Interpretive Structural Modeling (ISM) for Implementation of Green Supply Chain Management in Construction Sector within Maharashtra.

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Abstract - *The construction sector uses natural resources in highly unsustainable manner and release large amount of greenhouse gases. As result of this many economic, environmental and social problems are appeared from global warming to waste disposal. Green supply chain management has appeared as an important concept and can play vital role to solve this problem in eco-friendly manner. The research paper presents a hierarchical model for evaluating drivers affecting the implementation of green supply chain management in construction sector. The various drivers are identified of Green supply chain management through literature review and expert opinion. An interpretive structural modeling technique is used to develop a structural model.*

Key Words**: Green supply chain management (GSCM), Construction sector, Conventional supply chain, Interpretive Structural Modeling (ISM), MICMAC Analysis**

1. INTRODUCTION

India is facing one of the rapid development of last decade (Rajiv chopra,2016). Indian construction sector contributes to a growth of 11.1% of India's GDP (Dr.Pa.Kaja Mohideen, 2015). The construction sector use natural resources in highly unsustainable manner and release large amount of green house gases (Elizabeth Ojo et.al.,2014). Construction has an important impact on environment including high use of natural resources, high energy depletion and pollution of environment (Envirowise,2005).

Green supply chain management (GSCM) has arrived as an environmental innovation which combines environmental concerns into supply chain management. GSCM has gained popularity with both academic and practitioners. Nowadays, most organizations are starting to green in their business, as a concern to environmental sustainability. They have realized the greater benefit of the green technology adoption in business operation (Noor Aslinda Abu Seman et.al.,2012). Compared with conventional supply chain, green supply chain management adds more environmentally focus mindset. It is the further addition of conventional supply chain that includes reduction in product lifecycle, reducing environmental impact, reuse, recycle and manufacturing (Choudhary and Seth, 2011).

Various definitions of Green supply chain management exist in the literature. Accordingly, Zhu and Sarkis defines GSCM, as has ranged from green purchasing to integrated supply chains starting from supplier , to manufacturer , to customer and reverse logistics, which is "closing the loop"(Zhu,Q and Sarkis J,2004). According to Srivastava , Green supply chain management can be defined as " integrating environmental thinking into supply chain management, it includes different stages ranges from designing a product , selection of material, manufacturing process , delivery of the complete product to the customers, as well as end of life management of the product"(Elizabeth Ojo et al.,2014).

This paper deals with drivers of Green supply chain management which were identified on basis of extreme literature review and expert opinion. An interpretive structural modeling technique is used to develop a structural model for the drivers, for implementation of green supply chain management in construction sector.

2. LITERATURE REVIEW

The construction industry plays an important role in shaping societies physical environment. Its output is used for production, commerce and shelter and providing vital utilities (Elizabeth Ojo et.al, 2014). Supply chain is a concept used to explain the life cycle process supporting information physical, financial and knowledge flows for services and moving products from suppliers to end users. In terms of construction industry, supply chain can be identified as process through which builders and design team working tighter to deliver an end-product to their customers (Bachok S,2004).

Conventional supply chain concentrate more on controlling the final product, while neglecting the negative effects that occur during the production process. Green supply chain considers the ecological causes. Green supply chain combines, in addition to human toxicological effects, the ecologically negative effects on the natural environment resulting in minimum ecological impacts during production (Ashish J. Deshmukh,2014). Nowadays, most organizations are starting to green in their business operation as a concern to environmental sustainability. Organizations have realized the greater advantage by adoption of the green technology in their business operation. (Noor Aslinda Abu Seman et al.,2012). Government regulation and legislation, Green design, Reducing energy consumption, Reusing and recycling materials, Green image are some important drivers for implementation of Green supply chain management in construction Projects(Ali diabat et.al.,2011 , Khstiji Dashore et.al.,2013, Wnimemann T Kothze et.al.,2016 etc). Drivers affecting GSCM have been identified through literature review and expert opinion such as Green design, Reducing energy consumption, Government regulation and legislation, Green image. After analysis through response of construction companies, it shows that most of companies think implementation of EMS is successful. Most of companies feel environmental pressure from local resident. Waste management is top priority for environment performance among construction companies (Prashant Kulkarni et.al.,2017).

For identifying the structural relationship among specific items, which defines the problem under study, Interpretive Structural Modeling (ISM) is well-established methodology proposed by Warfield (Reza Tabrizi et.al.,2010, Firoz N et.al.,2014, Kshitij Dashore et.al.,2013, Ali Diabat et.al.,2011). ISM is an interactive learning method, that enables individual or group to construct a map of the complex relationship between many criteria involved in a complex situation (Firoz N,2014). In this method a set of different directly and indirectly related elements are structured into a comprehensive systematic model (Firoz N et al.,2014, Nitin Upadhye et al.,2014).

