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Barriers to Implement Green Supply Chain Management in Small Scale Industry using Interpretive Structural Modeling Technique - A North Indian Perspective

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ABSTRACT

Small scale manufacturing industries started implementing the green concept in their supply chain management recently to focus on environmental issues. Maximum of the small scale industries are setting up their own manufacturing plants in economical Indian market. Owing to community consciousness, economic, environmental or governmental reasons, the obligation of green supply chain management has been in demand. In this framework, this study purposes to improve an important model of the barriers to implement green supply chain management in north Indian small scale industry. We have recognized numerous barriers and background relationships between the identified barriers. Arrangement of barriers has been carried out based upon requirement and driving power with the support of MIC-MAC analysis. In accumulation to this, a structural model of barriers to implement green supply chain management in north Indian small scale industry has also been place forward using Interpretive Structural Modeling (ISM) technique. Sixteen numbers of applicable barriers have been recognized from literature and following debates with professionals from industry. Available of which, four numbers of barriers have been identified as dependent variables; six numbers of barriers have been identified as the independent variables andsix numbers of barriers have been identified as the linkage variables. Elimination of these barriers has also been argued. Concluded this paper we donate to identify the barriers to implement green supply chain management in north Indian small scale industry and to overgrown them. The structured model developed will assistance to appreciate interdependence of the barriers.

Key words: Small scale industry, green supply chain, Barrier analysis, MIC-MAC analysis, interpretive structural modeling

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INTRODUCTION

Along with the rapid alteration in universal industrial state, ecological and social topics are pleasant more significant in handling any industry. Green supply Chain Management (GSCM) is a sequence to increase performance of the method and products giving to the provisions of the ecological rules [1] GSCM has looked in the last few years and covers all points of product's life cycle from design, production and distribution points to the exercise of products by the end users and it's dumping at the end of product's life cycle [2]. GSCM is integrating environmental thinking [3] into Supply Chain Management (SCM). This study classifies various barriers to implement GSCM in north Indian small scale industry, to classify further the background relationship among the recognized barriers to implement GSCM, to classify these barriers depending upon their driving and dependence power and finally to develop ISM based model of these barriers. ISM is a deep-rooted methodology for classifying relationship among exact item which describe problem or an issue.

BARRIERS TO IMPLEMENT GSCM IN NORTH INDIAN SMALL SCALE INDUSTRY

The small scale industries in India perform a vital role in the Indian economy the growth of small scale industries (SSI) in India is vast in recent years. The small scale industries in India creates a largest employment opportunities for the Indian population, next only to agriculture. It has been estimated that a hundred thousand rupees (US $ 2000) of investment in fixed assets in small scale sector generates employment for four persons. The small scale industries contribute 40% of gross manufacture to the Indian economy. In spite of this small scale industries play a major role in India's present export performance. 45%-50% of the Indian export is being contributed by small scale industries sector. There are three major types of small scale industries which have more revenues; they are food product

industries, garment manufacturing industries and metal industries. The growth of the industries is rapid but the growth can't be stated as dynamic growth because of their awareness and concern towards environmental manufacturing. The industries are experiencing an increased pressure to reduce cost, improve quality and reduced time of delivery to sustain in the present market, so they are narrowed on focusing to the factors of their sustainability and other influencing factors to the environment are ignored. The lack of awareness and because of high recklessness the environment is affected to great extent by these industries. Majority of worlds manufacturing domain would be carried out in Asia for several reasons in the upcoming decades [12]. This would motivate the industries to think on GSCM in order to maintain their competiveness. The many actions of the concept is restrained due to economic reasons, so there is a need of necessity to show the guidance and proof of economic benefits that would help for the broader appliance of the concept. We have identified various barriers to implement GSCM in north Indian small scale industry from the literature reviews and expert opinions. Literature was reviewed to identify barriers to implement GSCM in north Indian small scale industry. We conducted an interview and asked the questions according to the questionnaire prepared, in which different experts from academia and industry were interviewed. Three were from industry and two were from academia. Thinking session was conducted and sixteen barriers relevant to in north Indian small scale industry were identified. Again thinking session was conducted to reach consensuses about the contextual relationships to form a structural self-interaction matrix. The above said identified barriers are explained as below:

Lack of Acceptance of Advancement in New Technology

Technology is a kind of knowledge. An organization will have higher innovative capability when knowledge can be shared more easily within the organization [13]. An organizational barrier means difficulty of implementing fundamental change in the organization. This is especially true when there are changes in the core features of organizations like organizational goals, forms of authority, core technology, operational strategy and market strategy [15].Therefore, lack of acceptance of advancement in new technology is important barrier to implement GSCM in north Indian small scale industry.

