting, product recovery after end-of-life, are hardly being practiced in organizations surveyed.
- Environmental responsiveness related parameters are rarely used in performance reviews of employees.
Organizations are more inclined to pursue pollution control than pollution prevention approach. Environmental policy beyond legislative compliance is moderately adopted in Indian industry.

Environmental performance measurement is not extensively practiced in the Indian manufacturing organizations.

Use of recycled paper is found to be low in the Indian manufacturing industry.

Pollution prevention, improved working environment, increased employees environmental awareness, better corporate image, and exploring international markets were the five most cited benefits of integrating concerns in business processes.

Top management commitment, societal concern for protection of natural environment, government policies & regulations, eco-literacy of the supply chain partners, and customer's demand for environmental improvement emerged as five key enablers influencing integration of environmental concerns in business processes.

Results of the ISM-based model suggest that four barriers namely lack of corporate social responsibility, lack of commitment from the top management, inadequate strategic planning and lack of support & guidance from regulatory authorities have strong driving power and low dependence on other barriers. Thus, these barriers, by virtue of their strong driving power, create remaining barriers as well, such as lack of appropriate environmental performance matrices, lack of preparedness on the part of suppliers, lack of eco-literacy among the supply chain partners, resistance to change and adopt innovations, lack of integrated information system, etc.

ISM-based model also suggests that enablers such as government policies and regulations, societal concern for protection of natural environment, eco-literacy among supply chain partners, top management commitment, lean manufacturing, ISO 14001 certification and proper workplace management & housekeeping form the base. So, organizations need to focus ensuring presence of these enablers.

ISM-based model also indicates that enhanced customer satisfaction through better environmental performance can be achieved by continuously improving
the enablers possessing higher driving power. Most of these enablers have strategic orientation.

- Continuous improvement of organization's environmental performance is positively influenced by: (i) assignment of roles and responsibilities with respect to environmental programs (ii) setting of quantifiable environmental objectives, and (iii) benchmarking environmental performance.

- Implementation of proactive environmental policy beyond compliance to legislative requirements is facilitated by: (i) environmental accounting (ii) balanced scorecard for environmental performance measurement, and (iii) environmental criteria in the performance review of employees.

- Market demand for green products is negatively influenced by (i) lack of support and guidance from regulatory authorities, (ii) lack of eco-literacy amongst the supply chain partners, and (iii) inadequate adoption of reverse logistics practices.

- Large enterprises pay greater attention to regular monitoring of environmental performance indicators than SMEs.

- Electrical & electronics sector pays more attention to products designed for energy efficiency in comparison to automobile sector.

- All the industrial sectors accord similar importance to certification to ISO 14001 EMS as enabler facilitating integration of environmental concerns in business processes.

- Eco-literacy among the supply chain partners leads to development of green products.

- Green product development leads to eco-labeling of products.

- Eco-labeling of products creates a better corporate image.

- Pollution prevention leads to reduction in consumption of resources.

- Reduced consumption of resources helps in improving productivity.

- Increased productivity leads in improvement in returns on investment.

- Results of the SEM-based model suggest that greening of production and TQEM practices help in resource conservation and pollution prevention.

- SEM analysis also suggests that adoption of green business practices such as greening of suppliers, TQEM and greening of production lead to
improvement in competitiveness and economic performance of the organization.

Results of the Hypotheses Testing

The results of hypotheses testing using various statistical tools are summarized in Table 1.

