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The impact of Barriers and Benefits of sustainable supply chain management (SSCM) on its adoption decision: An empirical analysis

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Abstract

The aim of this study is to investigate the effects of the barriers and benefits of sustainable supply chain management (SSCM) practices on the adoption decision of sustainable supply chain management practices in Indian industries. An empirical analysis is performed for a select manufacturing industries which operates in footwear and textile sector in India. Interpretive Structural Modeling (ISM) technique is applied to the selected barriers and benefits to determine their contextual relationships. Lack of public awareness in domestic market on sustainability, Market uncertainty due to economic slowdown , Competitive cost of sustainable product / SSCM practices implementation cost and Perceived lack of government support are found to be the most important barriers in the adoption of sustainable supply chain management practices. On the other hand, the most significant benefits are determined as Enhancement of corporate value by investment in firms people and environment, Reduction in consumption in hazardous and toxic material and Product quality improvement The barriers and benefits, which have high driving power and the capability to influence the other drivers, are then integrated into the structural equation model.

The results denote that barriers and benefits of sustainable supply chain management practices have negative and positive effect respectively on the sustainable supply chain management practices adoption decision for the company. In addition with the help of hypothesis testing in structural equation modeling , it is found that the effect of benefits on the adoption decision is higher than that of the barriers. Thus, based on this analysis, it would be beneficial for the company to adopt the SSCM practices.

Keywords*- Barriers and Benefits of sustainable supply chain management (SSCM) practices, Interpretive Structural Modeling (ISM), adoption decision, Structural equation modeling*

I. INTRODUCTION

In recent years, there has been an increasing business concern over the environmental effects caused due to industrialization and advent of technology. Several studies have been carried out over the past decades that depict the past, current and future status of earth (Markley and Davis, 2007). There are concerns over depletion of ozone layer, natural resources, and other hap hazardous environmental effects. As the population is increasing, the demand is increasing, as the demand is increasing, the production is increasing which eventually impacts the natural systems, resources and ecology. These issues elevate the need, more than ever before to focus on environmental hazards caused by organizations. The term sustainability, which is increasingly referred to an integration of social, environmental, and economic responsibilities, has begun to appear in the literature of business disciplines such as operations and management (Carter et al., 2007). Though the major stream of research on sustainable supply chain management dates back to mid – 1990‘s its only of late that there has been an increasing demand and organizations are waking up to incorporate sustainability in their operations.

Every process that is involved in the production, manufacturing, distribution of products adds to environmental concerns. Supply chains are critical links that connect an organization's inputs to its outputs. Traditional challenges have included lowering costs, ensuring just-in-time delivery, and shrinking transportation times to allow better reaction to business challenges. However, the increasing environmental costs of these networks and growing consumer pressure for eco-friendly products has led many organizations to look at supply chain sustainability as a new measure of profitable logistics management. This shift is reflected by an understanding that sustainable supply chains frequently mean profitable supply chains.

In recent years the topic of sustainability in supply chain management (SSCM) has received growing attention and has become increasingly popular research area (Tueteberg and Wittstruck, 2010). Tsoulfas et al (2008) present a model for supply chains environmental performance analysis and decision making. Srivastava (2007) presents a literature review on green supply chain management. Hervani and Helms (2005) present performance management techniques for green supply chain management. Kainuma and Tawara (2006) present a multiple attribute utility theory approach to lean and green supply chain management. Kannan et al (2009) present a hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider. Teuteberg and Wittstruck (2010) present a systematic review of sustainable supply chain management research. Theyel (2001) emphasizes the importance of customer and supplier relations for environmental performance**.** Ninlawan et al (2010) present implementation of green supply chain management practices in electronics industry. Companies now have to face multiple challenges such as addressing problem of rapid climate changes, financial crisis, and also deal with growing public interest in ecology and ensure environmental sustainability.

II. LITERATURE REVIEW

In this section, we provide a review of the literature that is available on the topic of sustainable supply chains. We have taken into consideration all the famous journals and publications related to the topic for the purpose of this review and laid focus on years 2010 to 2015. This does not mean that the papers before 2010 were not used in the study, they are just excluded from the literature analysis since, Seuring and Muller (2008) have provided a very detailed literature review from the years 1994 – 2007, outlining 191 papers from various journals. Their paper can be used as a base reference for comprehensive review on sustainable supply chain research conducted during the years 1994 – 2007.

Sustainable Supply Chain Management has its roots in supply chain management, i.e. it is based on the adoption and extension of its concepts. Harland defines supply chain management as "the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers" (Harland 1996, p. 64). In a second step, the concept of supply chain management can be extended by adding the aspect of sustainability. Sustainability refers to an integration of social, environmental, and economic issues (Carter and Rogers 2008, p. 361). Shrivastava defines sustainability as "the potential for reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management" (Shrivastava 1995, p. 955). Here, sustainability is looked at from a more ecological angle without explicit consideration of social aspects. In contrast, Sikdar takes a "macro-viewpoint" that includes social, environmental, and economic aspects. According to him, sustainability is "a wise balance among economic development, environmental stewardship, and social equity" (Sikdar 2003, p. 1928).

With regard to a macro-viewpoint on supply chains and in order to achieve the balance between the environmental, social and economic dimensions (idea of the "triple bottom line" developed by Elkington (2004)) we will follow Carter and Rogers who define Sustainable Supply Chain Management (SSCM) as the strategic achievement and integration of an organization's social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its value network. (Carter and Rogers 2008, p. 368).
Figure 1 illustrates the problem area and the scope of SSCM ("House of Sustainable Supply Chain Management"). The house is built on the triple-bottom line (Carter and Rogers 2008, p. 369, Elkington 2004). The three dimensions of sustainability are visualized here as pillars which are necessary to keep the building in balance. Risk and compliance management forms the building's foundation. In order to achieve long-term profits, risks have to be identified and mitigated. Laws, guidelines and standards serve as a starting point for the implementation of sustainability principles and practices along the supply chain.

III. Barriers in Sustainable Supply Chain

Walker et al. (2008) states that there are two primary factors acting as barriers: Internal barriers and external barriers. Internal barriers being those internal to the organization and external barriers are those arising outside the organization. A better understanding of this concept can be gained by reading the following concepts.
In 2011, Luthra et al. developed a research aiming at developing a structural model of the barriers to implement GSCM in Indian automobile industry. With the help of MICMAC analysis and a structural model of barriers to implement GSCM in Indian automobile industry, Luthra et al. (2011) have initiated their research. Market Competition and uncertainty; lack of implementing green practices; cost implications; unawareness of customers have been identified as top level barriers and lack of government support systems the most important bottom level barrier.
Sarkis (2011) provided a very unique identification of GSCM considering its boundaries and flows. Sarkis previewed GSCM boundaries from nine different perspectives which added a unique value to the research. These nine boundaries were analyzed through different levels ranging from individual (sub-micro) to global cross-industry supply chain (supra-macro) boundaries. From Sarkis point of view, GSCM nine boundaries are organizational, proximal, informational, political, temporal, legal, cultural, economic and technological. Recently, Abbasi and Nilsson (2012) identified challenges facing sustainable supply chain and they included costs, complexity, operational, mindset and culture changes and uncertainties as the main barrier.

