

Environmental Sustainability through Green Supply chain management practices among Indian Manufacturing Firms with special reference to Tamilnadu

B.L.Lakshmi Meera *, Dr.P.Chitramani **

* Research Scholar, Avinashilingam School of Management Technology

** Professor, Avinashilingam School of Management Technology

Abstract- The escalating deterioration of the environment is a major concern for business organisations today. Green is a strategy implemented to improve the environmental sustainability and with supply chains evolving dynamically towards competitive advantage, Green Supply chain management practices has gained importance in business research. Though sustainability is the major concern in today's organisations, very little research has been done to investigate the GSCM practices in Indian Industries and their Environmental Performance.

An empirical study was conducted through survey method in 155 manufacturing Industries in Tamilnadu, India. The study investigates the pressures for implementing GSCM practices and the relationship between GSCM practices and Environmental Performance. With extensive review of literature, the research proposes a model that demonstrates the relationship between Green SCM pressures, Green SCM practices and Environmental Performance in manufacturing companies. Six external pressures on today's business organization relevant to India were considered for the study. GSCM practices include the Inbound/procurement practices, Design and production practices, Outbound practices and the Reverse logistics of the company was studied using a five point Likert scale. Rigorous statistical methods were used to validate and access the constructs. The method used was Path analysis using Smart PLS software. The results showed a significant positive relationship between the constructs. It implies that the Green SCM pressures that influence Green supply chain practices can improve environmental performance and hence enable organisations to be responsible citizens. The research empirically attempts to bring out the need for Green practices and environmental sustainability of organisations.

Index Terms- Environmental Sustainability, Green supply chain management, Green Pressures, Environmental Performance, GSCM Practices

I. INTRODUCTION

Changing environment and the deterioration of the natural resources has triggered organizations to identify, understand and manage the issues of environmental sustainability. This has led to new paradigms in supply chain management strategies, and this has shifted the attention towards the impact to the natural

environment and the environmental performance of organizations. This shift in the supply chain management has evoked due to the growing social, political and legislative pressures. According to Ford Chairman, William Clay Ford Jr., "Sustainability is not a soft issue, or a passing fad. When people are empowered with knowledge and choices, they will do what's best for themselves, their families, and their communities. And in fiercely competitive global market where information is shared instantly, consumers will virtually have all the knowledge and choices in the world. Companies that don't do the right thing will find that they are not sustainable."

With growing environmental hazards this paper focuses mainly on the environmental sustainability of organizations. Worldwide industrialization has led to the destruction of the environment, industrial wastes severely damage and pollute the environment and cause ozone depletion, greenhouse effect and Antarctic icebergs melt. These issues have triggered the manufacturers on their substantial developments and production responsibilities towards a sustainable environment for all. Since corporations are vital organs of society, corporate interests pose serve societal concerns. Consumers are becoming more attuned to and involved in the growing green interests. With customer loyalty shifting towards environmentally friendly products, businesses are increasingly trying to make their supply chains greener by introducing sustainability strategies throughout their organizations and supplier networks.

Environmental issues under legislations and directives from customers have become an important concern for manufacturers in India. To combat these pressures and that from the society, customers and the stake holders and manufacturers have started to adopt a more systematic and integrated strategy of Environmental management in supply chain system. This is termed as Green Supply Chain Management (GSCM). GSCM is a management activity that crosses organizational boundaries and requires active integration and involvement from the supply chain partners.

II. LITERATURE REVIEW

Green Supply Chain Management:

Green Supply Chain Management (GSCM) can be defined as the management of the raw materials, parts /components and processes from suppliers to manufacturer to customers and

product take back with improvement to environmental impacts through life cycle stages. (Hu & Hsu(2010)). Sarkis et al.,(2005) also defines GSCM by adding the green component to supply chain management and hence it involves addressing the influence and relationships of supply chain management to the natural environment. It considers the environmental effects of all processes of supply chain from the extraction of raw materials to the final disposal of goods. With this integration, the GSCM practices strive to achieve what any individual organization on its own could not possibly achieve: minimized waste, minimized environmental impact while assuring maximized consumer satisfaction, and healthy profits.