In past many authors applied ISM in various industries such as (Diabat and Kannan,2011) developed a model of the drivers affecting the implementation of green supply chain management using interpretive structural modeling framework. (Reza Sigari Tabrizi et.al.,2010) ISM used inside Malaysian organizations to determine the relationship among knowledge management criteria. (Jacob P et.al.,2014) used ISM to develop relationship among the important barriers of steel re-rolling mills through ISM approach. (M. D. Singh et al.,2008) used ISM to develop the relationship among the identified knowledge management barriers.

3. OBJECTIVE

The research is aimed to identify specific objectives as follows

1) Identify the drivers which affect implementation of Green supply chain management in construction industry.
2) Develop a structural model using Interpretive Structural Modeling technique (ISM) for green supply chain management in construction industry.

A. Scope of study

This study is carried out in Western Maharashtra and Mumbai Region of Maharashtra State.

4. METHODOLOGY

The first objective to identify the driver affecting implementation of green supply chain management is done through literature and expert opinion. And second objective is developing a model which is done by using interpretive structural modeling technique. First extensive literature review was done to identify major drivers which affect the implementation of green supply chain management. The drivers identified were shortlisted based on expert opinion from construction industry having average10 years work experience in construction field. 13 drivers were found to be important for green supply chain management.

A questionnaire were prepared for this drivers and respondents were asked to rate importance of each driver based on five-point Likert scale (1=No Effect, 2= Little Effect, 3= Moderate Effect, 4= Strong Effect, 5= Very Strong Effect). Questionnaire were sent to the respondent as per as possible by through direct visit. Total 30 responses were obtained with no missing data. The mean of the data collected were calculated by PSPP software. The reliability of data collected is calculated Cronbach's-Alpha coefficient. The value is obtained 0.702 which is acceptable.

Second Interpretive structural modeling (ISM) technique was used to determine the second objective. ISM process starts with the identification of elements which are important to the problem. A structural self-interaction matrix (SSIM) is developed by a group of experts based on a pair-wise comparison of elements. After that SSIM is converted into reachability matrix. Then in next step ISM model is obtained by the partitioning of the elements based on level obtained by reachability matrix, an initial digraph is obtained. In this development, the top level driver is positioned at top of digraph and second level driver placed at the second position and so on until final driver is placed at bottom of a digraph. In next step, the digraph is converted into ISM model replacing elements nodes with the statement (Reza Sigari Tabrizi et.al.,2010).

5. ISM METHODOLOGY for Model Development

Interpretive Structural Modeling, A well-proven method which described as an interactive learning process (Firoz N et al.,2014, Nitin Upadhye et al.,2014). In this method a set of different directly and indirectly related elements structured into a comprehensive systematic model (Firoz N et. al.,2014, Nitin Upadhye et. al.,2014). The model is so formed portrays the structure of complex problem a system of field study, in a carefully designed pattern implying graphics as well as Words (Nitin Upadhye et. al., 2014).

ISM is a well-established technique for identifying the relationship among particular items, which defines a problem (Jacob P George et al.,2014, Firoz N et al.,2014, Nitin Upadhye et al.,2014). The various steps involved in ISM methodology is given below (Jacob P George et al.,2014, Firoz N et al.,2014, Nitin Upadhye et al.,2014).