3.1. Internal barriers

- **Lack of SSCM practices in organizational vision**

Hanna et al. (2000) discussed the need for aligning sustainable strategy with corporate strategy and having sustainable vision and mission. Lack of sustainable practices in the organization's vision and mission as an extreme barrier. Sustainability practices could be termed as green practices , the word green is sometimes used interchangeably with sustainability. Innovative green practices are associated with the explicitness of green practices accumulation of green related to knowledge, organizational and quality of human resources. (Ynlin & Hu, 2008). Innovative green practices involves hazardous, solid waste disposal, energy, reusing and recycling of materials. Implementation of GSCM practices initially involves high investment

- **Lack of top management commitment and support**

Lack of top management commitment and support as an extreme barrier. Top management commitment is necessary for any strategic program success (Hamel & Prophalad, 1989, Zhu & Sarkis, 2007). Top management commitment is essential for practices such as SSCM, it has the ability to influence, support actual formation and implementation of sustainable initiatives across the organizations (Sarkis, 2009) and also provides supports for SSCM in the strategic plans and action plans for successfully implementing them (Ravi & Shankar, 2005). .

- **Lack of knowledge of SSCM among the supply chain partners**

lack of knowledge sharing between firms and supplier is an extreme barrier. Information linkages and improved communication helps the organizations to adopt SSCM practices (Yu Lin & Hui Ho, 2008). Training and education are the prime requirements for achieving successful implementation of SSCM in any organization. (Ravi & Shakar, 2005)

- **Lack of environmental monitoring system (EMS) in the organization**

Lack of knowledge about environmental impacts as an extreme barrier. Knowledge is power and informative. In a situation whereby environmental impacts of manufacturing are not known, precautions will not be taken against it.

- **Lack of Legitimacy**

The most famous con of sustainable supply chain management is that the companies do not change practice but merely advertise that they do, creating a green wash (Greer and Bruno; 1996). This leads to a very poor display on the companies‘part. In order to avoid this from happening there is a grave need for audits and certifications such as ISO 14000 and stricter government policies. This also requires management commitment to avoid such mishaps from happening.

- **Costs associated in implementation**

According to Orsato (2006) costs can cause hindrance to application of sustainable supply chain management. A study carried out at US firms revealed that cost is one of the main concern and the most serious obstacle when it comes to implementing SSCM methodologies (Min and Galle, 2001; Walker et al., 2008).

3.2. External barriers

- **Perceived lack of government support**

There are numerous environmental regulations and legislations on one hand they play a role of a driver, on the other they are also barriers as they cause unnecessary inhibitions to innovations (Porter and Linde, 1995; Walker et al., 2008). Governement regulations can encourages or discourage the adoption of innovation, as governement sets the environmental regulations for industry (Scupola, 2003). Time Consuming regulatory requirements, fees or levies may discourages smaller firms. Tax structures that distort incentives can discourage industry to implement SSCM/GSCM (Luthra et al, 2011). Government institutions are considered as barriers to the developement in the environmental management in the sense that institutional process for implementating GSCM are going on but very limited institutional process for implementing GSCM (Luthra et al., 2011). The tendency of government to encourage old practices is a major barrier (Alkhdir & Zalani, 2009).

- **Shortage of professionals in sustainability**

Lack of resources consider as an extreme barrier. Walker et al., (2008) identified lack of resources as an internal barrier. The initial investment requirement by sustainable practices are expensive (Luthra, 2011). Engaging in environmental management involves cost which constitutes a vital barrier in SSCM implementation. IT enablement, Technology advancement adoption hiring good quality of employees, motivating and training of employees towards SSCM will require high initial investments. Lack of resources is a major barrier.

- **Lack of communication and information sharing among SC stakeholders**

lack of information sharing between manufacturing firms and supplier is an extreme barrier. Information linkages and improved communication helps the organizations to adopt sustainable practices (Yu Lin & Hui Ho, 2008). Training and education are the prime requirements for achieving sucessful implementation of SSCM/GSCM in any organization. (Ravi & Shak, 2005)

- **Lack of public awareness on sustainable issues.**

Lack of public awareness is an extreme barrier.Customer's awareness means if customers's demands green products, the company has to change technology and organization for innovative green products (luthra et al, 2010). In U.S.A, an estimated 7% of consumers claim that their purchases are influenced by reputation and 80% would be willing to pay more for environmentally products.(Lamming & Hmapson, 1996). Thus, this supports the findings from this study that lack of awareneness is a major barrier to implement SSCM in manufacturing firms.

- **Lack of cooperation among supply chain partners:**

In a study carried out at chemical firms in US, it was found that cooperation among supply chain partners led to waste reduction and environmental innovation (Theyel, 2001). Generally there is lack of trust and commitment in the supply chain due to confidentiality which acts as a barrier. We listed out 12 principal barriers of sustainability in supply chain as follows:

Sr.No.	Barriers to adoption of SSCM	Abbreviation
1	Lack of SSCM practices in organizational vision & commitment	OVC
2	Lack of knowledge sharing about sustainability among SC partners	KIS
3	Lack of environmental monitoring system (EMS) in the organization	EMS
4	Lack of internal/External sustainability audits	IEA
5	Lack of Legitimacy	LEG
6	Lack of organizations CSR	OES
7	Competitive cost of sustainable product & implementation cost	CSI
8	Shortage of professionals in sustainability	SPS
9	Perceived lack of government support	GOS
10	Market uncertainty due to economic slowdown	UNS
11	Lack of public awareness in domestic market on sustainability	PAS
12	Supply chain partners resistance to change	CRC

IV. Benefits of Sustainable Supply Chain

Sustainable supply chains are more complex to achieve as compared to the traditional supply chains. In this thesis, we have determined 10 Benefits for sustainable supply chains that have a major impact in achieving sustainability. These Benefits are listed in Table 2.4. The Benefits were selected based on literature review and opinions of supply chain experts.

