Barriers To Implement Green Supply Chain Management in Transmission Tower Manufacturing Industry using Interpretive Structural Modeling Technique

Dheeraj Dave
Mechanical Engineering Department
Takshshila Institute of Engineering & Technology Jabalpur (M.P.), India

Asst. Prof. Vijay Choudhary
Mechanical Engineering Department
Acroplis Technical Campus, Indore (M.P.), India

Abstract **- The research paper presents a ranked sustainable model for assessing the barriers to the implementation of the green supply chain management (GSCM) in transmission tower manufacturing industries. A total of 16 barriers to the implementation to the GSCM are recognized through broad literature review and expert opinion to academics and industrial professionals. The nature of the recognized barriers is intricate and interdependent; an Interpretive Structural Modeling (ISM) technique is applied to develop a structural model of barriers according to their priority. A MICMAC analysis is used to define driving and dependence power of recognized barriers. This can be very helpful for decision making by decision makers and top level management of the organization which can recognize and prioritize the barriers important for implementation of GSCM in transmission tower manufacturing industries at INDIA.**

Keywords —Green Supply Chain Management, Barriers Interpretive Structural Modeling (ISM), MICMAC analysis.

I. INTRODUCTION

Environmental sustainability is one of the burning issues of current times. Earlier corporate environmental management has focused on managing internal environmental problems. Now attention is increasingly shifting towards the management of a corporation's impacts outside the boundaries of the firm, into the management of upstream and downstream activities i.e. the whole supply chain system (Hu and Hsu, 2010). At present in INDIA number of transmission & telecom tower manufacturing industries are run so many domestic and international projects. Transmission industry comes under Power Sector, a core area for economic development of the country. To cater to this need number of transmission tower manufacturing industries are compete to each other. This competition will adversely affect the Environmental Sustainability, Employee Satisfaction & Community Quality Of Life. To overcome the adverse effect of competition and to maintain tangible & intangible outcomes drivers those are very important for growth, profitability and sustainability point of view Green Supply Chain is become very compulsory tool instead of conventional Supply Chain. Green Supply Chain Management (GSCM) has emerged as an important new approach for enterprises to achieve profit, efficiency and market share objectives by reducing environmental risk and impact (van Hoek, 1999; Hu and Hsu, 2010). This research paper considers the 16 barriers (listed in the Table II), which were recognized on the basis of broad literature review (as mentioned in Table I) and expert's opinion of academics professionals and from industries. An interpretive structural modeling (ISM) technique is applied to develop a structural model to the barriers for the implementation of GSCM in transmission tower manufacturing industries at INDIA and resultant ranking is done for the particular barriers, which is to be given urgency for excluding process taken under consideration by the policy makers and top level management hierarchical of the industry.

II. LITERATURE REVIEW

The Transmission & Telecom Tower Manufacturing and processing industry's rapid growth relates to two major dimensions affecting environmental sustainability, environmental burden and resource shortage. The rapid and continuous growth of Transmission & Telecom Tower Industries at INDIA has also brought great challenges to maintain Environmental Sustainability, Employee Satisfaction & Community Quality Of Life. The large transportation system in Transmission & Telecom Tower manufacturing Industries based on gasoline and diesel fuels, which would dramatically increase carbon emission and reduce profit cost due to continuous increasing cost of gasoline and diesel fuels. The Transmission & Telecom Tower Manufacturing companies at INDIA have experienced increasing environmental pressure while simultaneously recognizing various benefits and incentives to green their supply chains. Internal awareness is a key-dimension for enterprises to implement environmental practices such as GSCM. In INDIAN Transmission & Telecom Tower Manufacturing companies, the diversity in the adoption rates has seen some manufacturing supply chain companies proactively implementing environmental strategies such as

green purchasing, eco-design and green processing. However, investment recovery and development of recycled material markets in Transmission & Telecom Tower Manufacturing companies have not received much attention. That is to say the requirement of GSCM is still progressing and has yet to create a critical mass to be economically worthwhile for development of a used parts market and however, a regulated manufacturing product take-back system has been in operation in India. These take-back system forces manufacturers to consider environmental effects in the whole life cycle, and thus providing motivation for organizations to further pursue GSCM practices and closing the manufacturing supply chain loop. Thus, GSCM practices have emerged as a systematic approach within the manufacturing industry in India to balance the economic and environmental sustainability of firms [Rajesh Kumar, Rituraj Chandrakar (2012)].