The key practices worth noting from the previous research work are the concepts of green design, green operations, reverse logistics, waste management and green manufacturing (Guide & Srivastava(1998), Srivastava(2007)). The environmental laws and CSR practices and ISO 14000 certifications have improved the environmental practices in many Indian companies. But the question lies if the same has been extended to the supply chain .It is important to integrate the organizational environmental management practices into the entire supply chain to achieve a sustainable supply chain and maintain competitive advantage (Zhu et al., (2008), Linton et al., (2007)). Most of the research works on GSCM practices are fragments of a part of the Porter's value chain model. Emmet and Sood(2010) have classified GSCM practices as Green procurement and supply, Green production, Green packaging, Green marketing, Green Logistics and Supply loop. In this descriptive work a framework of the GSCM practices across five major functions-1) In-bound logistics(Manish(2011), (Ninlawan et al.,(2010),Sanjeevkumar(2012), 2) Design and Production(Ninlaw(2010),Toke(2010),Sanjeevkumar(2012),Sarbjit Singh(2010),Halme et al(2002), 3) Out-bound logistics(Toke(2010)) ,4) Reverse logistics(Toke (2010),Sreevatsa(2007),Tonanont(2008)) and 5) Management support practices(Ninlawan et al.,(2010),Hu & Hsu(2010)) is conceptualized and studied.

GSCM Drivers:

Various research in the area of GSCM show that there are numerous drivers that influence the implementation of GSCM practices. Increasing scarcity of resources, building awareness among consumers, stringent laws that are more environment conscious and the demand from the export markets are posing real challenge to Indian companies today.(Vachon and Klassen, (2006); Srivastava, (2007)). Globalization has made is even more significant to the Indian industries as the majority of the world's manufacturing will be carried out in Asia, making India an integrated part of the Global supply chain. (US-AEP (1999)). But this tremendous growth opportunity to the country also brings equal environmental challenges (Rao, (2002)).Previous studies identified numerous drivers that have a potential to motivate organizations to adopt environmental practices. These drivers generally emanate from pressures of external and internal stakeholders such as government, investors, customers, suppliers, community groups and competitors (Donaldson & Preston, (1995), Cetinkaya et al., (2011), Cervera and Flores(2012),Carter & Jennings (2002)).

Increasing pressures from a variety of directions have caused the Indian supply chain managers to consider and initiate implementation of green supply chain management (GSCM) practices to improve both their economic and environmental performance. Some of earlier works investigating the GSCM pressures/drivers are an empirical analysis of 89 automotive enterprises within China show that the Chinese automobile supply chain enterprises have experienced high and increasing regulatory, market pressure, ecological pressures from governmental and competitive sources.(Zhu & Sarkis(2004)). Another research work conducted a moderated hierarchical regression analysis of data provided by 341 Chinese manufacturers and examined the relationships between GSCM practice, environmental and economic performance, incorporating three moderating factors market, regulatory, and competitive institutional pressures.(Zhu & Sarkis(2007)).

New government policies have prohibited products made from environmentally destructive materials and polluting processes. Companies that utilize environmentally destructive and/or polluting processes are not allowed to sell their goods and may be subject to financial penalties and criminal prosecution. Manufacturers have realized the importance of GSCM practices due to this regulatory pressure. Baird and Rowen (2010) and Zhu et al., (2008) have argued in their research work that changes in government policies have made the industry responsible for post disposal of products too, forcing the implementation of sustainable operations across the supply chain.

