To identify critical barriers of supply chain management in manufacturing organization by ISM

(INTERPRETIVE STRUCTURAL MODELING)

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Abstract : Aim of this paper is to identifying critical barriers supply chain management in manufacturing organization and establish relationship among them which hinder the performance of supply chain management. ISM (INTERPRETIVE STRUCTURAL MODELING) methodology is used to identify interrelationship among barrier for better understanding relationship among barrier and MICMAC (matrix of cross impact multiplications applied to classification) analysis use for analyzing driving and dependence power of supply chain barrier (obstacle). Barriers are broadly classified into mainly 5 cluster namely strategic, organizational. Cultural, individual and technological barriers.

1. introduction

The concept of supply chain emerged in the middle of 1980 and since has been widely used by academic experts and industrial practitioners and is still in a developing process. The supply chain management (SCM) implementation in a manufacturing organization achieve competitive advantage and strategic fit over other manufacturing organizations. A supply chain (SC) includes all the activities, functions and facilities involved in the flow and transformation
of goods and services from the material stage to the customer The SCM help in reduction in the Inventory, accurate information sharing and
develop trust among the SC partners Yet, despite these important benefits, organizations continue to encounter a barrier which hinders them from effective implementation of supply chan. These barriers are known as SCM barriers. Supply chain is all activities involved directly or indirectly in completing a customer's order. a basic supply chain mainly consists of 5 steps.

- supplier

- manufacturer

- distributor

- retailer

Customer Barriers are hinder performance of supply chain which directly affect economy of any manufacturing organization. From literature review 23 key supply chain management barriers are identified which hinder the performance of supply chain. Identification of barrier is not adequate it is necessary to identify which barrier more influence on supply chain network. After identification of barrier its driving and dependence power are help which barrier most influence on supply chain network. For reducing complexity barriers are classified into mainly 5 clusters namely strategic, organizational. Cultural, individual and technological barriers. Each cluster is analyzed by ISM (INTERPRETIVE STRUCTURAL MODELING) and MICMAC (matrix of cross impact multiplications applied to classification) analysis.

ISM is methodology in which interrelationship among cluster of each barrier is identify which help to understand problem more detail.in this paper ISM methodology is use for finding relationship among cluster of barrier and MICMAC analysis is use for driving and dependence power of each cluster. Industrial practitioners and academic expert's opinion help in development of ISM model.

From literature review 23 key supply chain management barriers are identifying which hinder performance of supply chain network in manufacturing organization. Barriers are validated through industrial practitioners and academic expires. Main aim of this research is to identify SCMBs and establish relationship among them using ISM and analyzing driving and dependence power using MICMAC analysis

2. Literature Review

The SCM is now very popular in manufacturing organization dew to capability to obtain competitive advantage ((Gorane and kant 2015). supply chain management process always increase profit of the manufacturing organization. Barriers are broadly classified into mainly five cluster namely strategic, organizational. Cultural, individual and technological barriers. SCM can be effectively implement by identification and analyses critical barrier and change environment according to environmental condition. Resistance to change, Unawareness among society about social practices,lack of financial gain, lack of awareness about environmental and other sustainability issues, Low customer satisfaction index are significant barriers. All these SCM barriers are important because it will effect on wall supply chain network and also for managers and practitioner's deep understanding of these barrier is essential for effective SCM.