TABLE I: Concepts and models related to environmental issues have been suggested by different researchers is summarized in the following table

(Source: Kshitij Dashore and Nagendra Sohani, April 2013)

Year	Title	Author	Description
2012	An Overview of Green Supply Chain Management in India	Nimawat Dheeraj & Namdev Vishal	The paper seeks out environmental performance index (EPI) of India and four activities of the green supply chain management; namely green purchasing, green manufacturing, green marketing and reverse logistics.
2012	Examining Green Production and its Role within the Competitive Strategy of Manufacturing	Tim Banies, Steve Brown, Ornella Benedettini, Peter Ball	It relates and summarizes the core knowledge on green production, aligns to production and operations management prospective.
2012	A Hierarchical Framework of Barriers to Green Supply Chain Management in the Construction Sector	Sreejith Balasubramanian	In this paper barriers are identified and then they are classified as external and internal barriers to the organization which help policy makers to focus on specific barriers important to the adoption of GSCM in the UAE construction sector.
2012	Modeling the Knowledge Sharing Barriers using an ISM Approach	B. P. Sharma, M. D. Singh and Neha	Variables which resists knowledge sharing (KS) in the organizations are known as Knowledge Sharing barriers (KSBs) were identified and ISM model is proposed showing solutions.
2011	Barriers to implement Green Supply Chain Management in automobile industry using Interpretive Structural Modeling (ISM) Technique – An Indian Perspective	Sunil Luthra, Vinod Kumar & Abid Haleem	An industry based approach was used to develop a structural model of the barriers to implement green supply chain management.
2011	An Analysis of the Drivers Affecting the Implementation of Green Supply Chain Management	Ali Diabat & Kannan Govindan	A case study approach is used to identify various drivers of green supply chain management for a manufacturing firm.
2011	Drivers of Green Supply Chain Management Performance: Evidence from Germany	Large, R.O. & Thomsen, C.G.	The paper seeks to evaluate two practices – green supplier assessment and green collaboration which impacts purchasing department and environmental commitment of the firm. Out of this commitment influences green assessment directly and environmental performance impact purchasing performance directly.
2011	The Influence of Greening the Suppliers and Green Innovation on Environmental Performance and Competitive Advantage in Taiwan	Chiou, T.Y., Chan, H.K., Lettice, F., & Chung S.H.	The paper aims at providing empirical proofs to encourage companies to implement GSC and green innovation in order to improve their environmental performance, and to enhance their competitive advantage in the global market and uses Structural Equation Modeling that verifies the significance of the proposed relationships among the selected variables.
2011	Sustainable Production: Practices and Determinant Factors of Green Supply Chain Management of Chinese Companies	Xianbiag Liu, Jie Yang, Sixiao Qu, Leina Wang, Tomohiro Shishime and Cunkuan Bao	A special emphasis is laid on companies' overall green supply chain practices, which is measured by using data from various respondents in a questionnaire survey.