Leading companies are going beyond basic supplier compliance schemes, and are working to improve the sustainability performance of their supply chains. By building closer relations with suppliers, developing supplier capacity, and identifying and investing in opportunities for environmental and social improvement throughout the supply chain, companies can begin to reap the benefits from a more sustainable supply chain and achieve productivity and efficiency gains.

In addition to contributing to the social, economic and environmental well-being of people, sustainable supply chain management can deliver additional benefits for the society. It will enable the society to:

• Achieve value for money by considering and then lowering the whole life-cycle costs of goods, services and works and through improved resource efficiency;

• Report on progress towards meeting its legal duties and other obligations in relation to climate change and sustainable development;

• Stimulate the market and encourage innovation for sustainable products and services;

• Help build a sustainable supply chain for the future and improve supplier relationships;

• Enhance its reputation locally, nationally and internationally by being an exemplar

Reputation and brand are among a company's principal assets.

For the business community, sustainability is more than mere window-dressing. By adopting sustainable practices, companies can gain competitive edge, increase their market share, and boost shareholder value. What's more, the growing demand for 'green' products has created major new markets in which sharp-eyed eco-entrepreneurs are reaping rewards. Companies embracing sustainable development can benefit from being a first mover in a market.

Eighty-two percent of UK consumers prefer to purchase goods from socially and environmentally responsible companies, according to a 2003 study, and 23% would do so even if this option is more expensive.

We listed out 10 principal benefits of sustainability in supply chain as follows:

S.No	Benefits on adoption of SSCM	Abbreviation
1	Enhancement of corporate value by investment in its people and environment.	ECV
2	Increased market share by brand image improvement	IMS
3	New overseas market opportunity	NMO
4	Increase sales and brand security	SBS
5	Reduction in energy consumption	REC
6	Reduction in consumption in hazardous and toxic material	RHZ
7	Reduction in solid liquid waste and emission	RWE
8	Reduction in the frequency of environmental accidents	REA
9	Product quality improvement	PQI
10	Reduction in employee turnover rate	RET

V. RESEARCH APPROACH

5.1. Introduction of Interpretive Structural Modeling (ISM)

This study combines two techniques: ISM and SEM. We will discuss ISM in this subsection, and SEM in the following one. ISM is found and handled by Warfield (1973) and its roots come from graph theory. The ISM process transforms unclear, poorly articulated mental models of systems into visible, well-defined models useful for many purposes (Sage, 1977).Ravi and Shankar (2005) describe the significant characteristics of ISM as follows: (i) This methodology is interpretive as the judgment of the group decides whether and how differentelements are related; (ii) It is structural as on the basis of the relationships, an overall structure is extracted from the complex set of elements; (iii) It is a modeling technique as the specific relationships and overall structure are portrayed in a digraph model.The steps involved in the ISM methodology are given below (Ravi and Shankar, 2005;Govindan et al., 2012):

Step 1. Variables affecting the system under consideration are listed.

Step 2. A contextual relationship is established among variables with respect to which pairs of variables would be examined.

Step 3. A Structural Self-Interaction Matrix (SSIM) is developed for variables, which indicates pair wise relationships among variables of the system under consideration.

Step 4. Reachability matrix is developed from the SSIM and the matrix is checked for transitivity. The transitivity of the contextual relation is a basic assumption made in ISM. It states that if variable A is related to B, and B is related to C, then A is necessarily related to C.

Step 5. The reachability matrix obtained in Step 4 is partitioned into different levels.

Step 6. A digraph is drawn and the transitive links are removed based on the relationships given in the reachability matrix.

Step 7. The resultant digraph is converted into an ISM model, by replacing variable nodes with statements.
Step 8. The ISM model developed in Step 7 is reviewed to check for conceptual inconsistency and necessary modifications are made.
In this study, after applying the ISM methodology to the barriers and benefits of adoption of sustainable supply chain management, the barriers and benefits that form the base of the hierarchies are then entered into the structural equation model to investigate their effects on the e-procurement adoption decision. The next subsection describes the SEM methodology. Structural Equation Modeling
SEM is a multivariate technique that enables the researcher to simultaneously examine a series of interrelated dependence relationships among the measured variables and latent constructs as well as between the latter ones (Hair et al., 2010). This study uses Anderson and Gerbing's (1988) two-step approach, in which the measurement model is estimated prior to the structural model. The AMOS 20.0 software is used to test the measurement and structural models based on the maximum likelihood estimation method. We test the measurement model using the confirmatory factor analysis (CFA) as described in Hair et al. (2010). We investigate the model and its significance first. As Jöreskog and Sörbom (1993) propose, we also examine the with the number of degrees of freedom, i.e.,$\chi 2$ df . Additionally, we calculate other goodness-of-fit measures. Based on the recommendations of Hu and Bentler (1998), we choose standardized root mean square (SRMR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA).
After evaluating the fit of the measurement model, we assess the convergent validity and discriminant validity of the constructs. We test the convergent validity by examining (i) the factor loadings; (ii) the average variance extracted (AVE) for each latent construct; and (iii) construct reliability (CR). To test the discriminant validity, the AVE values for the constructs are compared with the square of the correlation estimate between these two constructs (Fornell and Larcker, 1981). After assessing the convergent and discriminant validities, we examine the standardized residual co-variances and modification indices to identify the problems in the measurement model.
Once the measurement model is validated, we test our structural model where our main focus is to test the hypothesized relationships. The goodness-of-fit of the structural model is evaluated with the same measures that we use to test the measurement model. After evaluating the goodness-of-fit measures for the structural model, we finally analyze the path coefficients and loading estimates

VI. NUMERICAL APPLICATION

6.1. Application of Interpretive Structural Modeling for Barriers

In this section, we present the results of application of ISM on the list of barriers to adopt SSCM for each of the three social, environmental and economic dimensions.

6.1.1 Structural Self Interaction Matrix

Firstly, the SSIM's are developed for barriers and benefits of sustainability. In order to get an unbiased solution to the problem opinions of academic experts in sustainable supply chains was taken and the accumulated results were used to develop the final Self Structure Interaction Matrix (SSIM).

V: BARRIER i will help achieves BARRIER j;

A: BARRIER j will help achieves BARRIER i;

X: BARRIER i and j will help each other;

O: BARRIER i and j are unrelated;

Structural self interaction matrix (SSIM)													
Sr.No.	Barriers to adoption of SSCM	12	11	10	9	8	7	6	5	4	3	2	1
1	OVC	X	O	O	A	O	O	A	A	V	V	O	X
2	KIS	A	O	O	O	A	V	O	A	X	V	X	
3	EMS	A	A	A	A	A	O	A	A	V	X		
4	IEA	A	A	O	A	A	X	A	A	X			
5	LEG	O	A	O	A	V	O	O	X				
6	OES	V	O	O	A	V	A	X					
7	CSI	V	O	A	A	X	X						
8	SPS	O	A	A	X	X							
9	GOS	O	O	A	X								
10	UNS	O	A	X									
11	PAS	O	X										
12	CRC	X											

6.1.2 Reachability Matrix

Once we have the SSIM, the next step is to obtain the reachability matrix. Based on the rules mentioned in Chapter 3, we obtain an initial reachability matrix for the SSIM. These matrices are as shown in the Tables 4.2 & 4.3.