A global survey conducted by Boston Consulting Group in 2009 of more than 9,000 consumers, have inferred that 73 percent of consumers consider it important that companies have good environmental records and that a majority of those respondents are willing to pay a premium of 5 percent or more for green products. Consumer demand for environmentally friendly products has changed the attitude of the market. Companies are seeking to capture this market opportunity by minimizing their environmental impacts and/or selling environmentally friendly products. Christmann and Taylor (2001), Baird and Rowen(2010), Zhu et al., (2008) research has also shown that customer pressure is a primary driver for enterprises to improve their environmental image and practices. The practices of green purchasing and customer cooperation have developed the market for product take-back and product reintroduction (Van Hoek(1999)).

The literature indicates that there are nine basic drivers for green supply chain initiatives; regulations, customer pressures, expected business benefits, social responsibility, supplier pressures, competition, market demand, community pressures, and employee pressures. most of the available studies, on drivers for green supply chain initiatives, support the significant effect of the top four drivers as potential key drivers to green supply chain initiatives(Ninlawan et al(2010), Gyaneshwar(2010),Zhu & sarkis(2004),Ma jun(2010), some other studies found no significant effect of these drivers on green supply chain initiatives. Bowen et al. (2001),Zhu, Sarkis and Lai (2007). This study has considered the customer, export market, regulation and government policies, industrial group activities, competitors and stakeholders as the relevant drivers in Indian context and has investigated the impact on green supply chain initiatives.

III. ENVIRONMENTAL PERFORMANCE

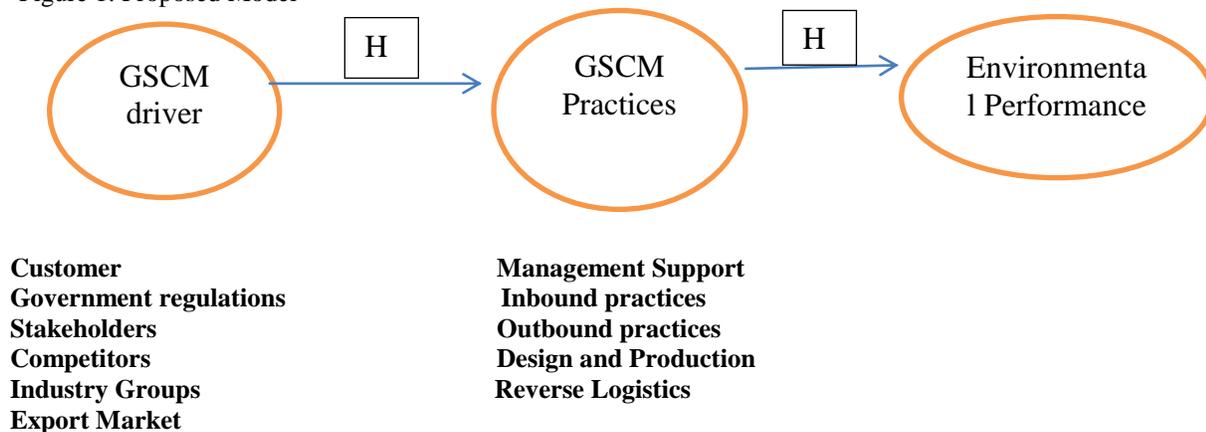
Environmental performance is defined as the measure of reduction of substances and emissions that reduces environmental impacts caused by business organizations. Zhu et al(2004), Wu et al.(2010), Ninlawan et al.(2010), Sanjeev kumar et al.(2012), Bhateja et al.(2011),Sarkis(2003),Chein and Shih(2007).It also helps to improve efficiency and synergy among business partners and helps to enhance environmental presence, minimize waste and achieve cost saving (Rao and Holt, 2005) and good will.(Cervera and Flores(2012)). Environmental performance is measured in many research works. Researchers have proved that GSCM practices enhance environmental performance in organisations. (Chan et al., cited en Lou, 2011; Hu and Hsu, 2010; Efron, 2009). Cervera and Flores(2012), Ninlawan et al(2009), Zhu et al.,(2007).