2011	Research on the Performance Measurement of Green Supply Chain Management in China	Yan Li	The paper tries to improve the environmental performance by implementing a variety of GSCM practices in additionally top level manager's commitment is necessary for development of any GSCM program.
2010	Evaluating Green Supply Chain Management among Chinese Manufacturers from the Ecological Modernization Perspective	Zhu, Q., Geng, Y., Sarkis, J., & Lai, K.H.	The study includes a comparison between Chinese manufacturers and Japanese manufacturers which implies more significant improvements made in environmental and financial performance and additionally four other GSCM practices were implemented.
2009	Opportunities in Green Supply Chain Management	Jonny C. Ho, Maurice K. Shalishali, Tzu-Liang Tseng and David S. Ang	A comparison is performed between traditional and green supply chain. It includes several important opportunities in green supply chain management, including those in manufacturing, bio-waste, construction, and packaging.
2009	An Empirical Study of Green Supply Chain Management Practices Amongst UK Manufacturers	Daine Holt and Abby Ghobadian	The paper identifies various operational activities within a supply chain and also suggests the factors which are driving these operational changes.
2008	Environmental Management System and Green Supply Chain Management: Complements for Sustainability?	Nicole Darnall, G. Jason Jolley and Robert Handfield	The paper evaluates a relationship between environmental management system (EMS) and green supply chain management (GSCM) practices.
2008	Influences, Practices & Opportunities for Environmental Supply Chain Management in Nova Scotia SMEs	Raymond P.C., Lopez J., Marche S., Perron G.M. & Wright R.	This paper demonstrates that opportunities exist to reduce greenhouse gas emissions and solid waste within supply chains using environmental performance and environmental issues as working variables.
2008	Drivers for the Participation of Small and Medium-Sized Suppliers in Green Supply Chain Initiatives	Su-Yol Lee	The paper shows that buyer's GSC practices, readiness and participation, also government support plays a vital role in motivating small and medium-sized suppliers towards GSCM practices.
2008	Knowledge management barriers: An interpretive structural modeling approach	M. D. Singh and R. Kant	The paper identified KM barriers to the organization and a relationship among them is made, further giving solutions by using ISM methodology.

III. FINDINGS

From the literature review and expert's opinion from academics professionals following 16 barriers to implementation of GSCM are consider under this study. The selected 16 barriers are shown in table II as follows:

TABLE II: Barriers for GSCM in transmission tower manufacturing industry

Sr.No.	Barrier to Implement GSCM	Description	Researcher's
1	Lack of acceptance of advancement in new technology	It emphasis on adoption of various advancement in technology to the older established technology in existing organization.	Shreejith B. (2012); Christian B. (2011); Jie Yang (2011); AlKhidir et al. (2009); Daine Holt (2009); Hsu et al. (2008); Hosseini (2007); Digalwar et al. (2004); TSai et al. (1999); Gant (1996); Cooper (1994).
2	Poor organizational culture in GSCM	It directs towards the participation of top level management in motivating the employee.	Brooks W. (2011); Cunkuan Bao (2011); Abby Ghobadian (2009); Yu Lin et al. (2008); Yu Lin (2007); Hsu et al. (2008); Chien et al. (2007); Ravi et al. (2005).

3	Lack of skilled human resource professionals in sustainability and GSCM	It reflects the lack of skills in human resource department of the organization	Shreejith B. (2012); Xianbing Lui (2011);GiocondaQ. (2011);Yu Lin et
4	Uncertainty and competition in market	Market competition and uncertainty is high due to global competitiveness and varying customer's requirements.	Jie Yang (2011); Mudgal et al. (2010); Daine Holt (2009); Hosseini (2007); Yu Lin (2007).
5	Lack of government initiatives system for GSCM practitioners	It means government not making industry friendly policies toward GSCM and not giving special benefits to those organizations implementing GSCM.	Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2010); Mudgal et al. (2009); Yu Lin et al. (2008); Hsu et al. (2008); Srivastva (2007); Hosseini (2007); Scupola (2003).
6	Poor implementation of green practices within a supply chain	Lack of consideration of green practices like hazardous solid waste disposal, energy conservation, reusing and recycling materials etc	Christian B. (2011); Jie Yang (2011); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2009); Yu Lin et al. (2008); Hsu et al. (2008); Ravi et al. (2005).
7	Lack of top level management commitment	It means top level management resisting towards implementation of green practices.	M.D. singh (2012); Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2010); Sarkis (2009); Mudgal et al. (2009); Zhu (2007); Ravi V. et al. (2005); Digalwar et al. (2004).
8	Cost of implementation for GSCM	It reflects to the high initial cost investment required to implement various green methodologies such as green design, green manufacturing, green labeling of packing etc	Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2009); AlKhidir et al. (2009); Hosseini (2007); Ravi et al. (2005).
9	Supplier's flexibility to change towards GSCM	This means suppliers unwillingness to be involved in design process and technology, which affects overall performance of whole chain.	B.P. Sharma (2012); Shreejith B. (2012); Tomohiro Shishime (2011); Sanjay K. (2010); Lettice et al. (2010); Hsu et al. (2008); Kannan et al. (2008); Srivastva (2007); Sarkar et al. (2006); Ravi et al. (2005).
10	Customer's unawareness towards GSCM products and services	This reflects customers do not know about green products and their benefits	B.P. Sharma (2012); Shreejith B. (2012); Tomohiro Shishime (2011); Sanjay K. (2010); Mudgal et al. (2009); Zhu et al. (2008); Zhu et al. (2007); Ravi et al. (2005).
11	Lack of green architects, consultants, green developers, contractors in the region	Lack of green practitioners available in the region for an organization.	Sixiao Qu. (2011); Daine H. (2009); Yu and Hui (2008); Tsai and Ghosal (1999).