Initial reachability matrix

Sr.No.	Barriers to adoption of SSCM	1	2	3	4	5	6	7	8	9	10	11	12	Driving power
1	OVC	1	0	1	1	0	0	0	0	0	0	0	1	4
2	KIS	0	1	1	1	0	0	1	0	0	0	0	0	4
3	EMS	0	0	1	1	0	0	0	0	0	0	0	0	2
4	IEA	0	1	1	1	0	0	1	0	0	0	0	0	4
5	LEG	1	1	1	1	1	0	0	0	0	0	0	0	5
6	OES	1	1	1	1	0	1	0	0	0	0	0	1	6
7	CSI	0	0	0	1	0	1	1	0	0	0	0	0	3
8	SPS	0	1	1	1	0	0	1	1	1	0	0	0	6
9	GOS	1	0	1	1	1	1	0	1	1	0	0	0	7
10	UNS	0	0	1	0	0	0	0	1	1	1	0	0	4
11	PAS	0	1	1	1	1	0	0	1	0	1	1	0	7
12	CRC	1	1	1	1	0	0	1	0	0	0	0	1	6
Dependence power		5	7	11	11	3	3	5	4	3	2	1	3	

Final reachability matrix

Sr.No.	Barriers to adoption of SSCM	1	2	3	4	5	6	7	8	9	10	11	12	Driving power
1	OVC	1	1	1	1	0	0	0	0	0	0	0	1	5
2	KIS	0	1	1	1	0	0	1	0	0	0	0	0	4
3	EMS	0	0	1	1	0	0	0	0	0	0	0	0	2
4	IEA	0	1	1	1	0	0	1	0	0	0	0	0	4
5	LEG	1	1	1	1	1	0	0	1	0	0	0	1	7
6	OES	1	1	1	1	0	1	0	1	0	0	0	1	7
7	CSI	0	1	0	1	0	1	1	1	0	0	0	1	6
8	SPS	0	1	1	1	0	0	1	1	1	0	0	0	6
9	GOS	1	0	1	1	1	1	0	1	1	0	0	1	8
10	UNS	0	0	1	0	0	0	0	1	1	1	0	1	5
11	PAS	0	1	1	1	1	0	0	1	1	1	1	0	8
12	CRC	1	1	1	1	0	0	1	0	0	0	0	1	6
Dependence power		5	9	11	11	3	3	5	7	4	2	1	7	

6.1.3 Level Partitioning

Tables 4.4 to 4.11 present the results of level partitioning for the different barriers to adopt SSCM from social, economic and environmental dimensions. In the first set (Table 4.4) of iteration of barriers it is found that barrier (3) i.e. Lack of environmental monitoring system (EMS) in the organization And barrier (4) i.e. Lack of internal/External sustainability audits are on level I as the reachability set and intersection set are the same. Thereby in the next iteration i.e. iteration II (Table 4.5) we separate barrier 2 i.e. Lack of knowledge sharing about sustainability among SC partners from all the sets. These iterations are continued till **Iteration no.8** then we will find the diagraph to find the level of each barrier

6.1.4 Diagraphs for ISM (Barriers)

Figure 4.1 presents the results of ISM for the barriers on adopting SSCM practices for Indian industries. It can be seen from the digraph the most important barrier that will drive other barriers in achieving SSCM practices in Indian industries is Lack of public awareness in domestic market on sustainability. The next level consists of Market uncertainty due to economic slowdown. It can be said that there is problem related to public unawareness for sustainable products hinders the demand for the such products from domestic customer as well Market uncertainty due to global economic slowdown affects demands from the overseas customer are considered as the most important barriers to adopt SSCM practices from Indian manufacturer. The next level, level 3, in our digraph consists of a pair of barriers including Competitive cost of sustainable product & implementation cost and Perceived lack of government support. Most of these elements are related to each other and are strongly dependent on awareness about sustainable products and other barriers of lower levels. Successful elimination of these barriers leads to adoption of practices such as environmental monitoring system (EMS) in the organization, knowledge sharing about sustainability among

SC partners and internal/External sustainability audits in decreasing order of hierarchy.

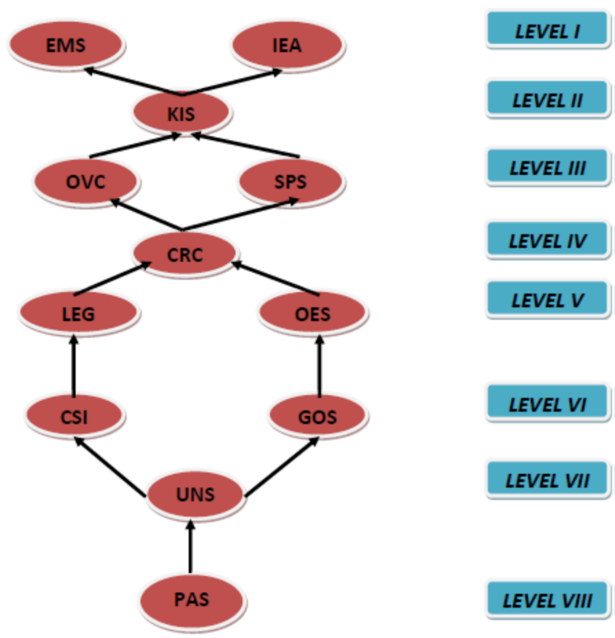


Fig.4.1: ISM Framework for Barriers of SSCM adoption

6.1.5 MIC MAC Analysis

Figures 4.1 present graphically the results of MICMAC analysis. From the results of final reachability matrix it is found that Lack of public awareness in domestic market on sustainability (BR11) and Perceived lack of government support have a strong driving power and fall in the cluster IV which is cluster of independent variables. Not even a single Barrier fall under the cluster in between dependent and independent variables i.e. linkage variables cluster. We have Lack of knowledge sharing about sustainability among SC partners, Lack of environmental monitoring system (EMS) in the organization, Lack of internal/External sustainability audits Shortage of professionals in sustainability and Supply chain partners' resistance to change under cluster II which is the cluster for dependent variables. We have Lack of SSCM practices in organizational vision & commitment, Competitive cost of sustainable product & implementation cost and market uncertainty due to economic slowdown as autonomous variables.