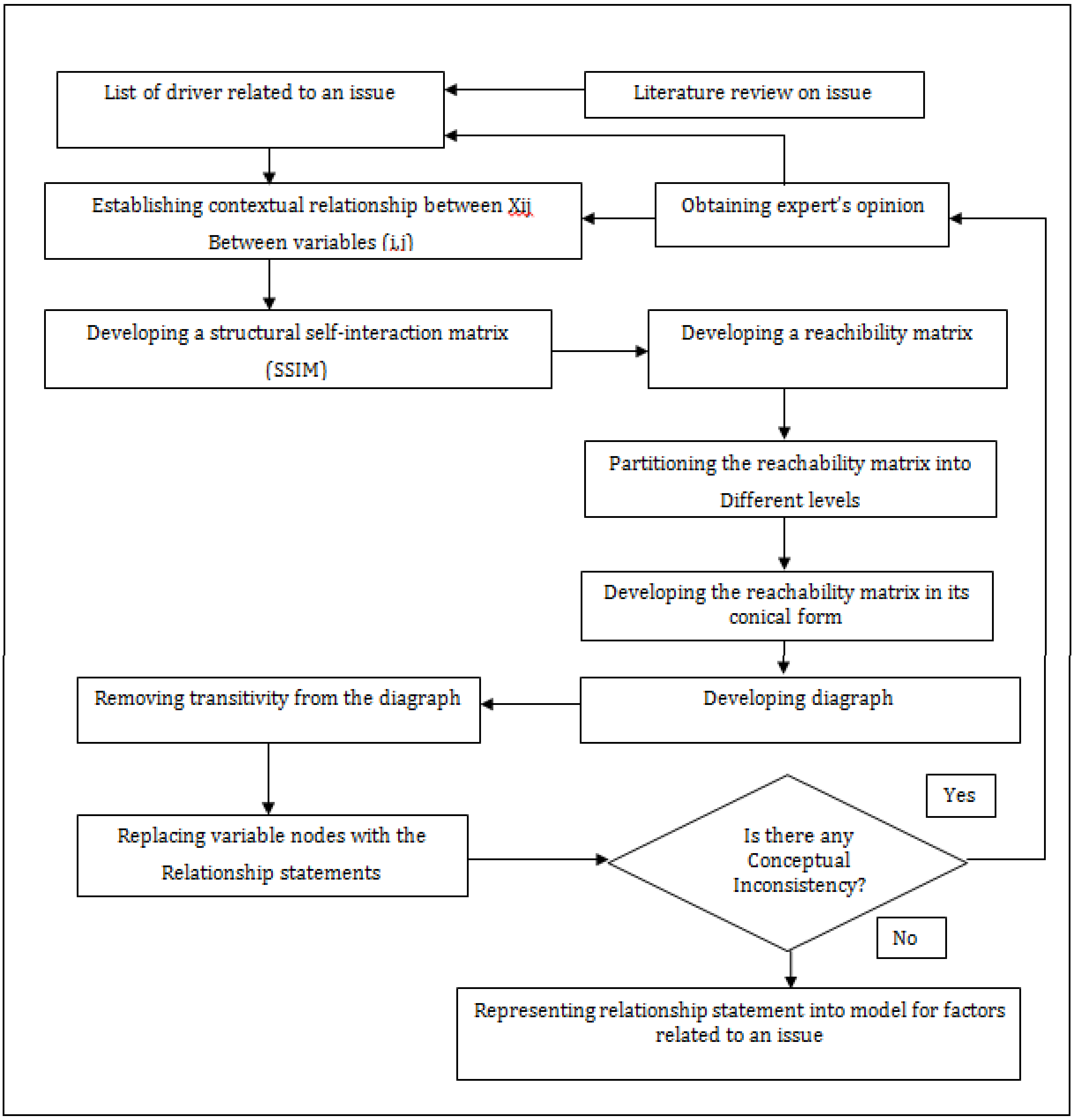

Fig -1: Flow chart for preparing ISM model.

Table -1: Drivers of Green supply Chain management

Sr. No.	Drivers	Resource
1	Government regulations and legislation.	Green et al(1996),Ali Diabat (2011),Walker et al(2008),W Niemann(2016), M. M. G.Elbarkouky et.al(2013)
2	Environmental collaboration with suppliers.	Ali Diabat (2011), Zhu et al.(2008a,c),Holt and Ghobadian(2009), M. M. G.Elbarkouky et.al(2013)
3	Collaboration between product designers and suppliers to reduce and eliminate product environmental impacts.	Ali Diabat and (2011),Holt and Ghobadian(2009),
4	Environmental collaboration with customers.	Ali Diabat (2011), Zhu et al.(2008a,c), Holt and Ghobadian(2009), M. M. G. Elbarkouky et.al(2013)
5	Certification of suppliers environmental management system.	Ali Diabat (2011),Zhu et al.(2008a,c),
6	ISO 14001 Certification.	Ali Diabat (2011), Zhu et al.(2008a,c), Holt and Ghobadian(2009), Kuo-zui Wu (2011)
7	Integrating quality management into planning and operation process.	Ali Diabat (2011), Zhu et al.(2008a,c),
8	Reusing and recycling materials and packaging.	Ali Diabat (2011), Holt and Ghobadian(2009), M. M. G.Elbarkouky et.al(2013)
9	Reducing energy consumption.	Kshitij Dashore (2013), Holt and Ghobadian(2009)
10	Green design.	Kshitij Dashore (2013),Zhu et al.(2008a,c),Kuo-zui Wu (2011)
11	Reverse logistics	Ali Diabat (2011), Kshitij Dashore (2013), A. Kamolkittiwong (2015)
12	Establishing companies green image locally and globally.	Gioconda Quesada et.al(2011), Daine Holt(2009), W Niemann(2016)
13	Cost of environmentally friendly goods.	Ali Diabat (2011), Gioconda Quesada et.al (2011); Daine Holt(2009)

The various steps involved in the ISM methodology are given below.