12	Lack of training in GSCM	This reflects lack of training given to the employee of the organization, thus resisting enhancement of overall performance of supply chain and green practices in it.	B.P. Sharma (2012); Daine H. (2009); Yu and Hui (2008); Bowen et al. (2001); Cooper et al. (2000).
13	Lack of internal sustainability audits within the organization	It reflects integration of all internal departmental issues related to the coordination for the supply chain.	Walker and Preuss (2008); Min and Galle (2001); Wycherley (1999).
14	Lack of professional treatment and long term contracts for adopting GSCM from government	It shows poor government regulations and support to the GSCM practitioners.	B.P. Sharma (2012); Shreejith B. (2012); Cunkuan Bao (2011); Sanjay K. (2010); Yu (2007); Linton et al. (2007); Carter and Ellram (1998).
15	Lack of management initiatives for transport and logistics	It shows poor managerial management of logistics in the organization.	M.D. Singh (2012); Daine Holt (2009).
16	Lack of energy management and waste management of the organization	It shows poor management of organization towards its resources.	M.D. Singh (2012); Daine Holt (2009); Alemayche (2008); Roger and R.S. (1998).

IV. METHODOLOGY

Interpretive structure modeling (Warfield, 1974) was adopted by many researchers for prepare the model of implementation of GSCM and finding the barriers to implement GSCM. ISM model to evaluate the barriers of GSCM in the automobile industry in India was taken under study by Luthra et al. (2011). Kshitij Dashore, Nagendra Sohani (2013) applied ISM for prepare hierarchical framework for barriers in GSCM I an organization. Mudgal et al. (2010) used ISM to model the enablers and barriers of GSCM in the Indian manufacturing industries. The ISM procedure can be described briefly as encompassing the following steps:

Step 1:- Variables affecting the system are listed; in our research work barriers to implement GSCM in Indian automobile 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.