VarioCorderio and Sarkis(1997), Walley and Whitehead (1994),Zhu et al., (2007),Zhu et al.,(2010), Montabon et al. (2007), Wagner et al., (2001) and Zhu et al., (2008) have found significant and positive relationships between GSCM practices and environmental performance.

IV. THE RESEARCH MODEL

The conceptual framework from the extensive literature review is shown in Figure 1. The causal relationship between GSCM drivers, Green SCM practices and Environmental performance has been found in literature and is proposed to be tested empirically.

Figure 1: Proposed Model



Practices adopted by organisations across the supply chain from green inbound, green operational, green outbound and reverse logistics to work with suppliers to improve products or processes and increase the environmental performance of the supply chain is termed as the Green supply chain management practices. (Srivastava(2007),Svensson(2007), Zhu et al.,(2007),Ninlawan et al.,(2010),Sanjeev kumar et al.,(2012), Shang et al(2010),Zhu et al.,(2008), Toke et al(2010),Chung Hsiao(2008),Florida et al(2001),Bhateja et al(2011), Chein & Shih(2007)).

Since many manufacturers are implementing Green practices beyond their shop floor to meet green commitments it becomes imperative to check the influence of the GSCM drivers on Green SCM practices and their causal effect on the Environmental performance. Thus the following hypothesis is framed to test the relationship of GSCM drivers, GSCM practices and environmental performance in manufacturing industries.

H1: The link between GSCM drivers and Green SCM practices is positively associated.

H2: The link between Green SCM practices and environmental performance is positively associated.

V. METHODOLOGY

The study focused on the Green SCM drivers, GSCM practices and their impact on Environmental performance in

Indian manufacturing industries. Based on the literature review the instrument was developed to measure GSCM drivers, Green SCM practices and Environmental performance with some alteration with expert consultations. The instrument was tested for reliability and validity. Five sub constructs as shown in Fig.1 where identified to define Green SCM practices ((Zhu et al., (2007),Ninlawan et al., (2010),Sanjeev kumar et al.,(2012)) and six variables for GSCM drivers were identified. Environmental performance was ascertained using six variables with expert intervention. (Zhu et al., (2007), Ninlawan et al., (2010))

The instrument used for the study consists of three parts, Part 1: The company profile that documented the demographics of the industry type, organization size, turnover, products manufactured. Part 2: The Green profile that analysed the critical practices in GSCM implemented in the organization on a five point scale to indicate the extent in which each item was practiced in the organization. Part 3: The Green SCM drivers and the environmental performance were captured on a five point scale. The Reliability is tested by the Cronbach alpha and the Convergent validity of each construct is examined by the AVE value. Constructs with an alpha score greater than 0.7 are accepted for accuracy (Nunnally,(1978)) and constructs with AVE value greater than 0.5 are said to have convergent validity and unidimensionality. (Chin (1995), Barclay et al., (1995), Chin et al., (2003)).

The list of member companies from CII (Confederations of Indian Industries), Tamilnadu chapter which comprised a list of

1182 companies was filtered to remove organisations having <100 employees, educational institutes, service companies and individuals. The data collected was administered with Senior / Top management executives over a period of 9 months in the state of Tamil Nadu, India. The respondents of the survey are key informants who are knowledgeable in the field of Green and Lean practices in each firm.

Using G-power a sample with alpha of 5%, beta of 20% and the no. of largest predictors of 32 with a large effect size ($f^2 = 0.35$) measured to 111 samples. The study was conducted for a total number of 155 firms with an effective sample size of 9.7%.