6.2 Application of Interpretive Structural

All the procedural steps to find the hierarchical relationship are similar to barriers of SSCM. In this paper we are showing diagraph of the benefits directly.

6.2.1 Diagraphs for ISM (Benefits)

Figure presents the results of ISM for the benefits of SSCM practices adoption for Indian firms. It can be seen from the digraph the most important benefit that will drive other benefits to adopt concept of sustainability in its entire three dimensions is Enhancement of corporate value by investment in its people and environment. The next level,

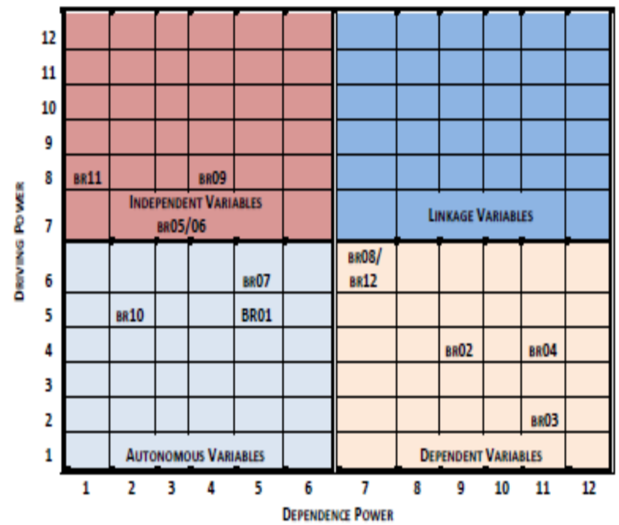


Fig.4.2: MICMAC Analysis

level 2, in our digraph consists of a Reduction in consumption in hazardous and toxic material. The next level, level 3, in our digraph consists of a benefit such as product quality improvement Most of the other benefits are related to each other and are strongly dependent on enhancement of corporate value and other benefits of lower levels. Successful implementation of these benefits leads to Reduction in employee turnover rate, Increase sales and brand security and ultimately increased market share by brand image improvement and availability of new overseas market opportunity in decreasing order of hierarchy.

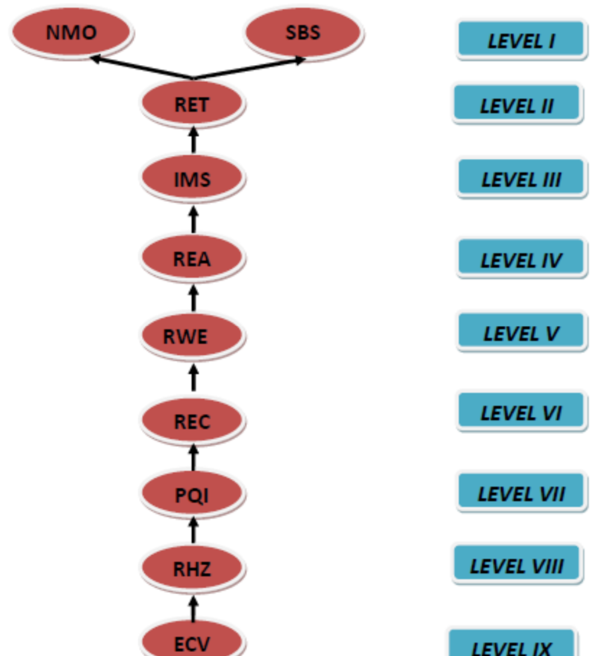


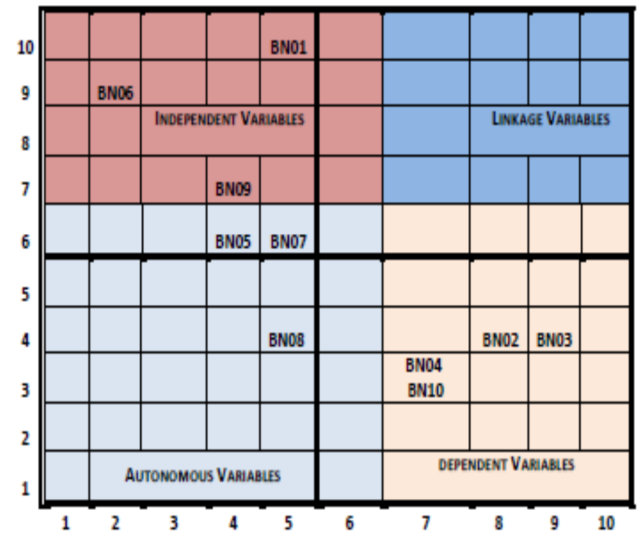
Fig.4.3: ISM Framework for Benefits of SSCM adoption

6.2.2 MIC MAC Analysis

Figure present graphically the results of MICMAC analysis. From the results of final reachability matrix it is found that Enhancement of corporate value by investment in its people and environment, reduction in consumption in hazardous and toxic material, reduction in energy consumption and product quality improvement are the key benefits associated on adoption of SSCM in Indian firms, these benefits have a strong driving power and fall in the cluster IV which is cluster of independent variables.

We do not have any variables falls under cluster III which stands for linkage variables.

We have increased market share by brand image improvement, new overseas market opportunity, increase sales and brand security and reduction in employee turnover rate under cluster II which is the cluster for dependent variables. Lastly we have found Reduction in the frequency of environmental accidents as autonomous variables.



6.3 Analysis of Structural equation modeling

There are two hypotheses to be tested and two constructs to be developed from the ISM hierarchy as in previous chapters. In this study, there are four stages of construct development: (1) In the first pre-pilot stage, the definition and items of each construct are first generated from a broad literature review; (2) then, the potential items extracted from ISM hierarchy for both barriers and benefits of SSCM are given to two practitioners and five academicians for a pretest, whose purpose is to clarify the instructions and the questions in the questionnaire; according to their feedback, the items are modified, included, or discarded to ensure the content validity of the instruments; (3) the third stage is the pilot study; in this stage, a small sample of respondents is used to answer the surveys; the reliability and validity of the instruments can be evaluated and then the instruments are refined; (4) the fourth stage is testing validities and reliabilities of all instruments through analyzing large-scale survey data.

We have two main research hypotheses as follows:

Hypothesis 1 (H1). Barriers of SSCM practices have negative effect on the adoption decision.

Hypothesis 2 (H2). Benefits of SSCM practices have positive effect on the adoption decision.