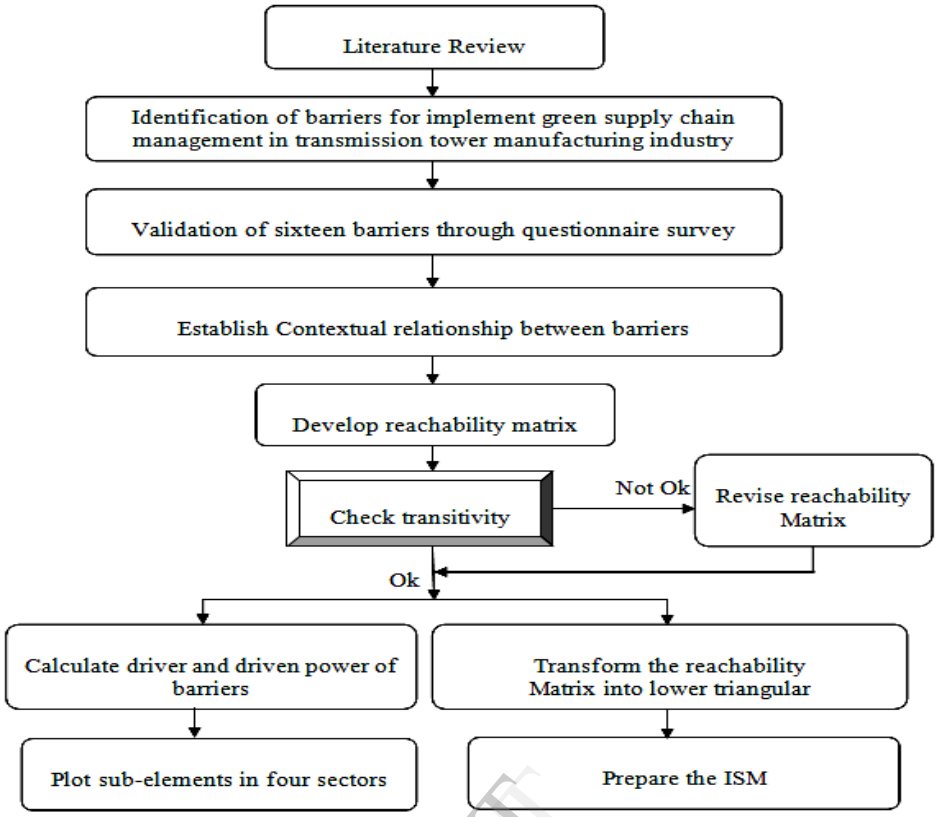

Fig.1. Flow chart of the Interpretive Structural Method

(A) Structural self-interaction matrix (SSIM)

Experts from the transmission tower manufacturing industry and experts from academics were consulted in categorizing the nature of appropriate relationship among the barriers (See Tab.2). To analyzing the barriers in developing structural self-interaction matrix, the following four symbols have been used to indicate the direction of relationship between barriers (i and j):

V – Barrier i will drive to Barrier j;
A – Barrier j will drive to Barrier i;
X – Barrier i and j will drive to each other; and
O – Barrier i and j will not drive to each other;

TABLE 3: Structural self-interaction matrix (SSIM)

Barrier Number		Barrier Number														
	Barrier Description	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 and GSCM	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 region	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 from government	V	V														
15	Lack of management initiatives for transport and logistics	X															
16	Lack of energy management and waste management of the organization	X															

(B) Reachability matrix

The SSIM has been converted into a binary matrix, called the initial reachability matrix (see Tab. 4) by substituting V, A, X and O by 1 and 0 as per given
case. The substitution of 1s and 0s are as per the following rules:

If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0;

If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1;

If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1; and

If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.

Thus there is no transitivity in this case; hence initial reachability matrix (See Tab. 4) will be used for further calculations. The driving power and the dependence of each barrier are shown in Tab. 4. The driving power for each barrier is the total number of barriers (including itself), which it may help achieve. Dependence is the total number of barriers (including itself), which may help to achieve it.

TABLE 4: Final 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**

TABLE 5: Partition of reachability matrix: First Iteration

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

(C) MICMAC Analysis

The MICMAC analysis is used to analyze the driver and dependency power of enablers. The main objective of MICMAC analysis is to analyze the driver power and the dependency of the variables (Mandal and Deshmukh, 1994). The enablers are classified into four clusters. The clustering involves dividing variables into four categories based on their driver power and dependency. Four quadrants are obtained by drawing average driver line and average dependence line as shown in Figure 4. Quadrant 1 shows the first cluster of the enablers, these are "autonomous enablers with weak driver and dependence power. These enablers are relatively disconnected from the system, with which they have only few links, which may be strong. Quadrant 2 shows, the second cluster known as the "dependent enablers. These enablers have weak driver-power but strong dependence.