Poor Organizational Culture in GSCM

Informal linkages and improved communication help the organizations to adopt Green's practices [8]. Training and education are the prime requirements for achieving successful implementation of GSCM in any [6]. Management may encourage employees to learn green information. Organizations may provide rewards for green employees. Employees may be helped when they face green problems and may be provided support to learn green information [1].

Lack of Skilled Human Resource Professionals in Sustainability and GSCM

A Company with higher quality of human resources such as better training or education will help in implementing Green Supply Chain Management. Quality human resources can provide new ideas for companies, learn new technologies easily, share knowledge with each other and use new technologies to solve problem [8]. However, due to financial constraint; quality of human resources is barrier. Therefore poor quality of human resources is an important barrier to implement GSCM in north Indian small scale industry.

Uncertainty and Competition in Market

In today's scenario market uncertainty is very high due to global competitiveness, and customer's requirements [16]. The external environment in which a firm conducts its business will also influence the innovative capability as well as intention to adopt innovations. We consider that market uncertainty and competition is very important barrier to achieve GSCM in north Indian small scale industry.

Lack of Government Initiatives System for GSCM Practitioners

Time consuming regulatory requirements, fees or levies may discourage smaller firms. Tax structures that distort incentives can discourage industry to implement GSCM. Government institutions are considered as barriers to development in the environmental management in the sense that institutional process for implementing GSCM are going on but very limited institutional support is given for new ideas to implement GSCM. Therefore lack of government support systems is a barrier to implement efficient GSCM in north Indian small scale industry.

Poor Implementation of Green Practices within a Supply Chain

Innovative green practices involves hazardous solid waste disposal, energy conservation, reusing and recycling of materials. Innovative green practices promote innovative design, new market opportunities and makes their quality better than others. However, due to market competition and cost implications, organizations try to save cost.

Lack of Top Level Management Commitment

In general, management support is a critical element of adoption and implementation of innovations in an organization, especially environmental systems. Organizational innovations may remain stuck at the initial idea stage absent dedicated champions. Top management support can affect new system initiatives success by promoting employee empowerment, by facilitating employee involvement by promoting a cultural shift and increased commitment by the organization's employees, by instituting rewards and incentives systems to affect employee

behavior, by providing training and increasing communication across units and encouraging teams and teamwork in the organization [15]. Top management support and commitment is necessary for any strategic program success [16]. Therefore, we assume that lack of top management commitment is one of the barriers to implement of GSCM in north Indian small scale industry.

Cost of Implementation for GSCM

Engaging in environmental management involves two types of costs, direct cost and transaction cost. Both types of costs are likely to constitute significant barrier to implement GSCM [19] IT enablement, Technology advancement adoption, hiring good quality of employees, motivating and training of employees towards GSCM will require high initial investment. Historically, cost has been used as the prime performance measure. Usually, high cost is a big pressure in GSCM as compared to conventional SCM. The initial investment requirement by green methodologies such as green design, green manufacturing, green labeling of packing etc. are too high. Therefore, cost implication is a major barrier among the barriers to implement efficient GSCM in north Indian small scale industry.

Supplier's Flexibility to Change towards GSCM

Suppliers Pressure and willingness is that driver of GSCM which states that suppliers can help to provide valuable ideas used in the implementation of environmental projects, but they generally do not act as a direct driving force. However, whilst suppliers may not be the drivers, integration and cooperation in supply chains can support more effective management of environmental issues. A collaborative paradigm has been used to explore green supply chain management practices in manufacturing plants [14]. Suppliers' reluctance to change towards GSCM is due to traditional mindset and suppliers' interests being different from those of the total network [10]. So we can say that flexibility to change towards GSCM is a very important barrier to implement GSCM in north Indian small scale industry.

Customer's Unawareness towards GSCM Products and Services

Customer's unawareness towards GSCM products and services is that driver of Green Supply Chain Management which states that the understanding and knowledge that a buyer should have of his rights as a customer. A major barrier of GSCM seen in north Indian small scale industry is lack of awareness of customers about the benefits of green products. Customer demands become most crucial type of external pressure. Customer's awareness means if customer demands green products; the company has to change technology and organization for innovative green products.