In Pre-pilot Study the questionnaire was first sent to five academicians and two practitioners to check the consistency of each item with the definition and the content of corresponding constructs as well as the accuracy of the wording in the questionnaire. According to their feedback, items were added, modified and eliminated.

In order to have preliminary confidence about the reliability and validity of the measurement Scale, a small Scale pilot study was conducted. A questionnaire was sent to five manufacturer of shoe manufacturing sector in Delhi NCR and two manufacturer in textile industries from Bhiwadi,Rajasthan. The sample size of this pilot study is 20. The pilot study results are very valuable for preliminary evaluation of the reliability and convergent validity of the instrument.

The results of statistical analyses also provide directions to clarify and/or modify items in the questionnaire. One purpose of the pilot data analyses is to ensure instrument reliability. Reliability indicates the degree to which a measurement will have same results when the test is repeated. This study uses a commonly agreed reliability indicator, Cronbach‟s alpha (Cronbach, 1951). An alpha value higher than 0.7 indicates an acceptable reliability for a measurement (Nunally, 1978). Another purpose of the pilot data analysis is to ensure convergent validity of each instrument. Convergent validity measures the extent to which each item in one dimension (construct) forms a common dimension. A dimension-level factor analysis is to assure unidimensionality (convergent validity) of each dimension in a construct. This study uses SPSS 22.0 to conduct factor analysis.

6.3.1Sampling Plan and Sampling Design

After the modification of the instruments, a large-Scale survey was conducted to have a sample of data for the instrument validation and the hypothesis testing. Sampling is a process of selecting members from a population of interest to conduct studies on and reach a conclusion; the conclusions made from the sample may be generalized back to the population if the sample is representative. This study focuses on manufacturers‟ perceptions toward barriers and benefits on adoption of SSCM practices. Manufacturer of Footwear and textile industries in India can be viewed as the population.

This study collected data from Footwear and textile industries in both western and northern India because of the importance of these two areas/regions‟ footwear and textile industries in India.

6.3.2The Large-Scale Data Collection process:

The data collection process started in May 2014 and ended in February 2015. In the first stage, key executives (purchasing managers, supply chain mangers, vice presidents of manufacturing or purchasing) were contacted through telephone calls or emails by the author or author‟s industry connections to inquire about the possibility of sending this survey to their employees. In the second stage, an email was sent to each of the key executives who agreed to participate and send the questionnaire to their suppliers; this email offered two options of their answering the survey: the Word/PDF version and the on-line version. Then, the executives sent emails to request their employees answer this survey. In the third stage, Employees of concerned industries submitted on-line answers or sent the completed survey to the executive through mail or email.

The number who received the questionnaire are 235 where the number of complete and usable responses was 112, resulting in a response rate of 47.65 %.

The large-Scale instrument development in this study includes reliability and validity assessment, using the 112 responses. Reliability measures the consistency of an instrument; if the same respondents retake the test under the same conditions, they will provide identical results. The validity measures the degree to which the instrument tests the “true” concept the designer wants. Reliability shows the precision of a construct, while validity measures the accuracy of a construct. A construct cannot be valid if it is not reliable; a construct can be reliable even if it is not valid. Validity includes content validity, unidimentionality (convergent validity), discriminant validity, and validation of the second-order construct.

Reliability indicates the degree to which a measurement can have same results when the test is repeated. This study uses a commonly agreed reliability indicator, Cronbach‟s alpha (Cronbach, 1951). An alpha value of 0.7 or above indicates a good measurement (Nunally, 1978). In addition, the Corrected Item-Total Correlation (CITC) of each item in an instrument measures how well the item contributes to the construct‟s internal consistency (Kerlinger, 1978).

Content validity measures the representativeness of each item to the construct. A construct has content validity if the items in the construct adequately cover the domain of the construct (Kerlinger, 1978). The content validity can be evaluated through one or all of procedures listed below: (1) a comprehensive review of the literature (Nunnaly, 1978), (2) an evaluation of the generated items by other researchers and/or professionals, and (3) a pilot study with a small sample from the population

Convergent validity measures the extent to which the items in one construct (dimension) form a common dimension. This study uses confirmatory factor analysis (CFA) in AMOS to test and modify the measurement model. Goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square residual (RMR) of each dimension in one construct are provided for the initial model and the final model.

Discriminant validity measures the independence of each dimension in a construct (Bagozzi and Philips, 1982). Discriminant validity is tested through a three-step pair-wise comparison process using structural equation modeling: (1) two dimensions in one construct form a correlated model, and $\chi 2$ of this two-factor model is recorded; (2) a single factor model with all items in those two dimensions is tested, and $\chi 2$ of this onefactor model is recorded; (3) the discriminant validity is supported if the difference of the two $\chi 2$ scores (df = 1) is significant at $p < 0.05$ level (Joreskog, 1971).

Indicators of the latent variables in the measurement and structural models		
Latent Variable	Indicator	Description
Barriers on adopting SSCM	PAS(BR1)	Lack of public awareness in domestic market on sustainability
	UNS(BR2)	Market uncertainty due to economic slowdown
	CSI(BR3)	Competitive cost of sustainable product & implementation cost
	GOS(BR4)	Perceived lack of government support
Benefits on adopting SSCM	ECV(BN1)	Enhancement of corporate value by investment in its people and environment.
	RHZ(BN2)	Reduction in consumption in hazardous and toxic material
	PQI(BN3)	Product quality improvement

Table: 4.24: Indicators of the latent variables

6.3.3 Measurement model results

In this study, Anderson and Gerbing's (1988) two-step approach is used, i.e., the measurement model is estimated prior to the structural model. The AMOS 20.0 software is used to test the measurement and structural models based on the maximum likelihood estimation method.

The measurement model consists of two latent variables, i.e., Barriers and Benefits, with four and three indicators, respectively shown in table 4.24. We test the measurement model using the confirmatory factor analysis (CFA) method as described in Hair et al. (2010). Here, we present the results for the final measurement model. The model $\chi2$ is calculated as 26.98 with 10 degrees of freedom and it is significant. However, because of the shortcomings of the $\chi2$ test statistic, too much emphasis should not be given to this test (Schermelleh-Engel et al., 2003). Jöreskog and Sörbom (1993) propose to compare the magnitude of $\chi2$ with the number of degrees of freedom, i.e., $\chi2/df$.

Our measurement model yields $\chi2/df=2.698$ which is below the threshold of 3.00. Additionally, we calculate other goodness-of-fit measures. Based on the recommendations of Hu and Bentler (1998), we choose standardized root mean square (SRMR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). The recommended values for these fit indices and the results for the measurement model are given in Table 4.25, which shows that all values are within the recommended ranges indicating that the measurement model has a good fit.