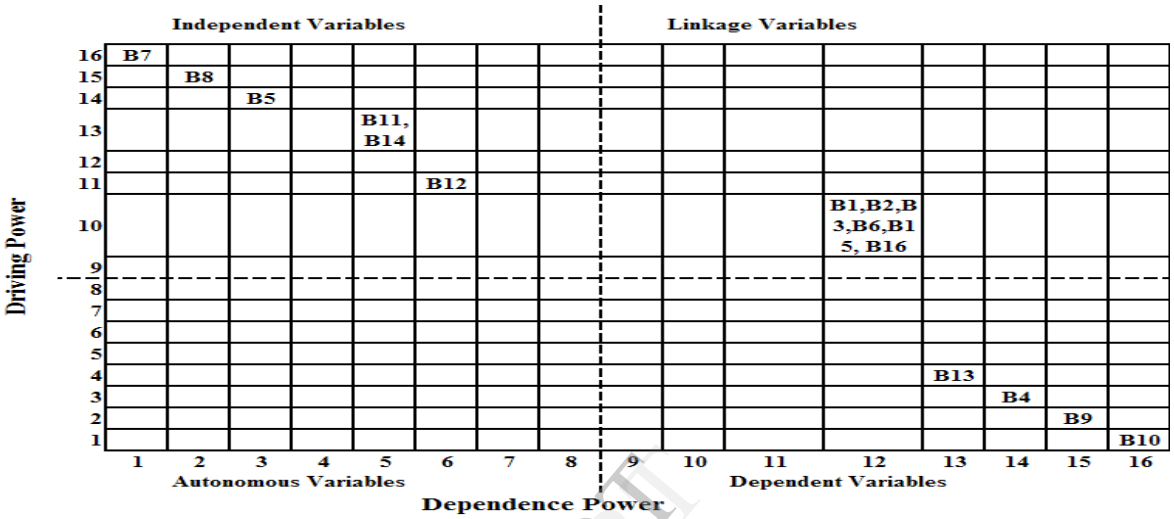

Fig.2. MICMAC Analysis

Level Partitioning of barriers - after 10 iterations

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

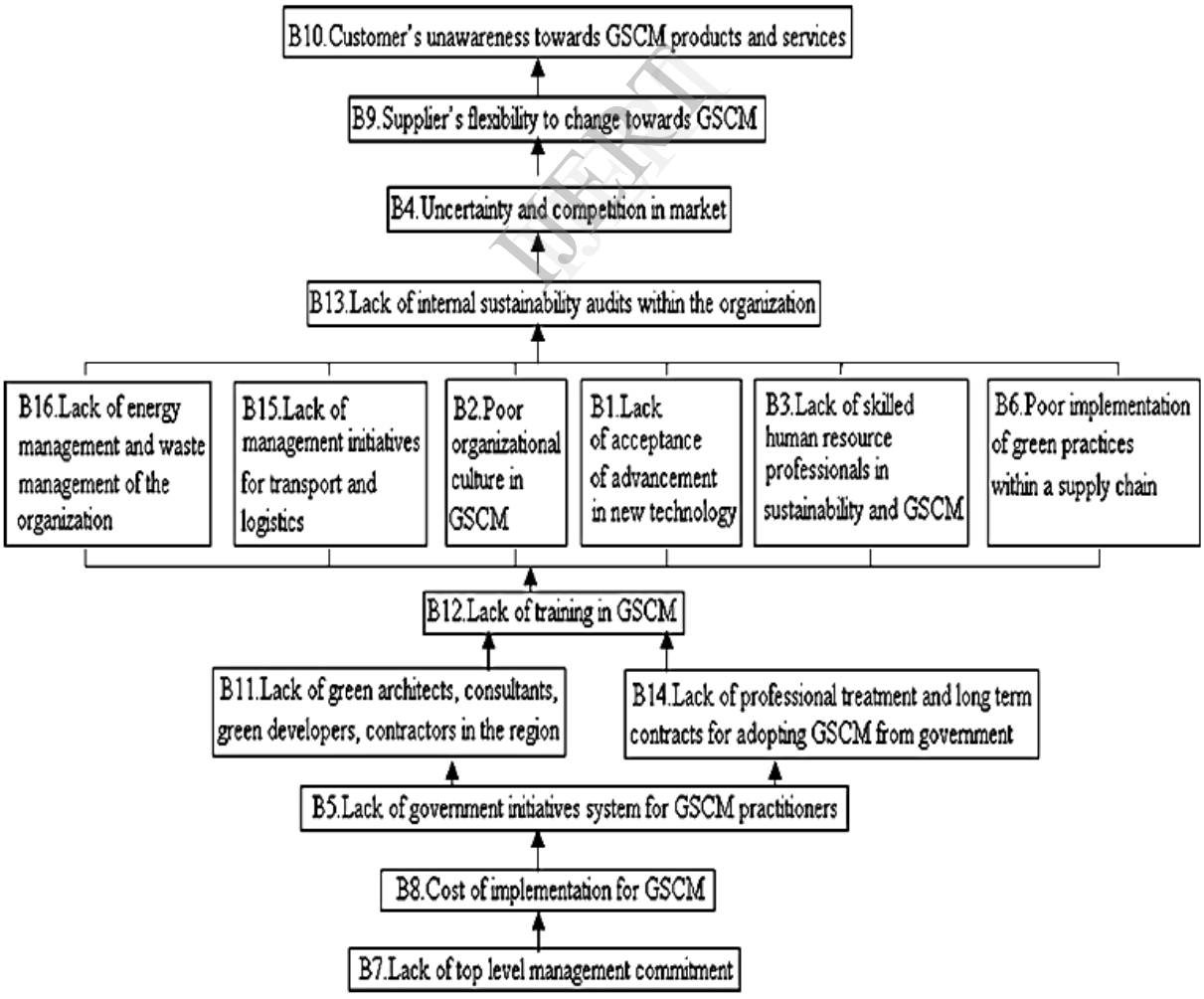

Fig.3. ISM Model for barriers

V. CONCLUSION

In this research paper 16 barriers to implement GSCM in transmission tower manufacturing industries were identified based upon the GSCM literature and on consultations with experts from academics and industries. For the better implementation of GSCM in the tower industries these barriers are arranged in ranking with priorities wise with the help of interpretive structural modeling technique. The interactions between these barriers were analyzed for the tower industries using the ISM model and MICMAC analysis. Form Fig.3, it is marked that Lack of top level management commitment, Cost of implementation for GSCM and Lack of government initiatives system for GSCM practitioners are independent variables and should be prioritize consider for excluding barriers from implementation of GSCM in transmission tower manufacturing industries by top level management and decision makers. The above model is based on the interpretive structural Modeling methodology, which has its own limitations. For example the model is highly dependent on the judgments of the expert team. In the future, we plan to validate this model using a structural equation modeling (SEM) framework.