Lack of green Architects, Consultants, Green Developers, Contractors in the Region

Lack of green architects, consultants, green developers, contractors in the region is that driver of Green Supply Chain Management which is adversely affect at the rural area because most of the architects, consultants, green developers and contractors are interested to work in urban area because in urban region are good for their professional and family responsibility point of view. Therefore this barrier should be given more emphasis for the implementation of Green Supply Chain Management in north Indian small scale industry.

Lack of Training in GSCM

Training and education are the prime requirements for achieving successful implementation of GSCM in any organization [6]. Management may encourage employees to learn green information. Organizations may provide rewards for green employees. Employees may be helped when they face green problems and may be provided support to learn green information [1]. Therefore, we assume that lack of Lack of training in GSCM is one of the essential barriers to implement of GSCM in north Indian small scale industry.

Lack of Internal Sustainability Audits within the Organization

Previous research has made predictions for supply, but not specifically for sustainable SCM. For example, five-year forecasts for supply shows academics have been making some effort to try to look ahead [15]. Studies have brought practitioners and academics together to try to predict the future for purchasing and supply 20 years into the future [12].Predictions for the future of consumer demand for environmentally products exist [16]. It reflects integration of all internal departmental issues related to the coordination for the Green Supply Chain Management barriers implementation in north Indian small scale industry.

Lack of Management Initiatives for Transport and Logistics

The impact of green logistics involvement on supply chain strategies should be one of the main focuses on this time. The pressure on timely delivery of product is very important and because of this logistics related issues focus on timely delivery due to this attention on environmental issue related to transportation were left. Therefore this barrier is one of the weightiest barriers for implementation of GSCM in north Indian small scale industry.

Lack of Energy Management and Waste Management of the Organization

It shows poor management of organization towards its resources. Innovative green practices involves hazardous solid waste disposal, energy conservation, reusing and recycling of materials. Innovative green practices promote

innovative design, new market opportunities and makes their quality better than others. However, due to market competition and cost implications, organizations try to save cost.

Lack of Professional Treatment and Long Term Contracts for Adopting GSCM from Government

This driver of Green Supply Chain Management states that the rule of law is a system of government in which a society adopts or maintains a set of good, just, and fair laws by which it and its government will be governed. Government Rules & legislation is a major driver for company's environmental management Regulations increase the threats of penalties and fines for non-compliance among companies. This driver is most helpful for implementing and adoption of Green Supply Chain Management in Manufacturing Industries. Lack of professional treatment and long term contracts for adopting GSCM from government have demotivate the organization for implementing the GSCM and this is also affect the north Indian small scale industry as well.

METHODOLOGY

Interpretive Structural Modeling (ISM) is a methodology used to identify relationship among specific items, which define a problem or issue; it was firstly developed in 1970's [24].ISM is interpretive as judgment of the selected group for the study decides whether and how the variables are related. ISM generally has following steps [6]:

Step 1:- Variables affecting the system are listed; in our research work barriers to implement GSCM in north Indian small scale industry have been identified as variables.

Step 2:- From the variables identified in step 1, contextual relationship among the variables with respect to which pairs of variables are examined.

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

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

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

Step 6:- Based on the contextual relationships in the reachability matrix, a directed graph is drawn and the transitive links are removed.

Step 7:- The resultant diagraph is converted into an Interpretive Structural Model by replacing variable nodes with statements.

Table - 1 Structural Self-Interaction Matrix

Barrier Number	Barrier Description	Barrier Number														
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1	Lack of acceptance of advancement in new technology	X	X	A	V	A	A	V	V	A	A	X	A	V	X	X
2	Poor organizational culture in GSCM	X	X	A	V	A	A	V	V	A	A	X	A	V	X	
3	Lack of skilled human resource professionals in sustainability	X	X	A	V	A	A	V	V	A	A	X	A	V		
4	Uncertainty and competition in market	A	A	A	A	A	A	V	V	A	A	A	A			
5	Lack of government initiatives system for GSCM practitioners	V	V	V	V	V	V	V	V	A	A	V				
6	Poor implementation of green practices within a supply chain	X	X	A	V	A	A	V	V	A	A					
7	Lack of top level management commitment	V	V	V	V	V	V	V	V	V						
8	Cost of implementation for GSCM	V	V	V	V	V	V	V	V							
9	Supplier's flexibility to change towards GSCM	A	A	A	A	A	A	V								
10	Customer's unawareness towards GSCM products and services	A	A	A	A	A	A									
11	Lack of green architects, consultants, green developers, contractors in the	V	V	X	V	V										
12	Lack of training in GSCM	V	V	A	V											
13	Lack of internal sustainability audits within the organization	A	A	A												
14	Lack of professional treatment and long term contracts for adopting GSCM	V	V													
15	Lack of management initiatives for transport and logistics	X														
16	Lack of energy management and waste management of the organization	X														