Table 1: Summary of Results (Hypotheses Testing)

<table>
<thead>
<tr>
<th>Hypothesis No.</th>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green procurement practices in an organization are positively influenced by (i) green product development, (ii) adoption of reverse logistics practices, and (iii) customers' demand for environmental performance improvement.</td>
<td>Accepted</td>
</tr>
<tr>
<td>2</td>
<td>Certification to ISO: 14001 Environmental Management System is positively influenced by (i) green procurement practices, (ii) customer's demand for environmental performance improvement, and (iii) governmental subsidized program/tax incentive for green products/processes.</td>
<td>Accepted</td>
</tr>
<tr>
<td>3</td>
<td>Organizational environmental competitiveness is positively influenced by (i) eco-labeling of products, (ii) green product development, and (iii) availability of cleaner technology.</td>
<td>Accepted</td>
</tr>
<tr>
<td>4</td>
<td>Pollution prevention activities are positively influenced by (i) reverse logistics practices in supply chain, (ii) top management commitment, and (iii) economic benefits through carbon trading.</td>
<td>Accepted</td>
</tr>
<tr>
<td>5</td>
<td>Market demand for green products is negatively influenced by (i) lack of support and guidance from regulatory authorities, (ii) lack of eco-literacy amongst the supply chain partners, and (iii) inadequate adoption of reverse logistics practices.</td>
<td>Accepted</td>
</tr>
<tr>
<td>6</td>
<td>Proactive environmental policy (even beyond compliance to legislative requirements) is facilitated by (i) environmental accounting, (ii) balanced scorecard for environmental performance measurement, and (iii) environmental criteria in the performance review of employees.</td>
<td>Accepted</td>
</tr>
<tr>
<td>7</td>
<td>Continuous improvement in organization's environmental performance is positively influenced by (i) assignment of roles and responsibilities with respect to environmental programs, (ii) setting of quantifiable environmental objectives, and (iii) benchmarking environmental performance.</td>
<td>Accepted</td>
</tr>
<tr>
<td>8</td>
<td>Risk reduction related to termination of business owing to environmental issues is positively influenced by (i) pollution</td>
<td>Accepted</td>
</tr>
</tbody>
</table>
prevention, (ii) reduced risk of litigation, and (iii) increased productivity.

9 (a) OEM and suppliers differ significantly in considering lean manufacturing practices as an enabler to the integration of environmental concerns in key business processes. Not Accepted

9 (b) Industrial sectors (i.e. automobile, electrical & electronics and chemical & paints) differ significantly in their perception of lean manufacturing practices as an enabler to integration of environmental concerns in key business processes. Accepted

10 (a) There is no difference between listed and non-listed companies regarding their belief in certification to ISO: 14001 EMS as a facilitator for integrating environmental concerns in key business processes. Accepted

10 (b) Industrial sectors (i.e. automobile, electrical & electronics and chemical & paints) differ significantly in their perception of certification to ISO: 14001 EMS as an enabler influencing integration of environmental concerns in key business processes. Not Accepted

11 (a) Large enterprises attach greater importance to educating their suppliers regarding techniques to improve their environmental performance than small scale and medium scale industries (SME). Not Accepted

11 (b) Significant differences exist among industrial sectors (i.e. automobile, electrical & electronics and chemical & paints) regarding importance they attach to educating suppliers in terms of techniques being deployed by them for improving environmental performance. Not Accepted

12 Large enterprises pay greater attention to regular monitoring of environmental performance indicators than SMEs. Accepted

13 Automobile and electrical & electronics sectors do not differ significantly in considering the design for energy efficiency approach while designing their products. Not Accepted

14 Lack of support and guidance from regulatory authorities leads to inadequate adoption of reverse logistics practices into supply chain processes. Accepted

15 Inadequate adoption of reverse logistics practices is positively related to financial constraints. Accepted

16 Financial constraints are positively related to inadequate strategic planning. Accepted

17 Competitive advantage through green product/process development positively influences pollution prevention. Accepted

18 Pollution prevention leads to reduced consumption of resources. Accepted

19 Reduced consumption of resources leads to increased productivity. Accepted

20 Increased productivity (an indicator of waste minimization) leads to improvement in return on investment (ROI) Accepted
Top management commitment to integration of environmental concerns in business processes is positively related to eco-literacy amongst supply chain partners.

Eco-literacy amongst supply chain partners leads to development of green products.

Green product development leads to eco-labeling of products.