Table I critical barriers of SCM

SCMB	Barrier identified	Literature support
SB 1.	Lack of top management commitment and support	Gorane and kant (2015), V. Ravi(2014), Jayant and azhar (2014), Milar (2012), XingxingZu et al. (2011), Arshinder et al.(2008), Sadi and al-dubaisi, (2008)
SB 2.	Unclear Organization Objective	Gorane and kant (2015)Milar (2012) Adhikari (2010) Sadi and al-dubaisi, (2008)
SB 3.	Political instability	Nathra and haleem(2015)
SB 4.	Low customer satisfaction index	Ou et al. (2010), Rao et al. (2005)
SB 5	Lack of awareness about SCM	Malihe et al. (2010)
SB 6.	lack of measurement system	Stanley et al. (2010)
SB 7.	Lack of awareness about sustainability issues	V. Ravi(2014)
OB 1	Lack of inter-organizational cooperation and coordination	Schulz et al. (2010)
OB 2	Lack of resources and capability	zhu and zeng (2010)
OB 3	Lack of frame work	Gill and pabla (2013)
OB 4	Lack of proper organizational structure to create and share knowledge	Schulz et al. (2010)
OB 5	Short-term decision-making perspectives	V. Ravi(2014)
OB 6	Lack of financial gain	zhu,andgeng (2010)
CB 1	Lack Of Motivation And Employee Involvement	Sadi and al-dubaisi, (2008)
CB 2	Unwillingness to implement supply chain practice	Ou et al. (2010), Rao et al. (2005)
CB 3	Unwillingness To Share Information Among Supply Chain Partners	Tai ,and Ho. (2010), Stanley et al. (2010, yigitbasioglu. Ogun.(2010), Meehan and Muir (2008)
CB 4.	Mistrust among employees and supply chain partners	Marks berry et al. (2011)
IB 1.	Lack Of Education And Training To Employee And Supplier	Monoh et al. (2010), Wickramasinghe and Gamage (2011), Rouibah, et al. (2009), archer et al. (2008), Meehan and Muir (2008), Lai and Lee (2007). Malihe et al. (2010)

IB 2	Lack of necessary tools management skills and knowledge	Lalit et al. (2014)
IB 3.	Employee Resistance To Change	Longinidis and Gotzamani (2009), Amaral and Sous (2009), Bhat and rajashekhar (2009), archer et al. (2008).
IB 4.	Unawareness among society about social practices	Nathra and haleem(2015)
TB 1	Poor ICT structure	Lee and Tseng, (2011), Tsinopoulos and Bell (2009), Donk. (2008).
TB 2.	Lack Of Information Technology	Tumaini (2011), Stanley et al. (2010), Donk. (2008)

Unclear Organization Objective is SCMB which responsible for achieving competitive advantage, improve organizational efficiency, and improve overall performance of employee and organization. (Gorane and kant, 2015; Milar, 2012, Adhikari, 2010; Sadi and al-dubaisi,2008). Short-term decision-making perspectives, Mistrust among employees and supply chain partners, Lack Of Education And Training To Employee And Supplier, Lack of inter-organizational cooperation and coordination, Unwillingness To Share Information Among Supply Chain Partners, Lack of financial gain, Unwillingness to implement supply chain practice, Lack Of Motivation And Employee Involvement main factor responsible for this barriers in top management commitment and support. Employee Resistance to Change is mostly facing barrier in all type of organizations (Longinus's and Gotzamani,2009: Amaral and Sous,2009; Bhat and rajashekhar, 2009; archer et al. 2008). Manufacturing organizations which have proper top management support result in achieving goal of any organizations. If objective of any organization is not clear management hesitate to give financial support to any organization. (Gorane and kant,2015; Milar'2012; Adhikari,2010; Sadi and al-dubaisi 2008).

Lack of inter-organizational cooperation and coordination and Lack of proper organizational structure to create and share knowledge are important for increase efficiency of organization. (Schulz et al., 2010). Lack of Information Technology and Poor ICT structure are critical barrier for supply chain network (Tumaini,2011; Stanley et al.,2010; Donk 2008) lack of measurement system is also impact on performance of SC. Lack of financial gain is critical barrier for effective implementation of SC Practice. Lack of Information Technology is major barrier for effective utilizations of organizations resource and capabilities

(Tumaini,2011; Stanley et al. 2010; Donk. 2008). Mistrust among employees and supply chain partners is major human barrier for improving performance of supply chain (Marks berry et al.,2011). Lack of awareness about SCM is also barrier which is hinder the performance and increase knowledge os SCM (Malihe et al.,2010).