VI. REFERENCES

1. Bhutta. K.S. and huq. F. (2002), Supplier selection problem: a comparison of total cost of ownership and analytical hierarchy process approach, Supply Chain Management: An International Journal, Vol.7 No.3, pp.126-135.
2. Business Intelligence journal Aug-2009 **(**Buyer-supplier relationships Handfield and Nichols, 1999).
3. C. Elanchezhian, B. Vijaya Ramnath, Dr. R. Kesavan Vendor selection using analytical hierarchy process in supply chain management (Journal of Engineering Research and Studies Vol. I/Issue I/July-Sept. 2010/118-127).
4. Ghodyspour, S.H. and O`Brien, C., 1998. A decision support system for supplier selection using an integrated analytic hierarchy process and linear programming, International Jour of Production Economics 56-57, 199-212.
5. Handfield, Robert B. and Nichols Jr., Ernest L., 1999. Introduction to supply chain management, Prentice-Hall, USA.
6. Karpak, Birsen, Kumcu, Erdogan, and Kasuganti, Rammohan R., 2001. Purchasing Materials in the supply chain: managing a multi-objective task, European Journal of Purchasing & Supply Management 7, 209-216.
7. King, A., Lenox, M., & Terlaak, A. (2005). The strategic use of decentralized institutions, Exploring certify cation with the ISO14001 management standard. Academy of Management Journal, 48(6), 1091-1106.
8. Krupesh A Chauhan, N.C. Shah and, R. Venkata Rao The Analytic Hierarchy Process as a Decision-Support System in the Housing Sector. (World Applied Sciences Journal 3: 609-613, 2008).
9. L.K.Toke, R.C.Gupta, Milind Dandekar,(2012),"An empirical study of green supply chain management in Indian perspective ",Journal of Applied Sciences and Engineering Research, Vol-1
10. Lexander Kott, William Boag, Luis Vargas, (1996) Analytical Hierarchy Process in Requirements Analysis (1996).
11. LMI The Green SCOR Model - Enabling Green Supply Chain Management through SCOR April 9, 2003.
12. M. Ghobakhloo, S. H. Tang, N. Zulkifli, and M. K. A. Ariffin. International Journal of Innovation, Management and Technology, Vol. 4, No. 1, February 2013.
13. Muralidharan, C., Anantharaman, N. And Deshmukh, S. G., 2001, Vendor Rating in Purchasing Scenario: A Confidence Interval Approach. International Journal of Operations and Production Management, 21(10): PP. 1306-1325.
14. Nimawat Dheeraj and Namdev Vishal (2012), 1"An Overview of Green Supply Chain Management in India" Research Journal of Recent Sciences Vol-1
15. Rajesh Kumar, Rituraj Chandrakar (2012), 4"Overview of Green Supply Chain Management: Operation and Environmental Impact at Different Stages of the Supply" Chain, International Journal of Engineering and Advanced Technology Vol-1
16. Rupesh Kumar, Vishnu Nath, Dr. Rajat Agrawal, Dr.Vinay Sharma (2012), "Green Supply Chain Management: A Case of Sugar Industry in India", National Conference on Emerging Challenges for Sustainable Business.
17. Saaty, Thomas L., 1990. The Analytic Hierarchy Process, RWS Publications, USA.
18. Saaty, Thomas L., 2001. Decision making in complex environments: the analytic network process for decision making with dependence and feedback, RWS Publications, USA.
19. Singh, R.K., Garg, S.K., Deshmukh, S.G., 2003, "Opportunities and Challenges for Small and Medium Enterprises in India", Proceedings for National Conference on Recent Development in Mechanical Engineering, Thapar Institute of Engg and Tech., Patiala, India.
20. Singh, R.K., Garg, S.K., Deshmukh, S.G., 2005, "Development of Competences by Indian Small, Medium and Large Scale Organizations", Proceedings of 14th International Conference on Mechanical Engineering in Knowledge Age, Delhi College of Engineering, Delhi, India.
21. The Analytic Hierarchy Process as a Decision-Support System in the Housing Sector. Krupesh A Chauhan, N.C. Shah and, R. Venkata Rao (World Applied Sciences Journal 3: 609-613, 2008).
22. Vendor selection problem, analytical hierarchy process in supply chain management C. Elanchezhian, B. Vijaya Ramnath, Dr. R. Kesavan (Journal of Engineering Research and Studies Vol. I/Issue I/July-Sept. 2010/118-127).
23. Verma, Rohit and Pullman, Madeleine E., 1998. An Analysis of the Supplier Selection Process, International Journal of Management Science, V. 26, No. 6, 739-750.
24. Weber, Charles A. and Current, John R., 1993. A multi objective approach to vendor Selection, European Journal of Operational Research 68, 173-184.
25. Weber, Charles A., Current, John R. and Benton, W.C., 1991. Vendor selection criteria and methods, European Journal of Operational Research 50, 2-18.