REACHABILITY MATRIX

The SSIM has been converted in to a binary matrix, named Initial Reachability Matrix by substituting V, A, X, by 1 or 0 applying following rules:
If (i, j) value in the SSIM is V, (i, j) value in the reachability matrix will be 1 and (j, i) value will be 0;for V(1,13) in SSIM, '1' has been given in cell(1,13) and '0' in cell(13,1) in initial reachability matrix.
If (i, j) value in the SSIM is A, (i, j) value in the reachability matrix will be 0 and (j, i) value will be 1;for A(2,14) in SSIM, '0' has been given in cell(2,8) and '1' in cell(14,2) in initial reachability matrix.
If (i, j) value in the SSIM is X, (i, j) value in the reachability matrix will be 1 and (j, i) value will also be 1;for X(1,16) in SSIM, '1' has been given in cell(1,16) and '1' in cell(16,1) also in initial reachability matrix.
By applying these rules, an initial reachability matrix for the barriers to implement GSCM has been obtained in Table 2. The final reachability matrix has been obtained by adding transitivity as explained. The driving power and the dependence power of each barrier have also been shown in the Table 2.

Table - 2 Initial Reachability Matrix

Barrier Number	Barrier Number																Driving Power
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	
D1	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
D2	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
D3	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
D4	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	3
D5	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	14
D6	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
D7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
D8	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	15
D9	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
D10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
D11	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	1	13
D12	1	1	1	1	0	1	0	0	1	1	0	1	1	0	1	1	11
D13	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	4
D14	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	1	13
D15	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
D16	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	10
Dependence Power	12	12	12	14	3	12	1	2	15	16	5	6	13	5	12	12	152

PARTITIONING OF LEVELS

The reachability and antecedent set for each barrier have been determined from the final reachability matrix. The reachability set for a barrier consists of the barrier itself and the other barriers, which it influences. The antecedent set consists of the barrier itself and other barriers, which may influence it. Reachability and Antecedent set and Intersection sets are found for the all barriers. Barrier having same reachability set and the intersection set is assigned as top level barrier in the ISM hierarchy or Level 1 is shown in Table 3.After finding Level 1, it is then discarded for finding further Levels. The iterative procedure is continued until Level of each barrier is found. We have identified ten levels in our study.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 has been identified as most important Bottom level barrier.

BARRIERS CLASSIFICATION

Variables are classified in to four clusters [25] named autonomous variables, dependent variables, linkage variables and independent variables. Autonomous variables (first cluster) have weak driving power and dependence. In our study, no barrier lies in this range. The second cluster is named dependent variables. They have weak driving power and strong dependence power. In our study, Six barriers Lack of top level management commitment, Lack of Cost of implementation for GSCM, Lack of government initiatives system for GSCM practitioners, Lack of professional treatment and long term contracts for adopting GSCM from government, Lack of green architects, consultants, green developers, contractors in the region, Lack of training in GSCM are lying in this range. The third cluster named linkage variables having strong driving power and strong dependence power. In our study, barriers named Poor implementation of green practices within a supply chain, Lack of skilled human resource professionals in sustainability and GSCM, Lack of acceptance of advancement in new technology Poor organizational culture in GSCM, Lack of management initiatives for transport and logistics, Lack of energy management and waste management of the organization are lying in this range. The fourth cluster named independent variables has strong

driving power and weak dependence power. In our study, three barriers named Lack of internal sustainability audits within the organization, Uncertainty and competition in market, Supplier's flexibility to change towards GSCM, Customer's unawareness towards GSCM products and services are lying in this range. The graph between dependence power and driving power for the barriers to implement GSCM in north Indian small scale industry is given in Fig.1.