Low customer satisfaction index is outside barrier but can be improve by better service with competitor (Ou et al. 2010; Rao et al.2005). Lack of Motivation and Employee Involvement is barrier for increase performance of employees and ultimately improve performance of organization (Sadi and al-dubaisi, (2008) Political instability and Unawareness among society about social practices are factor affecting strategic decision and also decrease performance of organization (Nathra and haleem,2015)

3. ISM methodology and model development

ISM was invented by J. Warfield in 1973For analysis of complex socioeconomic system.in complex situation relationship between different elements are difficult to identify in such situation ISM is helpful. ISM help in develop a graph of individual or group to develop map of complex situation.

ISM is one modeling technique because an overall structure is developed from set of variables hence it is structural on the basis of mutual relationship and overall structure are developed in diagraph model. ISM is learning process for finding interrelationship between variables of a system. ISM has predefined step for finding the result. For obtaining interrelationship between elements ISM use binary number 0 and 1. 0 used for no relation 1 for having relation.

Table II Literature review of ISM

Author	Details
Rupesh Kumar Tiwari,2013	ISM methodology is adopted in reverse logistics for solve complex situation for satisfying customer satisfaction
George & pramod,2014	For finding inner and outer barrier steel re rolling mills ISM is adopted.
Keshaorao et al.,2015	Using ISM methodology performance of world class manufacturing system was analyzed
Ravi kant,2015	supply chain management barrier identified from literature review and identify relationship among them using ISM fuzzy MICAMAC analysis
Rameshwar Dubey TriptiSingh , (2015)	ISM fuzzy MICMAC analysis is used for finding linkage variable in lean manufacturing enterprise.
Attri et al.,2013	ISM is explaining in detail and comprehensive way. benefits of ISM and limitation is also explaining
F.R.Janes,1988	In this work all basic understanding for effective utilization of ISM methodology is explained and easy to utilize them in actual work

Steps for ISM methodology

➢ Variables of the system are identified which are relevant to problem and then convert into group like strategic, organizational, cultural and cluster analysis is carried out which give more accurate result also industrial and academic experts opinion should be carried out.

➢ Identify relationship available between group of cluster from step 1. structural self-interaction matrix (SSIM) is developed by establishing relationship between them.

➢ From SSIM initial reachability matrix is developed and then final reachability matrix is developed by transitivity check. Transitivity is identifying relationship between variables in ISM. Transitivity states that if barrier 1 IS related to 2 and 2 is related to 3, then 1 and 3 is related.

➢ Diagraph representing SCM is developed from final reachability matrix diagraph is drawn by vertices and nodes and lines of the edges and transitive link are removed based on relationship given in the reachability matrix. Diagraph is then converted into an ISM model by replacing variable nodes with statement

3.1 Structural self-interaction matrix.

Structural self-interaction matrix is establishing relationship between to barriers of each cluster or as a whole system. which help in establishing close relationship between throw barriers(factors)For analyzing SCMBs in developing SSIM, the following four symbols have been used to denote the direction of the relationship between the SCMBs (i and j):

(1) V – SCMB i will lead to achieve SCMB j;
(2) A – SCMB j will lead to achieve SCMB i;
(3) X – SCMB i and j will lead to achieve each other; and
(4) O – SCMB i and j are unrelated

Structural self-interaction matrix of strategic cluster is given below in table. Likewise, other cluster organizational, technological, individual and cultural is carried   out

Table III : Structural Self-Interaction Matrix Of Strategic Barrier

SCMB	[SB7]	[SB6]	[SB5]	[SB4]	[SB3]	[SB2]
[SB1]	O	O	O	V	X	V
[SB2]	V	V	V	V	V	
[SB3]	V	V	V	V		
[SB4]	V	O	O			
[SB5]	V	V				
[SB6]	O					

3.2 Initial Reachability Matrix

SSIM is concerted into final reachability matrix by replacing symbols (V, A, X, and O) into binary digit (1 and 0). The substitution of 1s and 0s are as per following rules.