Eco-labeling of products leads to corporate image through environmental responsibility.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Top management commitment to integration of environmental concerns in business processes is positively related to eco-literacy amongst supply chain partners.</td>
<td>Accepted</td>
</tr>
<tr>
<td>22</td>
<td>Eco-literacy amongst supply chain partners leads to development of green products.</td>
<td>Accepted</td>
</tr>
<tr>
<td>23</td>
<td>Green product development leads to eco-labeling of products.</td>
<td>Accepted</td>
</tr>
<tr>
<td>24</td>
<td>Eco-labeling of products leads to corporate image through environmental responsibility.</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

**ISM-based Model for Barriers and Enablers**

After review of literature and the opinions of experts, both from industry and academia, a number of barriers and enablers impacting integration of environmental concerns in key business processes were listed in the questionnaire-based survey and respondents were asked to indicate their opinions on them. Through the results of the survey, all the barriers and enablers were ranked in descending order of their mean score. Based on survey rankings and opinions of experts, top 15 barriers and enablers were selected for further analysis. They are analyzed by Interpretive Structural Modeling (ISM) technique and the models so developed have been presented as Figure 2 & 3.
Figure 2: ISM Based Model for Barriers

Lack of appropriate performance metrics

Lack of preparedness on part of suppliers

Low level of supply chain integration

Lack of integrated information system

Resistance to change & adopt environmental innovation

Lack of Eco-literacy amongst supply chain partners

Restrictive company policies towards product/process stewardship

Lack of Market demand

Non adoption of Cleaner Technology

Inadequate adoption of Reverse logistics practices

Financial constraints

Lack of support from government/regulatory authorities

Lack of Strategic Planning

Lack of Top management

Lack of Corporate social responsibility
Validation of Conceptual Model
The conceptual model, presented in Figure 1, has been tested for its validity involving Structural Equation Modeling (SEM) technique using LISREL (version 8.5) software. The structural model, so obtained, described the causal relationship between the latent variables. It helped measure the strength of relationship between independent and dependent variables. The parameter estimates of the relationships of various latent variables along with their structural paths are presented in Figure 4.
Figure 4: Model depicting strength of relationships among various latent variables
The results obtained through SEM analysis suggest that adoption of GSCM practices help improve environmental as well as competitiveness and economic performance.

**Implications of the Research**

The key implications of this research for practitioners are as follows:

- The present state of green business practices has been explored in this research in the context of Indian manufacturing industry. This information may act as an input in design and development of green supply chain management programs in organizations, in general and manufacturing sector, in particular.

- Managers from operations, environmental health & safety (EHS) and supply chain management areas may gain insights from this empirical study. It is observed from the research that adoption of lean manufacturing practices, ISO: 14001 certification, implementation of proper housekeeping practices (such as 5S), enhancing eco-literacy of the supply chain partners, green purchasing, adoption of reverse logistics practices in the supply chain may be given top priority for improving the environmental performance of the organisations.

- Lack of corporate social responsibility and lack of commitment from top management have emerged as key barriers in adoption and implementation of green supply chain management practices and programs. Therefore, the top management of companies needs to make efforts to address these barriers.

- Integrating environmental concerns in business processes results into many benefits like pollution prevention, improved working environment, enhanced employees' environmental awareness, better corporate image, better exploration of international markets, reduced risks of litigations, etc. Therefore, managers can adopt green supply chain management practices in their organization in order to harvest related benefits.

- Suppliers, being an essential part of the supply chain, have very important role to play in green supply chain management programs. It is observed from the survey that organizations are taking limited initiatives to ensure and enhance the environmental performance of their suppliers. Managers need to make
efforts to ensure the active participation of their suppliers in the design and implementation of green business practices.

- Actions are called for to enhance the effectiveness of the enablers facilitating integration of environmental concerns in business processes. Simultaneously, there is a need to focus on reducing the impact and growth of the barriers for attaining success in green supply chain management programs.