Step 1: The drivers affecting implementation of GSCM under study are listed.

Step 2: For each pair of drivers, a contextual relationship is established for drivers in step1.

Step 3: In this step, a Structural self-interaction matrix(SSIM) is developed which indicates a pair wise relationship among drivers which under study.

Step 4: A Reachability matrix is developed from the SSIM and developed matrix checked for transitivity. The transitivity rules states that if element 'X' related element 'Y' and element 'Y' related 'Z' then 'X' is necessarily related to 'Z'.

Step 5: The Reachability matrix is derived in step 4 is portioned into different levels.

Step 6: A directed graph is created, Based on the relationship given above in the Reachability matrix, and transitive links are removed.

Step 7: The resulting graph is converted into An ISM by the variables with the statement.

Step 8: Final model is presented, after the developed ISM model in step 7 is reviewed for conceptual inconsistency.

5.1 IDENTIFICATION OF THE DRIVERS

The drivers which are important to the implementation of GSCM were identified through literature review and group of experts the identified drivers are shown in Table1

Table -2: Structural Self-Interaction Matrix (SSIM)

S.No.	Drivers for GSCM	13	12	11	10	9	8	7	6	5	4	3	2	1
1.	Government regulations and legislation.	O	O	V	O	X	O	V	O	V	V	V	V	-
2.	Environmental collaboration with suppliers.	X	O	O	O	O	A	V	X	A	O	O	-	
3.	Collaboration between product designers and suppliers to reduce and eliminate product environmental impacts.	O	O	O	A	O	X	V	O	O	V	-		
4.	Environmental collaboration with customers.	O	O	O	O	O	O	V	O	X	-			
5.	Certification of suppliers environmental management system.	O	V	X	A	O	A	V	V	-				
6.	ISO 14001 Certification.	X	O	A	O	A	A	V	-					
7.	Integrating quality management into planning and operation process.	O	X	A	O	A	A	-						
8.	Reusing and recycling of materials.	O	O	V	A	A	-							
9.	Reducing energy consumption.	O	O	O	X	-								
10.	Green design.	O	V	O	-									
11.	Reverse logistics	O	V	-										
12.	Establishing companies green image locally and globally.	O	-											
13.	Cost of environmentally friendly goods.	-												

5.3 Reachability Matrix

The next step in ISM technique is to develop an initial reachability matrix from SSIM. For this, SSIM format is converted into initial reachability matrix by replacing the four symbols (i.e., V, A, X or O) of SSIM by binary digits (1 or 0) in initial reachability matrix.

The rules for this substitution are as follows:

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

Table -3: Initial Reachability Matrix (SSIM)

Drivers No.	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	1	1	1	0	1	0	1	0	1	0	0
2	0	1	0	0	0	1	1	0	0	0	0	0	1
3	0	0	1	1	0	0	1	1	0	0	0	0	0
4	0	0	0	1	1	0	1	0	0	0	0	0	0
5	0	1	0	1	1	1	1	0	0	0	1	1	0
6	0	1	0	0	0	1	1	0	0	0	0	0	1
7	0	0	0	0	0	0	1	0	0	0	0	1	0
8	0	1	1	0	1	1	1	1	0	0	1	0	0
9	1	0	0	0	0	1	1	1	1	1	0	0	0
10	0	0	1	0	1	0	0	1	1	1	0	1	0
11	0	0	0	0	1	1	1	0	0	0	1	1	0
12	0	0	0	0	0	0	1	0	0	0	0	1	0
13	0	1	0	0	0	1	0	0	0	0	0	0	1

5.2 Structural Self-interaction Matrix (SSIM) Development

Based on contextual relationship between identified drivers, a structural self- interaction matrix (SSIM) was developed shown in a Table 2. The matrix shows the pair-wise relationship between drivers affecting the implementation of GSCM in the construction sector.

The symbols used to indicate the direction of a relationship between drivers are given below.

- V: Driver 'i' relate to driver 'j'.
- A: Driver 'j' relate to driver 'i'.
- X: Driver 'i' relate to driver 'j' relate to each other.
- O: Driver 'i' and driver 'j' are unrelated.