- If the (i, j) entry in the SSIM is V, then 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, then 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, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1.
- If the (i, j) entry in the SSIM is O, then the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.

Table IV Initial Reachability Matrix Of Strategic Barrier

SCMB	[SB1]	[SB2]	[SB3]	[SB4]	[SB5]	[SB5]	[SB7]
[SB1]	1	1	1	1	0	0	0
[SB2]	0	1	1	1	1	1	1
[SB3]	1	0	1	1	1	1	1
[SB4]	0	0	0	1	0	0	1
[SB5]	0	0	0	0	1	1	1
[SB6]	0	0	0	0	0	1	1
[SB7]	0	0	0	0	0	1	0

After getting initial reachability its transitivity is checked. According to expert's opinion (as discussed in section 3.1). According to transitivity rule if relationship between I-j and j-k and experts think that and no relationship exists between element i-k, then i-j and j-k entry in the reachability matrix becomes 1 and i-k entry becomes 0. But according to transitivity rule of the ISM technique, if

"i" is related to "j" and "j" related to "k", then ultimately the relationship established between "i" and "k" and i-k entry in the matrix converted to1 instead of 0. By applying the transitivity rule, the final reachability matrix obtained.by applying transitivity rule final reachability matrix is obtained as sown in Table V.

Table V Final Reachability Matrix of Strategic Barrier

SCMB	[SB1]	[SB2]	[SB3]	[SB4]	[SB5]	[SB5]	[SB7]	Driving power
SB1	1	1	1*	1	0	0	0	4
SB2	0	1	1	1*	1	1	1	6
SB3	1	0	1	1	1*	1	1	6
SB4	0	0	0	1	0	0	1	2
SB5	0	0	0	0	1	1	1	3
SB6	0	0	0	0	0	1	1	2
SB7	0	0	0	0	0	1	0	2
Dependence power	2	2	3	4	3	5	5	

NOTE: * indicates transitivity

3.3 level partition

From the final reachability matrix, the reachability set and antecedent set for each SCMB is found. The reachability set includes SCMBs itself and others which it may help to achieve, similarly the antecedent set consists of SCMBs itself and the other SCMBs which help in achieving it. Then, the intersection of these sets is derived for all SCMBs. The SCMB for which the reachability and intersection sets are same is the top-level SCMBs in the ISM hierarchy. The top-level element in the hierarchy would not help to achieve any other element above its own level. Once the top-level element is identified it is separated out from the other elements. Then, the same process is repeated to find out the elements in the next level. This process is continued until the Level of each element is found. These levels help in building the diagraph and the final model.