Path modeling using Smart PLS 2.0 (beta) is used to test the path. The analysis of interdependent variables is done together. For e.g. consider the dependencies $X \rightarrow Y \rightarrow Z$. This solved together gives the solution different than when analysed as $X \rightarrow Y$ and $Y \rightarrow Z$. This combined analysis is done using path analysis. This technique for path analysis doesn't make any assumptions about the distribution of the data and is non-parametric. (Wold(1989), Fornell (1982)). The main purpose of the theory is to examine the interrelationships between the

constructs. Each relationship is a hypothesis to be tested. As a non-parametric method, the hypothesis cannot be directly tested. Testing is done by means of resampling method of bootstrap. The accepted value for t-coefficients depends on the assumed significance level. A commonly assumed significance level of two tailed 5% significance level has a t-value =1.96. If the computed value of t-statistic happens to be higher than the this it implies that the path being considered is significant.

VI. DISCUSSIONS

The sample obtained belonged to the cross section of 8 sectors namely Automobile and Auto components (63), Textiles and Garments (56), Engineering and Electronics (36). Reliability and validity of the constructs are depicted in Table 1 which shows that Cronbach's alpha and the AVE value are higher than the required standards defined.

Table 1: Reliability & Validity

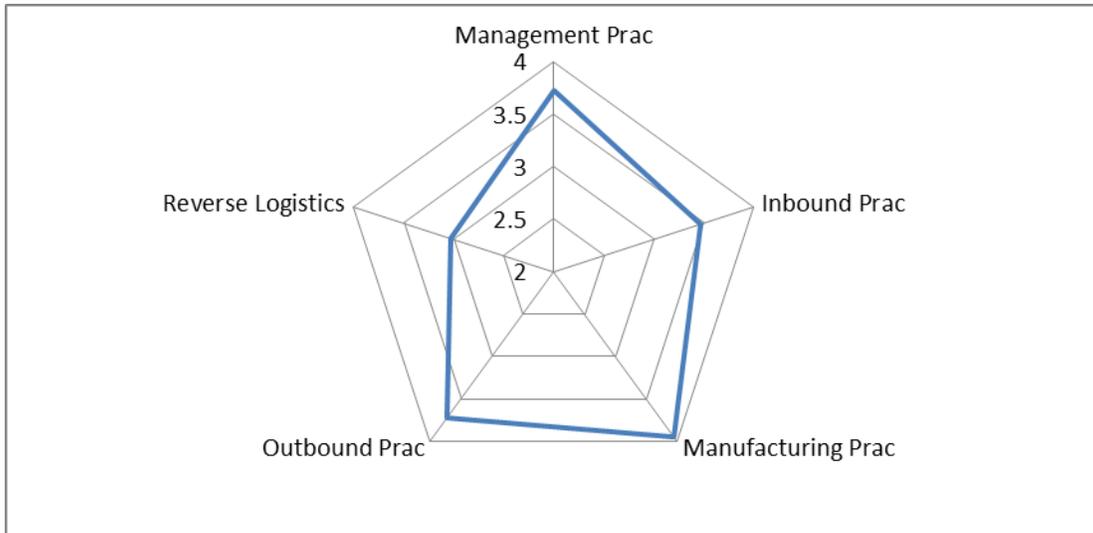
	AVE	Composite Reliability	Cronbachs Alpha	Communality	Redundancy
Gscm drivers	0.56	0.88	0.84	0.56	
Environemtal performance	0.74	0.95	0.94	0.74	0.31
Gscm practices	0.59	0.87	0.81	0.59	0.18

The Cronbach's alpha and AVE value for the three constructs Environmental performance, Green SCM practices and Gscm Drivers are above the defined standards and hence the constructs used in the study have proved to have Construct Reliability and Convergent Validity or Unidimensionality.