The following statement explains the use of symbols V, A, X and O in the SSIM:

- Government regulation and legislation [D1] will relate to Collaboration between product designers and suppliers to reduce and eliminate product environmental impacts [D3], So the relationship between drivers D1 and D3 is denoted by "V" in SSIM.
- Reusing and Recycling materials [D8] will relate to Green Design [D10], so the relationship between drivers D8 and D10 is denoted by "A" in SSIM.
- Environmental collaboration with suppliers [D2] and Cost of environment-friendly Goods [D13] will relate to each other, so the relationship between drivers D2 and D13 is denoted by "X" in SSIM.
- No relationship existed between reducing energy consumption [D9] and Establishing companies green image locally and globally [D12], so the relationship between drivers D9 and D12 is denoted by "O" in SSIM.

The initial reachability matrix is prepared after following these rules, 1^* entries are included in the matrix is checked for transitivity to fill the gap, if any of the opinion collected during development of structural self-interaction matrix. Transitivity can be explained as element 'x' relates element 'y' and element 'y' relates element 'z' then transitivity implies element 'x' also relates element 'z'. After completing transitivity process as described above the final reachability matrix is obtained (Table 4).

5.4 Level Partitions:

The final reachability matrix obtained in section 5.3 above was partitioned into different levels. From the final reachability matrix (Table 4) for each driver reachability set and antecedent sets obtained. The reachability set consists driver itself and other driver that it may impact, whereas the antecedent consist of the driver itself and other driver that may impact it. Thereafter the interaction of these sets is derived for all the drivers and levels of different drivers are determined, the driver for which the reachability and interaction sets are same takes the top position in ISM hierarchy. With this partition iteration 1 is completed. After competition of first iteration, the drivers forming level I are removed and with remaining driver, the same procedure is continued in iteration 2. This iteration is continued until the level of each driver is determined. Table 5 shows that, Integrating quality management into planning and operation process, establishing companies green image locally and globally are positioned at the level I at the top level of ISM hierarchy. Environmental collaboration with suppliers, ISO 14001 Certification and Cost of environment friendly Goods are positioned at level II then Environmental collaboration with Customers, Certification of suppliers for EMS and Reverse Logistics are positioned at level III.

Table -4: Final Reachability Matrix

Drivers No.	1	2	3	4	5	6	7	8	9	10	11	12	13	Driving Power
1	1	1	1	1	1	1*	1	1*	1	1*	1	1*	1*	13
2	0	1	0	0	0	1	1	0	0	0	0	1*	1	5
3	0	1*	1	1	1*	1*	1	1	0	0	1*	1*	0	9
4	0	1*	0	1	1	1*	1	0	0	0	1*	1*	0	7
5	0	1	0	1	1	1	1	0	0	0	1	1	1*	8
6	0	1	0	0	0	1	1	0	0	0	0	1*	1	5
7	0		0	0	0	0	1	0	0	0	0	1	0	2
8	0	1	1	1*	1	1	1	1	0	0	1	1*	1*	10
9	1	1*	1*	1*	1*	1	1	1	1	1	1*	1*	1*	13
10	1*	1*	1	1*	1	1*	1*	1	1	1	1*	1	0	12
11	0	1*	0	1*	1	1	1	0	0	0	1	1	1*	8
12	0	0	0	0	0	0	1	0	0	0	0	1	0	2
13	0	1	0	0	0	1	1*	0	0	0	0	0	1	4
Dependence Power	3	11	5	8	8	11	13	5	3	3	8	12	8	98

Collaboration between product designers and suppliers to reduce and eliminate environmental impacts, Reusing and Recycling materials are positioned at level IV finally remaining drivers, Government regulation and legislation, Reducing energy consumption and Green design are placed at level V. The iteration and final level of each driver is shown in (Table 5 to 9) and Table 10 respectively.

5.5 Formation of ISM based model:

With the help of level of partition shows in(Table 5 to 9) and table 10, a model was developed for the drivers which are important to the implementation of green supply chain management in the construction sector and is shown in fig 2.

5.6 MICMAC Analysis:

The purpose of a MICMAC analysis is to analyze the driver and dependence power of the elements. On the basis of above-mentioned study, the drivers were classified into four different sectors. Based on their driving power and dependence power, the drivers, have been classified into four categories as, autonomous drivers, linkage drivers, dependent and independent drivers. The driving and dependence power of each driver is calculated in final reachability matrix shown in Table 4. The driver has weak drive power and weak dependence power are called Autonomous driver will fall in sector I. the driver has weak drive power but strong dependence power are called dependent driver will fall in sector II. The driver has both strong driving as well as dependence power are called linkage driver will fall in sector III. They are also unstable any action on them will have an effect on others. The drivers have strong driving power but weak dependence power are called independent driver and will fall sector IV(Firoj N et al.,2014, Ali Diabat et al.,2011).