3.4 ISM Model

From final reachability matrix table V, structural model of strategic cluster is generated. If there is relationship between I and j exists, and it is indicated by arrow which points from I to j. the graph generated is called directed graph or diagraph (figure 1). after removing transitivity digraph is finally converted into ISM based model (figure 2). Likewise, other cluster is follow same steps and ISM model of each cluster is generated.
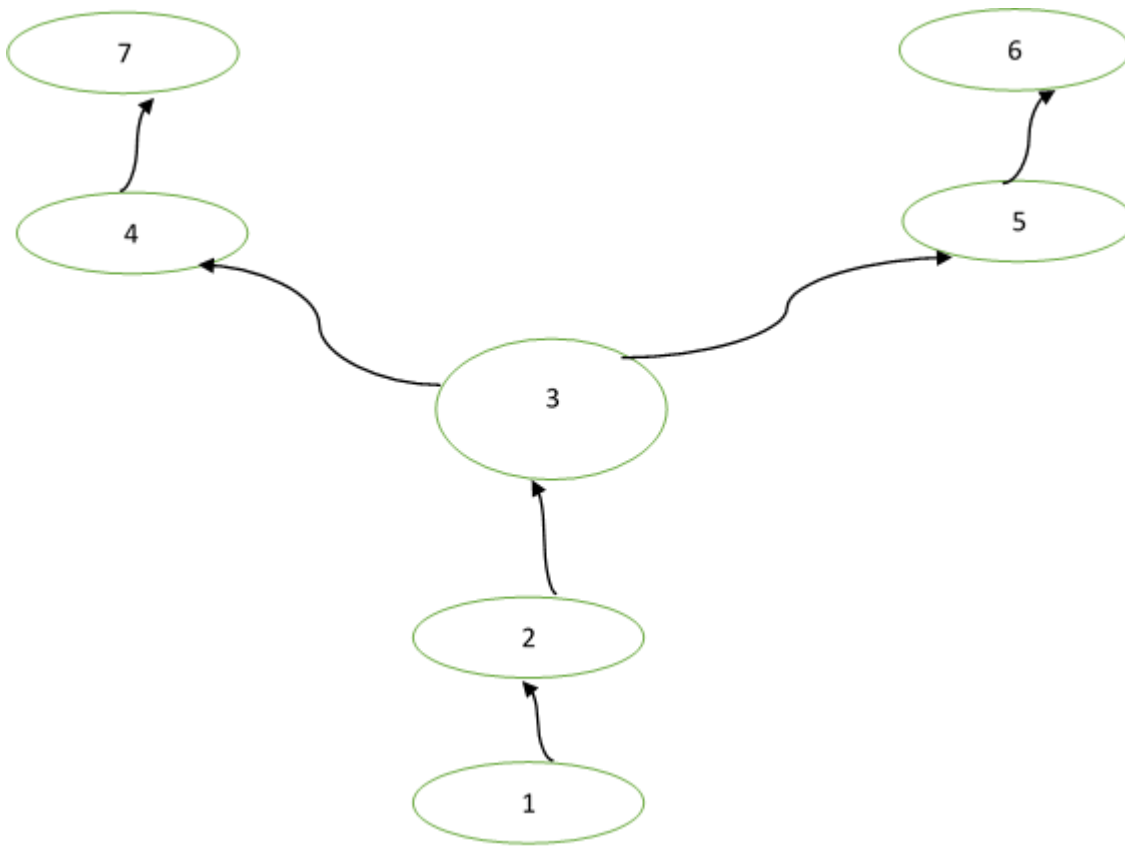
Figure 1 Digraph Represents Relationship among Strategic Barrier Cluster

4. ISM MICMAC analysis

The driving power for each barrier is total number of barriers (including itself) which may help to achieve it. Dependence is the total number of barriers (including itself) which may help to achieve it. This driving and dependencies are used in the classification of barriers into four groups, i.e. autonomous, dependent, linkage, and driver. They are (i) autonomous (ii) dependent (iii) linkage and (iv) Independent barriers. The driving power and dependence of each of these barriers are imported from final reachability, matrix