After evaluating the fit of the measurement model, one should also assess the construct validity that consists of two components: convergent validity and discriminant validity.

We test the convergent validity by examining the factor loadings first. All factor loadings are significant at the 0.001 level and except two of them all are above 0.70. Only BR1 and BR3 have factor loadings of 0.69 and 0.63, respectively; but since these are above 0.50, they are also acceptable. Second, the average variance extracted (AVE) is calculated for each latent construct. AVE values are calculated as 0.47 and 0.64 for barriers and benefits, respectively. Since an AVE of 0.50 or higher suggests adequate convergent validity, one can see that the AVE for barriers is just below this critical level. Third, we calculate the construct reliability (CR), which is also an indicator of convergent validity. CR values are calculated as 0.75 and 0.87 for barriers and benefits, respectively. Since they both exceed the threshold of 0.70, this also validates convergent validity. The results for the measurement model can be found in Table 4.26.

Goodness-of-fit measures for the measurement model.		
Goodness-of-fit measure	Recommended value*	Result
χ2/df	≤3.0	2.698
SRMR	≤0.10	0.059
GFI	≥0.90	0.965
AGFI	≥0.85	0.948
NFI	≥0.90	0.974
CFI	≥0.95	0.988
RMSEA	≤0.08	0.057

Table: 4.25: Indicators of the latent variables

***Recommended value from (Schermelleh-Engel et al., 2003)**

Results for the measurement model.					
Latent Variable	Indicator		Factor loading	AVE	CR
Barriers on adopting SSCM	*PAS*	*BR1*	0.693	.470	.758
	UNS	*BR2*	0.725		
	CSI	*BR3*	0.643		
	GOS	*BR4*	0.719		
Benefits on adopting SSCM	*ECV*	*BN1*	0.721	.645	.875
	RHZ	*BN2*	0.788		
	PQI	*BN3*	0.727		

Table: 4.26: Results for the measurement model

- **All factor loadings are Significant at the 0.001 level (two-tailed)**

6.3.4 Structural model results and hypothesis testing

After testing the measurement model, we test our structural model and our main focus is to test the hypothesized relationships. The structural model consists of two exogenous variables (Barriers and Benefits) and one endogenous variable (Adoption). Recall that the exogenous variables Barriers and Benefits have four and three indicators, respectively. On the other hand, the endogenous variable Adoption has a single indicator, which is measured through the question that investigates the SSCM practices adoption decision for the Indian firms. Effect of these barriers and Benefits of SSCM practices adoption decision are investigated in this part of the study.

Goodness-of-fit measures for the structural model.		
Goodness-of-fit measure	Recommended value	Result
χ2/df	≤3.0	1.612
SRMR	≤0.10	0.056
GFI	≥0.90	0.923
AGFI	≥0.85	0.957
NFI	≥0.90	0.929
CFI	≥0.95	0.921
RMSEA	≤0.08	0.046

Table: 4.27: Indicators of the latent variables

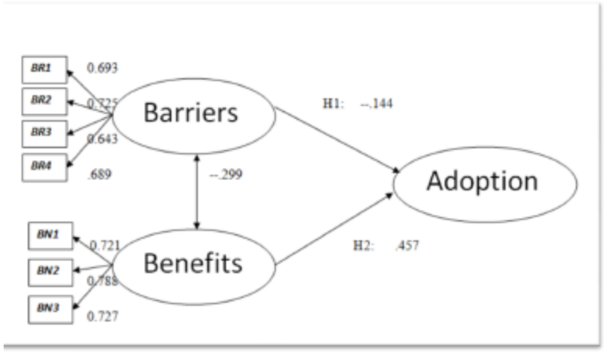


Fig.4.5: Results of the path analysis.

From Fig. 4, it can be seen that the path coefficient estimate between barriers and adoption is -0.14 and it is significant at the 0.05 level. Thus, our first hypothesis is supported, i.e., barriers of SSCM practices have negative effect on its adoption decision. On the other hand, the path coefficient estimate between benefits and adoption is 0.45 and it is significant at the 0.001 level. Thus, our second hypothesis is also supported, i.e., benefits of SSCM practices have positive effect on the adoption decision. As stated before, besides these hypotheses, another point of interest is to examine whether the barriers or benefits of SSCM practices have higher impact on the adoption decision. Since the path coefficient estimate of benefits is higher than that of the barriers, we conclude that benefits of adoption of SSCM practices into Indian firms system overweigh its barriers on adoption. Thus, it would be beneficial for the company to adopt the SSCM practices.

VII CONCLUSION

This study investigates the effects of the barriers and benefits of SSCM practices on sustainability adoption decisions. An empirical analysis has been performed for manufacturing units of Shoes and Textile sector in India. The first aim of the study is to list out barriers and benefits of SSCM practices for its adoption in Indian industries. This is achieved by measuring the driving power of each potential barrier and benefit as well as the inter-relations within them. The second and the ultimate aim of the study is to put forth whether barriers or benefits have higher impact on the company's SSCM practices adoption decision by using an approach based on cost/benefit analysis.

The results of the first part of the study denote that among the barriers of SSCM practices, inadequate most important barrier that will drive other barriers in achieving SSCM practices in Indian industries are lack of public awareness in domestic market on sustainability and Market uncertainty due to economic slowdown. It can be said that there is problem related to public unawareness for sustainable products hinders the demand for the such products from domestic customer as well market uncertainty due to global economic slowdown affects demands from the overseas customer are considered as the most important barriers to adopt SSCM practices from Indian manufacturer. Overcoming these barriers will help to reduce the negative effects of all other barriers. When we turn back to the benefits of SSCM practices the most important benefit is enhancement of corporate value by investment in its people and environment. Another key benefits considered in the study are reduction in consumption in hazardous and toxic material. and product quality improvement Most of the other benefits are related to each other and are strongly dependent on enhancement of corporate value and other benefits of lower level in hierarchy. The results of the second part of the study denote that barriers (benefits) of SSCM Practices have negative (positive) effect on the SSCM adoption decision and the effect of benefits on the adoption decision is higher than that of the barriers, which might be considered as indirect costs of adoption. In other words, the potential benefits of SSCM practices have stronger impacts than the costs that the company may put up with due to the potential barriers. Thus, based on the results of our cost/ benefit analysis, it would be beneficial for the company to adopt the SSCM practices. It is noteworthy that the results of this study might differ for other 70 | P a g e
companies and sectors. Thus, as a further study, the models could be enhanced with other factors and a sector-base analysis could be performed from a larger perspective.