Table -5: Level Partitions of Drivers- Iteration I

Iteration I				
Sr. No.	Reachability set	Antecedent set	Intersection Set	Level
1	1,2,3,4,5,6,7,8,9,10,11,12,13	1,9,10	1,9,10	
2	2,6,7,12,13	1,2,3,4,5,6,8,9,10,11,13	2,6,13	
3	2,3,4,5,6,7,8,11,12	1,3,8,9,10	3,8	
4	2,4,5,6,7,11,12	1,3,4,5,8,9,10,11	4,5,11	
5	2,4,5,6,7,11,12,13	1,3,4,5,8,9,10,11	4,5,11	
6	2,6,7,12,13	1,2,3,4,5,6,8,9,10,11,13	2,6,13	
7	7,12	1,2,3,4,5,6,7,8,9,10,11,12, 13	7,12	I
8	2,3,4,5,6,7,8,11,12,13	1,3,8,9,10	3,8	
9	1,2,3,4,5,6,7,8,9,10,11,12,13	1,9,10	1,9,10	
10	1,2,3,4,5,6,7,8,9,10,11,12	1,9,10	1,9,10	
11	2,4,5,6,7,11,12,13	1,3,4,5,8,9,10,11	4,5,11	
12	7,12	1,2,3,4,5,6,7,8,9,10,11,12	7,12	I
13	2,6,7,13	1,2,5,6,8,9,11,13	2,6,13	

Table -6: Level Partitions of Drivers- Iteration II

Iteration II				
Sr. No	Reachability set	Antecedent set	Intersection Set	Level
1	1,2,3,4,5,6,8,9,10,11,13	1,9,10	1,9,10	
2	2,6,13	1,2,3,4,5,6,8,9,10,11,13	2,6,13	II
3	2,3,4,5,6,8,11	1,3,8,9,10	3,8	
4	2,4,5,6,11	1,3,4,5,8,9,10,11	4,5,11	
5	2,4,5,6,11,13	1,3,4,5,8,9,10,11	4,5,11	
6	2,6,13	1,2,3,4,5,6,8,9,10,11,13	2,6,13	II
8	2,3,4,5,6,8,11,13	1,3,8,9,10	3,8	
9	1,2,3,4,5,6,8,9,10,11,13	1,9,10	1,9,10	
10	1,2,3,4,5,6,8,9,10,11	1,9,10	1,9,10	
11	2,4,5,6,11,13	1,3,4,5,8,9,10,11	4,5,11	
13	2,6,13	1,2,5,6,8,9,11,13	2,6,13	II

Table -7: Level Partitions of Drivers- Iteration II

Iteration III				
Sr. No	Reachability set	Antecedent set	Intersection Set	Level
1	1,3,4,5,8,9,10,11	1,9,10	1,9,10	
3	3,4,5,8,11	1,3,8,9,10	3,8	
4	4,5,11	1,3,4,5,8,9,10,11	4,5,11	III
5	4,5,11	1,3,4,5,8,9,10,11	4,5,11	III
8	3,4,5,8,11	1,3,8,9,10	3,8	
9	1,3,4,5,8,9,10,11	1,9,10	1,9,10	
10	1,3,4,5,8,9,10,11	1,9,10	1,9,10	
11	4,5,11	1,3,4,5,8,9,10,11	4,5,11	III

Table -8: Level Partitions of Drivers- Iteration IV

Iteration IV				
Sr. No	Reachability set	Antecedent set	Intersection Set	Level
1	1,3,8,9,10	1,9,10	1,9,10	
3	3,8	1,3,8,9,10	3,8	IV
8	3,8	1,3,8,9,10	3,8	IV
9	1,3,8,9,10	1,9,10	1,9,10	
10	1,3,8,9,10	1,9,10	1,9,10	

Table -9: Level Partitions of Drivers- Iteration V

Iteration V				
Sr. No.	Reachability set	Antecedent set	Interaction Set	Level
1	1,9,10	1,9,10	1,9,10	V
9	1,9,10	1,9,10	1,9,10	V
10	1,9,10	1,9,10	1,9,10	V