a driver power-dependence diagram is constructed as shown in Figure 3. Cluster I includes autonomous variables. They have low driving power and low dependence. They can be isolated from the system. Cluster II consists of Dependent variables that have low driving power and high dependence. Cluster III contains linkage variables that have high driving power and high dependence. Cluster IV consist of highest driving power and lowest dependence power. Likewise, other 4 clusters follow same step for MICMAC analysis
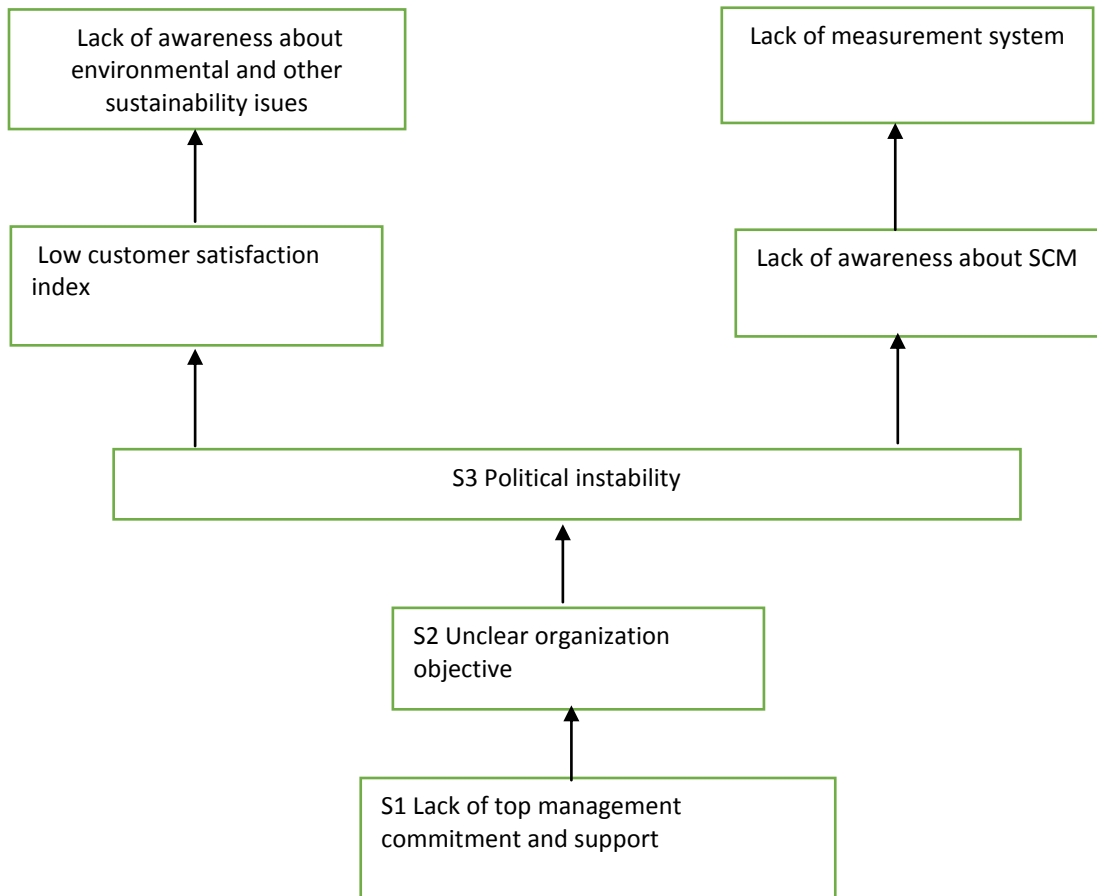
Figure 2 ISM model of strategic barrier

5.Result and discussion

Strategic Barrier

It is observed from MICMAC analysis that Lack of awareness about environmental and other sustainability issues [SB7], Low customer satisfaction index [SB4] has highest driving power and lowest dependence power. Lack of top management commitment and support [SB1], unclear organization objective [SB2] has highest driving power and lowest dependence power. Political instability [SB3], Lack of awareness about SCM [SB5], Lack of measurement system [SB6], are in transition. This barrier so it moves in other cluster depending on fuzziness. It is

Observed that there are no linkage barrier has highest driving power and lowest dependence power

Organizational Barrier

It is observed from MICMAC analysis that Lack of financial gain [OB 6] has highest driving power and lowest dependence power. Lack of inter-organizational cooperation and coordination [OB1], Lack of proper organizational structure to create and share knowledge [OB4], and Lack of frame work [OB3], Short-term decision-making perspectives [OB5], are linkage barrier has highest driving power and lowest dependence power. Manager need to take more concentrate on this barrier because this barrieris linkage barrier. Effect on hall system. Any effect on this barrier effects on other barriers and also provide feedback. Linkage barrier are effect on whole system. Lack of frame work [OB3] are in transition. This barrier so it moves in other cluster depending on fuzziness.

Cultural Barrier

In socio cultural barrier from MICMAC analysis it is found that Lack of motivation and employee involvement [CB1], Unwillingness to implement supply chain practice [CB2], Unwillingness to share information among supply chain partners [CB3], Mistrust among employees and supply chain partners [CB4] all four barrier are in linkage. All four barriers has highest driving power and highest dependence power.so practitioner has to take more seriously about this barriers. Because effect on this barrier effect on whole supply chain system. And also provide feedback.