VIII REFERENCES

[1] Abbasi, M. & Fredik, N., Themes and Challenges in making supply chains environmentally sustainable, supply chain management: An international journal, vol.17, no.5, pp.5, 17-530, 2012.
[2] Agarwal, Ashish; Shankar, Ravi; Tiwari M.K (2007). ―Modeling agility of supply chain Industrial Marketing Management‖, Volume 36, Issue 4, Pages 443-457.
Anderson, J.C., Gerbing, D.W., 1988. Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103(3), 411–423.
[3] Awasthi A; Chauhan S; Goyal S.K (2010). ―A fuzzy multicriteria approach for evaluating environmental performance of suppliers‖. International Journal of Production Economics, Volume 126, Issue 2, Pages 370-378.
[4] Business for social responsibility (2007). Perspectives on Information Management in Sustainable Supply Chains http://www.bsr.org/reports/BSR_Info-Management-Supply-Chains.pdf
[5] Carter Craig; Rogers Dale (2007). ―A framework of sustainable supply chain management: moving toward new theory‖. Volume 38, Issue 5, Pages 360 – 387.
[6] Chen S.P; Wu W.Y (2010). ―A systematic procedure to evaluate an automobile manufacturer–distributor partnership, European Journal of Operational Research. Volume 205, Issue 3, Pages 687-698.
[7]Clift Roland (2003), Metrics for supply chain sustainability, Springer-Verlag.
[8] Daly H., Cobb J. (1989), ―For the Common Good: Redirecting the Economy toward Community, the Environment and a Sustainable Future‖, Boston: Beacon Press.
[9]Elkington J (2004) Enter the triple bottom line. In: Henriques A, Richardson J (Eds) The Triple Bottom Line: Does It All Add up?. Earthscan, London.
[10] Faisal, Mohd Nishat; Banwet, D.K; Shankar, Ravi (2006). ―Supply chain risk mitigation: modelling the enablers‖, Business Process Management, Volume 12, Issue 4, Pages 535-552. 73 | P a g e

[11] Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39–50.

[12] Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2010. Multivariate Data Analysis. Pearson Prentice Hall, New Jersey.

[13] Hamel, G., & Prahalad, C. K. (1989). Strategic intent. Harvard Business Review, 67, 63-76.

[14] Hanna, M. D., Newman, W. R., & Johnson, P. (2000). Linking operational and environmental improvement through employee involvement. International Journal of Operations & Production Management, 20(2), 148-65.

[15] Harland CM (1996) Supply chain management: relationships, chains and networks. British Journal of Management 7(1):63-80.

[16] Hervani Aref A; Helms Merilyn M (2005). ―Performance measurement for green supply chain management‖, Benchmarking: An international journal, Volume 12, Issue 4, Pages 330-353.

[17] Hu, L., Bentler, P.M., 1998. Fit indices in covariance structure modeling: Sensitivity to unparameterized model misspecification. Psychological Methods, 3(4), 424–453.

[18] Jöreskog, K.G., Sörbom, D., 1993. Structural Equation Modeling with the SIMPLIS Command Language. Scientific Software, Chicago.

[19] Kainuma Y; Tawara N (2006). ―A multiple attribute utility theory approach to lean and green supply chain management‖, International Journal of Production Economics, Volume 101, Issue 1, Pages 99-108.

[20] Kannan G; Pokharel S; Kumar P. Sasi (2009). ―A hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider Resources‖, Conservation and Recycling, Volume 54, Issue 1, Pages 28-36.

[21] Linton, J. D., Klassen, R., & Jayaraman, V. (2007). Sustainable supply chains: an introduction. Journal of Operations Management, 25(6), 1075-82. 74 | P a g e

[22] Luthra, S., Kumar, V., Kumar, S., & Haleem, A. (2011). Barriers to implement green supply chain management in automobile industry using interpretive structural modeling technique: An Indian perspective. Journal of Industrial Engineering and Management, 4(2), 231-257.

[23] Markley J. M; Davis L (2007). ―Exploring future competitive advantage through sustainable supply chains‖. International Journal of physical distribution and logistics management, Volume 37, Issue 9, Pages 763-774.

[24] Ninlawan C; Seksan P; Tossapol K; Pilada W (2010). ―The Implementation of Green Supply Chain Management Practices in Electronics Industry‖.

[25] Ravi, V., Shankar, R., 2005. Analysis of interactions among the barriers of reverse logistics. Technological Forecasting and Social Change, 72(8), 1011–1029.

[27] Sage, A.P.(1977). Interpretive Structural Modeling: Methodology for Large-Scale Systems, McGraw-Hill, New York, NY, pp. 91-164.

[28] Sarkis, J. (2009). A boundaries and flows perspective of green supply chain management. GPMI working Papers. No-7, October. 2009.

[29] Seuring, Stefan; Müller, Martin (2008). ―From a literature review to a conceptual framework for sustainable supply chain management‖. Journal of Cleaner Production, Volume 16, Issue 15, Pages 1699-1710,

[30] Sikdar SK (2003) Sustainable development and sustainability metrics. AIChE Journal 49(8):1928-1932. Srivastava SK (2007). ―Green supply chain management: a state-of-art literature review‖. International Journal of management Reviews, Volume 9, Issue 1, Pages 53-80.

[31] Teuteberg, Frank; Wittstruck, David (2010). ―A systematic review of sustainable supply chain management research: What is there and what is missing?‖ MKWI 2010 – Betriebliches Umwelt- und Nachhaltigkeitsmanagement, Pages 1001-1015.

[32] Theyel G (2001). ―Customer and supplier relations for environmental performance‖, Greener Management International, Volume 35, Pages 61-69. 75 | P a g e

[33] Toktaş-Palut, P., Baylav, E., Teoman, S., & Altunbey, M. (2014). The impact of barriers and benefits of e-procurement on its adoption decision: An empirical analysis. International Journal of Production Economics, 158, 77-90.

[36] Tsoulfas, Giannis T; Costas P. Pappis (2008). ―A model for supply chains environmental performance analysis and decision making‖, Journal of Cleaner Production, Pages 1648-1657.

[37] Walker, H; Di Sisto, Lucio; McBain, Darian (2008). ―Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors‖, Journal of Purchasing and Supply Management, Volume 14, Issue 1, Pages 69-85

[38] Yu Lin, C., and Hui Ho, Y. 2008. An empirical study on logistics services provider, intention to adopt green innovations. Journal of Technology, Management and Innovation, 3(1), 17-26.

[39] Zhu, Q. and Sarkis, J., Relationship between operational practices and performances among early adopters of Green supply chain management practices in chinese manufacturing enterprises. Operationsmanagement