The mean score value of the constructs are studied to understand the extent of influence of the GSCM drivers and the

level of implementation of GSCM practices in Indian Manufacturing companies. Graph 1 depicts the level of Implementation of GSCM practices and Graph 2 depicts the various drivers that influence the implementation of Green practices in the industries,

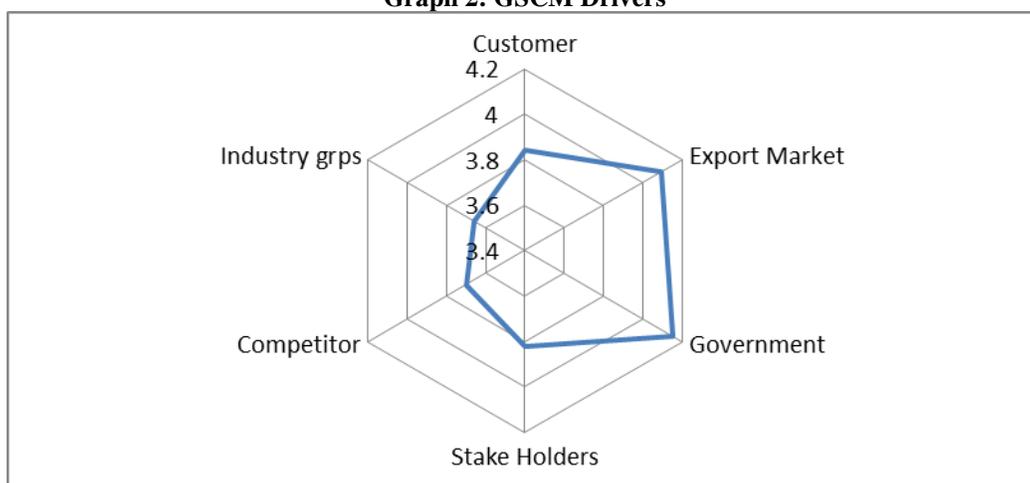
Graph 1: GSCM Practices



As seen in the Graph 1, the GSCM practices are adopted across the supply chain. Especially Manufacturing practices and Management support practices are relatively high which clearly depicts the notion that Environmental management systems are widely implemented in Indian manufacturing organization but mostly restricted within the company and are yet to be established strongly across the supply chain. Ninlawan et al.,(2010) in their study on Thai enterprises have also reported similar results. But Sanjeevkumar et al.,(2012) has studied various GSCM practices in Indian industries and have reported that the level of implementation of almost all the practices negatively. This may be due to the fact the study was conducted

pertaining only to electronics industry in India. Bhateja et al., (2012), Hu and Hsu (2010), Ferguson (2000) also clearly supports a significant implementation of GSCM practices in manufacturing firms.

Graph 2: GSCM Drivers



The above graph clearly depicts the drivers for GSCM implementation in Indian Manufacturing companies. Government regulations and Export market requirements are the two major drivers. Many studies on GSCM drivers show similar results.(Seuring(2004),Chien & Shih(2009)). Ninlawan et al.,(2010).

association using SPSS 16. The table below demonstrates the correlation between variables tested in the hypothesis.

A bivariate correlation was done to check the preliminary association between variable and the significance of the

Table 2: Correlation Coefficient

Variable	Correlation coefficient
GSCM drivers- GSCM Practice	0.622*
GSCM Practice – Environmental Performance	0.679*

*p<0.01

The above table shows that the correlation between variables is significant but the path has to be verified when the variables are put together in the model. Smart PLS was used and the

bootstrap was conducted for 155 samples across 500 cases and the results are depicted in Table 3.