Individual Barriers

From MICMAC analysis it is observe that Resistance to change [IB3], Unawareness among society about social practices [IB4] has highest driving power and lowest dependence power. And Lack of education and training to employee and supplier employee [IB1], Lack of necessary tools, management skills and knowledge [BI2] has highest driving power and highest dependence power so manager need to take more attention on this two barriers. Because it will effect on whole supply chain   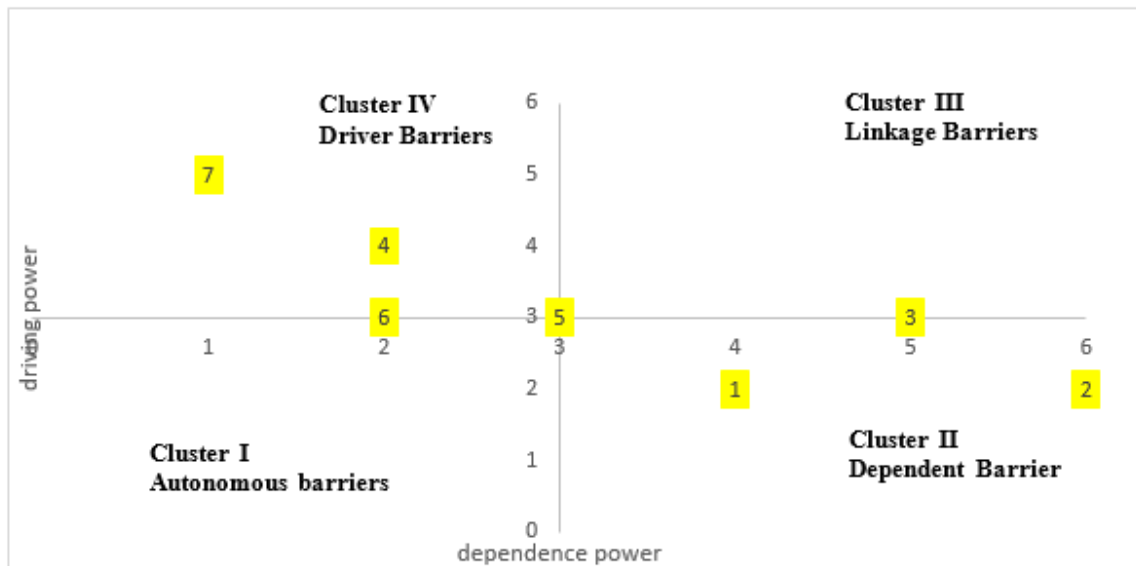   system.

FIGURE 3 MIC MAC Analysis of Strategic Cluster

5. CONCLUSION AND FUTURE WORK

In present research work, ISM based model for each cluster has been developed for successful implementation of supply chain in manufacturing organization for better operational and financial performance. For develop structure binary relationship used among barriers. Present work also tries to identify critical supply chain management barriers in manufacturing organization. For interaction among these barriers ISM and MICMAC analysis is used for better understanding relationship among barriers. The present work provides ISM-MICMAC based model for strategic, organizational, cultural and individual to understand relationship among each clusters.

a major finding of this recherché is that Resistance to change [IB3], Unawareness among society about social practices [IB4], Lack of financial gain [OB 6], Lack of awareness about environmental and other sustainability issues [SB7], Low customer satisfaction index [SB4] are significant barriers because they have highest driving power and lowest dependence power. Nature of barrier is depending upon driving and dependence power of each barrier through ISM analysis. ISM methodology develop interrelationship among barriers. This method develop model in which barriers are place according to their relation and importance. By model critical barrier is found from this relation and model. manager need to take care of all critical barrier while implementing supply chain management in manufacturing organization.

Only critical barrier identified is not enough for successful implementation of supply chain, validation is essential so in future researchValidation of ISM model is done through questionnaire survey in different manufacturing organization located at different part of India. This survey response help in validation of ISM model and also identified that this barrier really affects in real world practice or not.

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