Table - 3 Partition of Reachability Matrix

Criterion Number	Reachability Set	Antecedent Set	Intersection	Level
1	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,14,15,16	1,2,3,6,15,16	
2	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,14,15,16	1,2,3,6,15,16	
3	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,13,14,15,16	1,2,3,6,13,15,16	
4	4,9,10	1,2,3,4,5,6,7,8,11,12,13,14,15,16	4	
5	1,2,3,4,5,6,9,10,11,12,13,14,15,16	5,7,8	5	
6	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,14,15,16	1,2,3,6,15,16	
7	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	7	7	
8	1,2,3,4,5,6,8,9,10,11,12,13,14,15,16	7,8,	7,8	
9	9,10	1,2,3,4,5,6,7,8,9,11,12,13,14,15,16	9	
10	10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	10	**I**
11	1,2,3,4,6,9,10,11,12,13,14,15,16	5,7,8,11,14	11,14	
12	1,2,3,4,6,9,10,12,13,15,16	5,7,8,11,12,14	12	
13	4,9,10,13	1,2,3,5,6,7,8,11,12,13,14,15,16	13	
14	1,2,3,4,6,9,10,11,12,13,14,15,16	5,7,8,11,14	11,14	
15	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,14,15	1,2,3,6,15	
16	1,2,3,4,6,9,10,13,15,16	1,2,3,5,6,7,8,11,12,14,15,16	1,2,3,6,15,16	

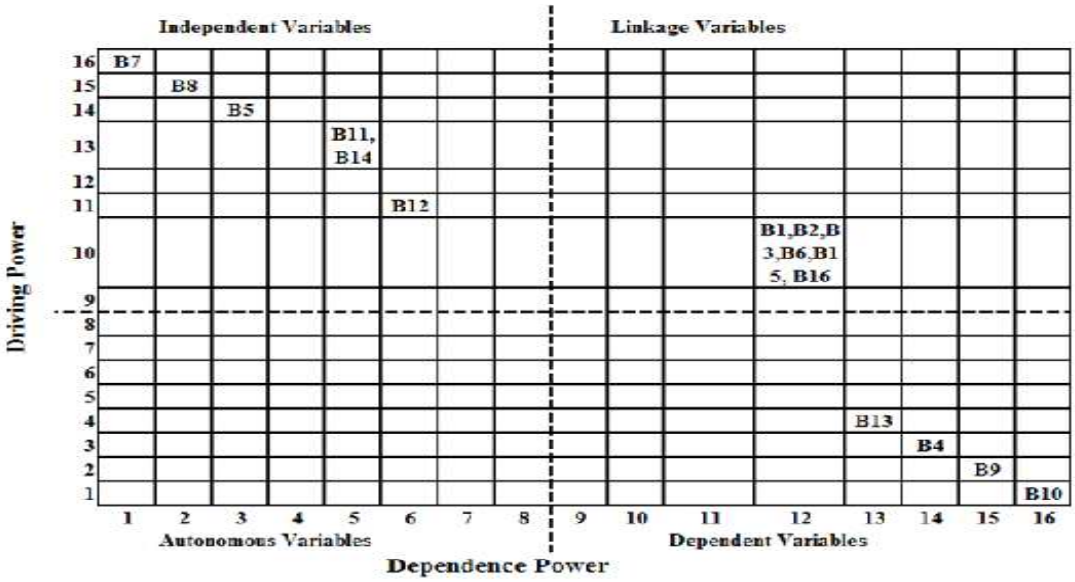

Fig. 1 MIC- MAC Analysis

RESULTS AND DISCUSSION

The findings of levels of barriers to implement GSCM in north Indian small scale industry are important in understanding of priority of barriers implementation. "Lack of top level management commitment" is the most important barrier due to its high driving power and low dependence among all the barriers. This barrier is positioned at the lowest level in the hierarchy of the ISM-based model. The barrier, Customer's unawareness towards GSCM products and services, is at the highest level in the ISM-based model due to its high dependence power and low driving power. Those barriers which are at the fourth and fifth levels in the model with highest driving power are known as 'strategic barriers'. These barriers play a key role in knowledge sharing, decision making supporting communication, collaboration, and in searching for knowledge and information. These barriers require greater attention from the top management. The driving power and dependence power diagram gives some valuable insights about the relative importance and interdependencies of the barriers. Autonomous barriers are weak drivers and weak dependents. The absence of autonomous barriers in this study indicates that all the identified barriers influence the process of implementation of GSCM in north Indian small scale industry.