Table 3: Bootstrap Overview

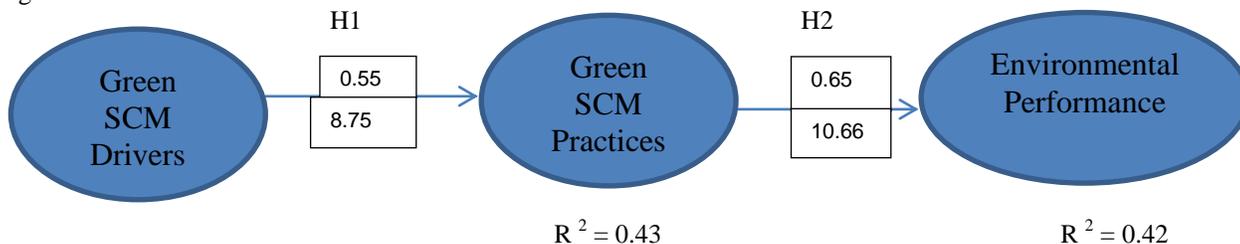
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (O/STERR)	Result
GSCM drivers- GSCM Practice	0.55	0.56	0.063	0.063	8.75	Significant
GSCM Practice – Environmental Performance	0.65	0.65	0.061	0.061	10.66	Significant

H1: The link between Green SCM drivers and Green SCM practices would be positively associated.

The relation was found to be significant (beta=0.55, t=8.75). The R² value is also 0.43 which shows a positive relationship. This reinforces the theory that an organization that adopt Green supply chain practices are influenced by the green SCM drivers of the company.

H2: The link between Green SCM practices and environmental performance would be positively associated.

Figure 2: Estimated Model



Various researchers have also shown significant relationship among Green SCM drivers, Green SCM practices and Environmental Performance. (Zhang et al., (1997), Zhu and Sarkis (2004), Zhu et al., (2005), Zhu et al., (2010)).

The main purpose of the paper was to ascertain the extent of GSCM practices implementation, the influence of GSCM drivers on GSCM practices and their impact on environmental performance. Although the strength of the relationship is not very strong it still implies that there exists a positive relationship

The relation Green SCM practices and Environmental performance was found to be significant (beta=0.65, t=10.66). The R Square value is also 0.43 which shows a positive relationship.

Hence the research hypothesis was generally proven and the results show significance and the estimated model is depicted in Figure 2.

between GSCM drivers and practices and the causal effect on the environmental performance. These practices have contributed to the environmental performance of the organization making them environmentally sustainable. It is an emerging field in India its progress can be ascertained by in-depth research. Though logically there is great relationship between the constructs the weakness shown is due to the change in the level of implementation across the supply chain. Many industries have their environmental management active within the organization

and have improved their environmental performance. Practices like inbound, outbound and reverse logistics have scored relatively low which indicates that the level of implementation across the supply chain is low. Coordination with their partner companies with regard to environmental objectives is hence weak. This is of serious concern as the major participants of the survey are the large and medium sized companies and their non-involvement with their partners for environmental objective will only cause a bull whip effect of negative impacts. This clearly indicates the need for future research to develop an environmental performance assessment for companies incorporating the performance of their partners in the supply chain.

VII. CONCLUSION

The concern for environment and organizational sustainability are increasing but there are not much empirical analysis on the strategies and practices. This study mainly projects the relationship between Green supply chain management practices and Environmental performance of manufacturing industries. A model that explains the causal effect relationships through the primary data collected by the survey conducted in manufacturing industries in Tamilnadu, India. As stated by Hook (2000) GSCM is an important innovation that helps organisations develops “win-win” strategies that achieve profit and market share objectives by lowering their environmental risk and impacts, while raising their ecological efficiency. As companies increasingly outsource manufacturing and “purchase in” components, the earlier points in the supply chain makes an important issues in today’s business. On the other hand handling customer inquiries and ensuring access to markets in the face of new dynamic challenges in the market with new regulations also requires understanding from the company on the outward arm of the supply chain. More importantly the closed loop strategy due to the advent of ‘take back’ regulations in various markets is extending the responsibility of capturing the product throughout its entire life cycle and across the supply chain. Hence GSCM implementation should be considered not just with in the organization but has to be extended to the supply chain for long term environmental sustainability.

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AUTHORS

First Author – B.L.Lakshmi Meera, Research Scholar, Avinashilingam School of Management Technology
Second Author – Dr.P.Chitramani, Professor, Avinashilingam School of Management Technology