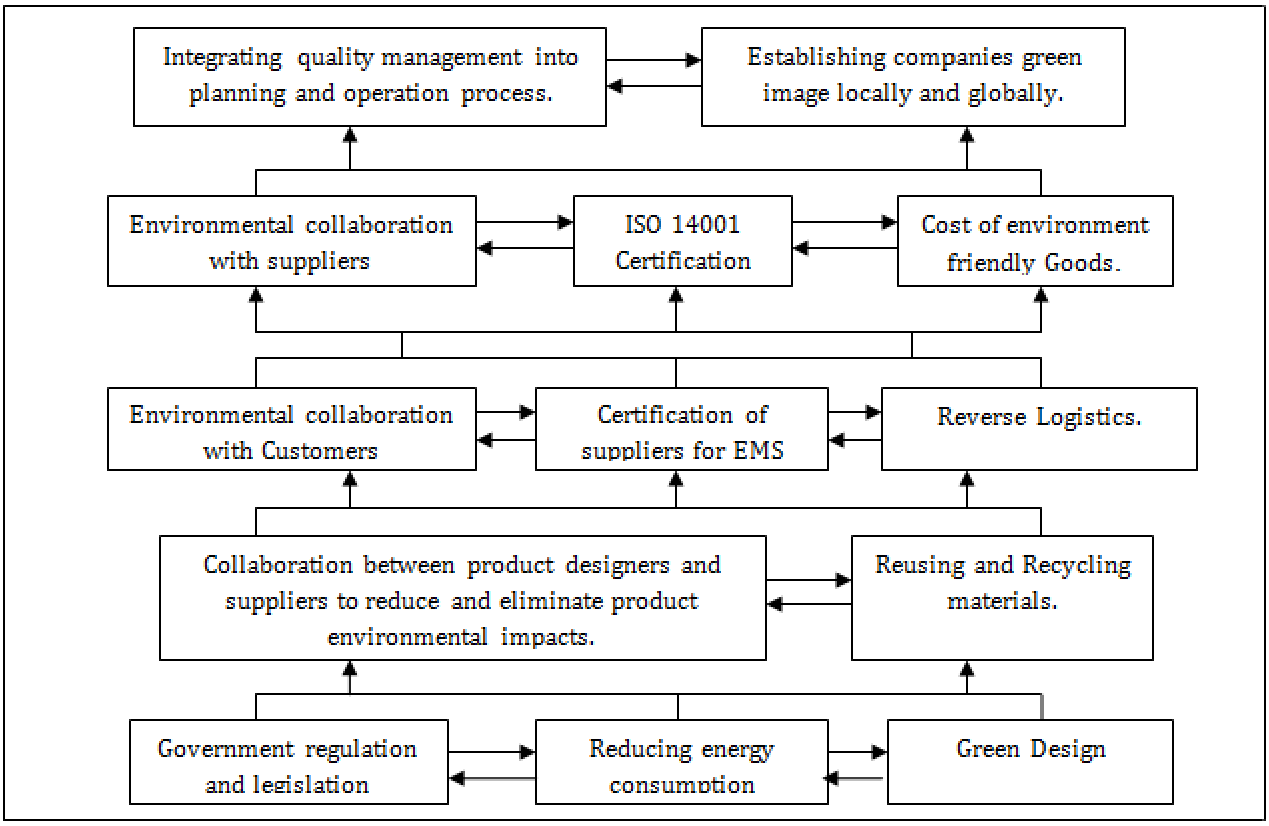

Fig -2: ISM model for drivers affecting implementation of GSCM in construction industry.