- Design for the Environment and Life Cycle Assessment are critical for GSCM programs. Managers may adopt these techniques for ensuring environmentally-friendly product designs and also capturing data related the environmental impact created by the product throughout its entire life.

- It is observed from the survey that green purchasing by government can give a significant fillip to GSCM programs. Possibilities in this area may be explored.

- It is observed that implementation of EMS such as ISO: 14001 is one of the significant enablers that help GSCM programs. Managers should make necessary efforts to adopt and implement EMS for enhancing the success of GSCM programs.

**Limitations of the Study**

Although efforts were made to carry on a research that was theoretically and empirically sound. However, the study suffers from several limitations:

- Participation and cooperation of respondents is serious problem in a survey based research. The same was observed in this study. Some respondents appeared reluctant to participate in the survey. They apprehended that that a study on a burning issue may expose the weaknesses of the organization in general and management in particular. This limitation caused a lower than the anticipated response rate from the targeted companies.

- The study assumed that the respondents were reflecting the state of the responding companies. However, their individual perceptions might have influenced their responses and their views may not represent the entire organizational reality. The
responses to the questionnaire reflect only the opinions of responding individuals who have filled up the questionnaire and could have some element of bias.

- Another significant limitation of the survey is the relative homogeneity of the respondent managers in the response sample. Majority of the respondents to the survey represented the top management in the organizations who held high ranking positions such as proprietors, chief executive officer, vice-president, general manager, plant manager, etc. These respondents could be in the best position to opine on the strategic aspects of green supply chain management practices. However, lower levels of managers are more involved in the operational aspects. Therefore, a good insight on operational issues related to GSCM could have been obtained from functional managers.

- There was lack of empirical studies in this field, specifically in Indian context. This limitation also affected the research. Such previous studies could have made the foundation of this effort even more robust and strong.

- The study focused upon the key business processes related to product development, procurement/purchasing, manufacturing, end-of-life management of products (reverse logistics), environmental performance evaluation and some miscellaneous management practices only. However, there are other business processes also that have a bearing on the environmental management in an enterprise. For examples, processes like planning and forecasting, inventory management, logistics, distribution of final products, after-sales support etc. too might impact the environmental performance of an enterprise. The inclusion of all of them would have made the study unwieldy. Therefore, only key business processes were focused upon. This, too, may be considered as a limitation of this study.

- The study was restricted to three industrial sectors. Although these sectors represent a significant part of Indian manufacturing sector, still they may reflect only partial reality of the entire Indian manufacturing sector.
Directions for Future Research

Based on the study, the following directions for future research may be pointed out:

- In this study, only three industrial sectors have been targeted, which may not represent the entire Indian manufacturing sector. Studies may be carried out in other industrial sectors. That shall help understand the context of environmental concerns in other sectors as well.

- The survey questionnaire developed in this research is a comprehensive one. It has emerged out of thorough literature survey. The same instrument, after suitable modification, could be used as an instrument for carrying out further empirical studies in green supply chain management.

- Majority of the respondents to the survey represented the top management in the organizations who were holding top ranking positions such as proprietors, chief executive officer, vice-president, general manager, plant manager, etc. These respondents could be in the best position to give opinion on the strategic dimensions impacting green business practices. However, lower levels of managers are more involved in the operational aspects. Therefore, a good insight of operational issues related to GSCM could have been obtained from functional managers. That may be attempted in future research efforts.

- This study has not covered many issues such as, environmental accounting, green consumerism, green marketing, inbound and outbound logistics, storage and distribution, etc which may be relevant to this theme. These issues may be included in future studies.

- In the present research, only fifteen barriers and enablers were considered for developing ISM-based models, which may further be improved by including additional barriers and enablers. The ISM-based models in the study are developed based on the opinions of the industry experts and academicians and, therefore, they have some element of bias. Another limitation of these models is that they have not been statistically validated. Structural Equation Modeling approach may be applied in future to test the validity of these models.