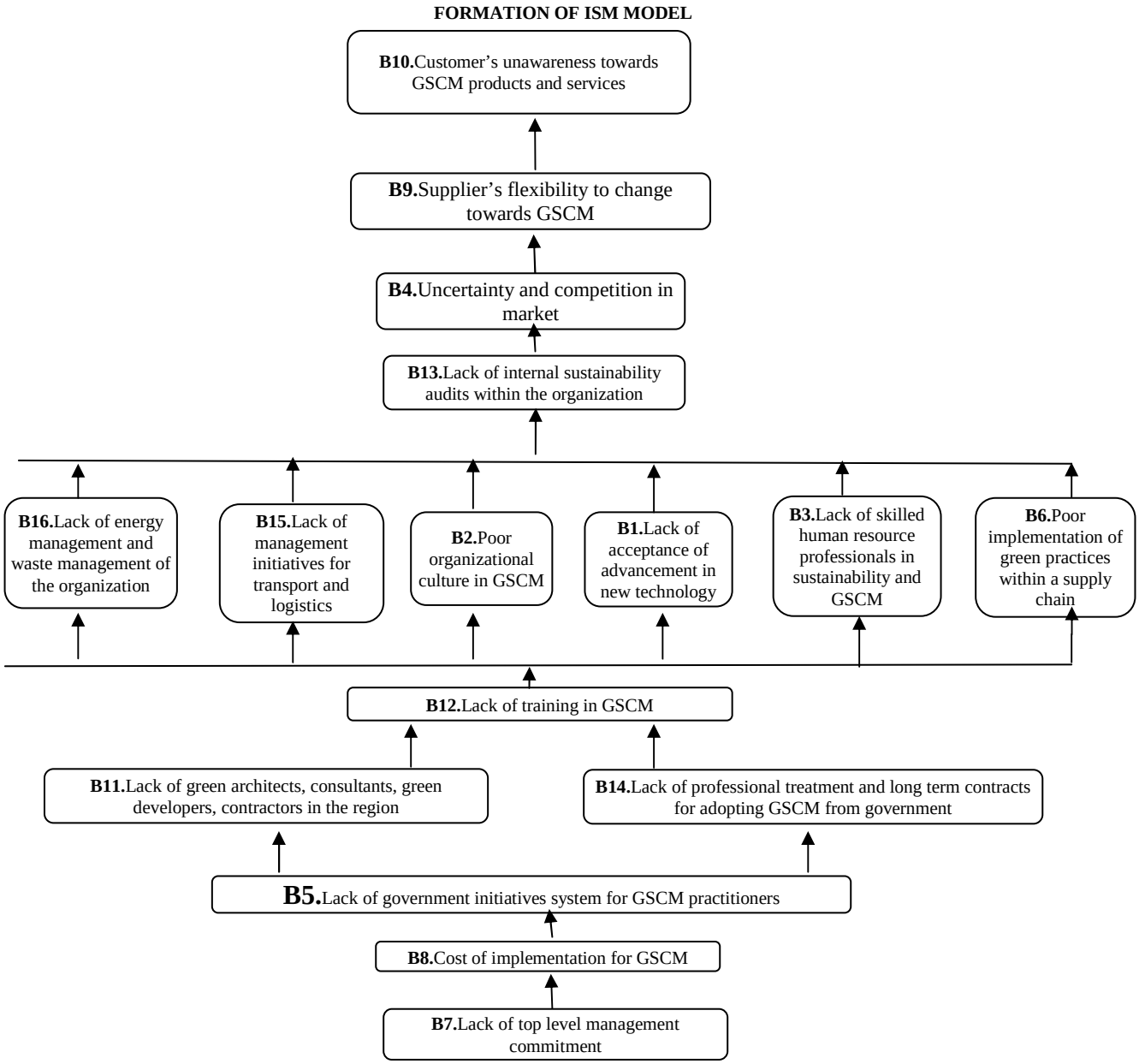

Fig. 2 ISM MODEL

CONCLUSION

Green supply Chain Management (GSCM) has been known as a method for improving recital of the processes and products according to the necessities of ecologicalrules. Sixteen barriers to implement GSCM in north Indian small scale industry have been identified and Interpretive Structural Modeling (ISM) methodology has been used for finding background relationships among various barriers to implement GSCM in north Indian small scale industry. A Model has been developed from ISM methodology and find barriers that is-Lack of top level management commitment, Lack of Cost of implementation for GSCM, Lack of government initiatives system for GSCM practitioners, Lack of professional treatment and long term contracts for adopting GSCM from government, Lack of green architects, consultants, green developers, contractors in the region, Lack of training in GSCM, Poor implementation of green practices within a supply chain, Lack of skilled human resource professionals in sustainability and GSCM, Lack of acceptance of advancement in new technology Poor organizational culture in GSCM, Lack of management initiatives for transport and logistics, Lack of energy management and waste management of the organization, Lack of internal sustainability audits within the organization, Uncertainty and competition in market, Supplier's flexibility to change towards GSCM, Customer's unawareness towards GSCM products and services. Elimination of these barriers will be help in implementing GSCM in north Indian small scale industry.

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