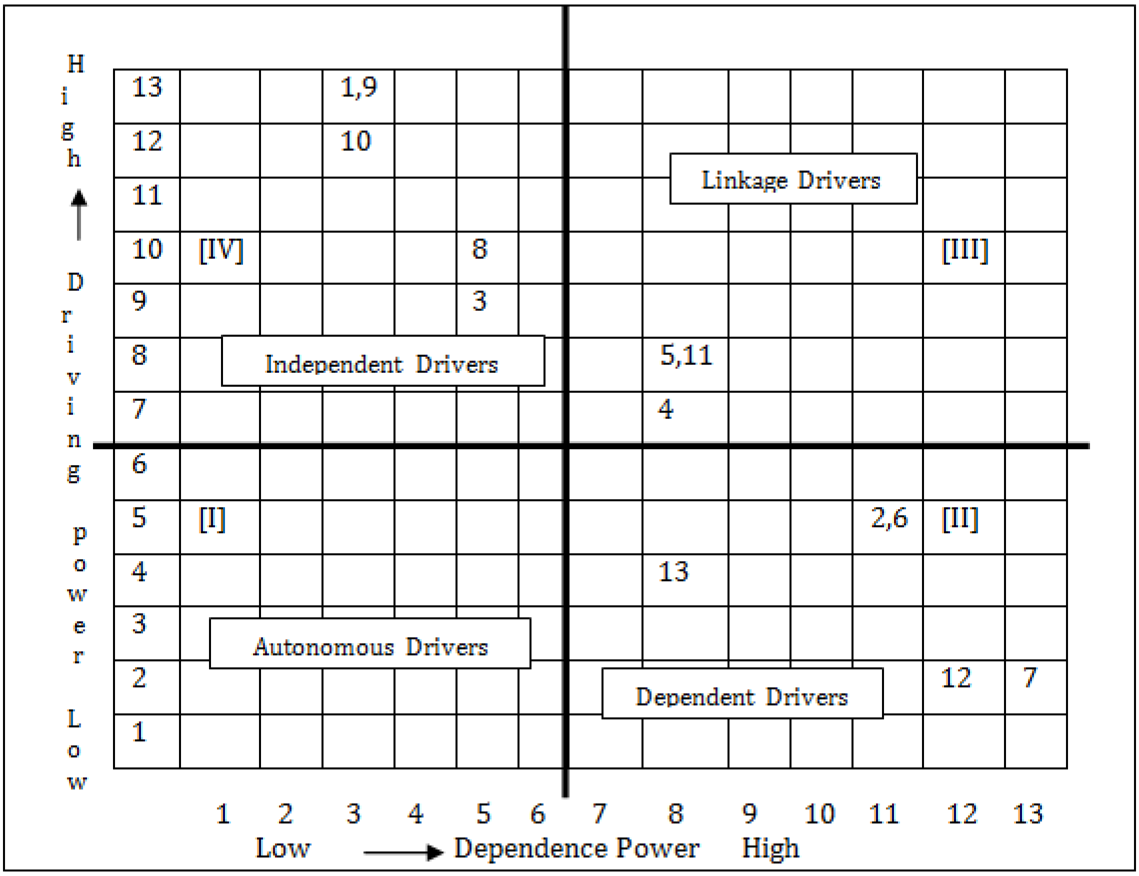

Fig -3: MICMAC Analysis

Table 10: Level Partitions of Drivers- after 5 Iterations

Sr. No.	Drivers for GSCM	Levels
1	Government regulation and legislation.	V
2	Environmental collaboration with suppliers.	II
3	Collaboration between product designers and suppliers to reduce and eliminate product environmental impacts.	IV
4	Environmental collaboration with Customers.	III
5	Certification of suppliers for EMS.	III
6	ISO 14001 Certification.	II
7	Integrating quality management into planning and operation process.	I
8	Reusing and Recycling materials.	IV
9	Reducing energy consumption.	V
10	Green Design.	V
11	Reverse Logistics.	III
12	Establishing companies green image locally and globally.	I
13	Cost of environment friendly Goods.	II

6. Discussion and Conclusion:

The proposed model is very helpful and important to understand the implementation of green supply chain management in construction industries in Maharashtra. In this model drivers are partitioned in different levels so that decision makers aware of importance of various drivers and techniques for implementing them. Total 13 types of drivers were highlighted and an ISM model was developed and interaction between them was analyzed with MICMAC analysis.

Model shown in Fig 2 states that, Government regulation and legislation, Reducing energy consumption and Green Design ,collaboration between product designers and suppliers to reduce and eliminate product environmental impacts and Reusing and Recycling materials are significant drivers and placed at the bottom of hierarchical structure, this drivers important to achieve Environmental collaboration with Customers, Certification of suppliers for environment management system and Reverse Logistics. Environmental collaboration with suppliers, ISO 14001 Certification and Cost of environment friendly Goods are placed at intermediate level of interpretive structural modeling technique. Integrating quality management into planning and operation process and establishing companies green image locally and globally are placed at top level of ISM model. In addition the interrelationship among drivers is expected to provide guidance to management for proper understanding of the complex situation and make effective implementation plan.

From the MICMAC analysis shown in Fig 3 it is evident that drivers, Government regulation and legislation, Collaboration between product designers and suppliers to reduce and eliminate environmental impacts, Reusing and Recycling materials, Reducing energy consumption and Green design have strong driving power and weak dependence power. They are the independent drivers and have the more driving power than the other drivers. So these drivers become more important drivers for implementation for GSCM in construction industry. Analysis shows that, Environmental collaboration with Customers, Certification of suppliers for EMS and Reverse Logistics are linkage drivers. They are unstable drivers any change in these drivers will lead change in other drivers as well as themselves. These changes can be positive and can be negative in adoption of GSCM in construction industry.

7. FUTURE RECOMMENDATIONS:

In this research, a relationship between drivers has been developed through ISM. This model has been developed on the basis of opinion from experts, as suggested in the ISM technique, which has its own limitations.

For further research of this study some key issues should be covered.

- Green supply chain management is relatively new concept in developing countries especially in India, so studies to investigate GSCM Practices, Performance and Adoption would be helpful.
- Comparison between developed and developing countries over GSCM in construction industry would be helpful.
- For addition in literature, analysis of GSCM in construction industries comparison with other sectors would be helpful.

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