

# An innovative approach to modeling the benefits of supply chain collaboration by using interpretive structural modeling

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## Abstract

Supply chain collaboration means the firms within the supply chain collaborate with each other to work together and gain mutual objective by sharing of ideas, information, knowledge, risks and rewards among all supply chain partners. Facing uncertainty in supply and demand, firms have strived to achieve greater collaboration to leverage the resources and knowledge among supply chain partners. Supply chain collaborative firms gain more benefits by satisfying customer's requirements as compared with firms those work individually and having no collaborative relation within partners of supply chain. Therefore there must be a proper understanding of the collaboration and its application within supply chain. One of the best methods to understand and create interest in collaboration is the understanding of the benefits which are come out from supply chain collaboration. Therefore in this study we identify various benefits of supply chain collaboration from literature and design a relation between these benefits with each others, so those decision makers understand these benefits and proceed towards collaborative supply chain. In this study ISM methodology is used for modeling the benefits and MICMAC analysis is used for classifying these benefits according to driving and dependence power. The study is helpful for supply chain decision makers to implement collaboration in supply chain.

## 1. Introduction

Firms try to make their supply chain more value generative by dealing with the products having short life cycle time. And this is possible by fallowing more and more collaborative supply chain among partners of supply chain. Supply chain collaboration (SCC) defined as 'two or more independent firms jointly working to align their supply chain processes so as to create value to end customers and stakeholders with greater success than acting alone' (Simatupang & Sridharan, 2002) (Simatupang & Sridharan, 2004). Numbers of researchers discussed the importance and requirement of collaborative practices in supply chain. performance of supply chain depends upon the ability of a company to which extent it collaborate among supply chain partners (Cooper, 1997) (Mentzer, DeWitt, & Keebler, 2001) (Christopher, 1999) (Spekman, 1998).

### 1.1. Objectives of the research

The objective summary of the research is as:

- Identify the benefits of supply chain collaboration;
- Establish the interrelationship among these identified benefits; and
- Develop an ISM model for knowing the dynamics among benefits that will be helpful to understand supply chain collaboration.

The ISM methodology used to specify the benefits and also develop contextual relationship among these benefits (Govindan & Azevedo, 2015). This methodology has been used for modeling the factors in the area of supply chain management (Shahababkar & Awt\_Tag, 2012).

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ISM is the tool which comparing the factors on the basis of driving power and dependencies ,known as MICMAC analysis (Sharma & Gupta, 1995), and develop a model. ISM convert an raw model into well defined structured model using a systematic procedure (Sage, 1977) (Kumar, Luthra, & Haleem, 2013). Then study describes an extensive literature review for indentifying benefits for the application of SCC. Further, next describe the problem and identifies the benefits in SCC, which followed by summary of ISM methodology. Data collection, and model formulation and MICMAC analysis for dependencies and driving power of indentified barriers are discussed and finally discuss the finding and conclusions of the study.

## 2. Literature Review

This part contains brief summary of literature available on supply chain collaboration, and identifies the benefits, which are relevant for the study.

### 2.1. Supply chain management:

SCM is one of the fields of research, and researchers have keen interest on this area (Stock, Boyer, & Harmon, 2010) (Wisner, 2003). Various authors defined SCM in different ways (Burgess & Steenkamp, 2006). SCM considered as the emerging area of interest as compared with other areas of management (Pilbeam & Obolevicute, 2012) (Wilding & Wagner, 2012) (Larson & Halldorsson, 2004). It had started from logistics, which used by military operations and latter its applications by business management (Gudehus & Kotzab, 2012). Then logistic management has emerged into SCM (Larson & Halldorsson, 2004). And became vast market concept (Seuring & Müller, 2003) (Alvarado & Kotzab, 2001). The main purpose of SCM is to provide customer satisfaction by reducing total supply chain cost (Lovelock, 2011). It is the management of two

way flow of money, information and products from supplier to end user and creates values in supply chain (Carter, Monczka, Ragatz, & Jennings, 2009).

## 2.2. Supply chain

In this global business environment, to increase economy is not easy task. To be remain competitive all partners of supply chain remain pressurized, which is tolerated by adding new techniques in supply chain that results more cost efficient and customer satisfaction (Mentzer, Myers, & Cheung, 2004). Supply chain is a network of organizations, which shared activities and processes to serve the customers at their best. All these organizations are the partners of supply chain, which worked together, manage and monitor all types of flow between supplier and end customers (Alber, Walker, & Educational, 1998).

By using information technology, all partners of supply chain convert information into knowledge and regularly shared information to enhance product flow and services (Robinson & Malhotra, 2005) (Soosay, Hyland, & Ferrer, 2008). Supply chain is a full 'cycle of product', have started from raw product to finished one, going through various stages, production is one of them (Sari, 2008).

(Mentzer et al., 2001) stated that by using collaboration, all partners of supply chain are responsible to work with other partners to achieve common goal, and this is achieved by sharing information, risk and profit. Collaboration is the mutual goal that is greater than a written contract. (Simatupang & Sridharan, 2008) concluded as SCC is the joint work among two or more organizations via a supply chain to gain customers satisfaction, also the primary purpose of collaboration is to achieve optimum profit for supply chain partners and make them more competitive in market. SCC started with simple transaction and ends with responsive collaborative relationship. collaborative relationship depends upon information sharing and risk distribution among the supply chain partners (Goffin, Lemke, & Szwajczewski, 2006).

## 2.3. Supply chain collaboration

Firms have worked together by altering the relationship among profit, value and cost equation (Wilding & Wagner, 2012). collaboration between supply chain partners is the working of two or more than two supply chain partners collectively and run the supply chain operations effectively and have better results as compared to when these firms worked individually (Simatupang & Sridharan, 2002).

Collaboration among partners results as effectively response of uncertainties that come from dependencies in the supply chain (Xu & Beamon, 2006). This is the sharing of resources, information, responsibilities, risk and rewards that leads to improve performance, which is not possible by working individually (Barratt & Oliveira, 2001) (Phillips & Moon, 2000) (Hogarth-Scott, 1999) (Spekman, 1998).

Collaboration between supply chain partners is the emerging area of research from last decade (Singh & Power, 2009). Competitions are within the supply chain, therefore firms thought outside the boundaries to tackle with the global completion and environment to find reasonable solutions (Braggins & Mehrjerdi, 2009). competition and customers demand are the major enablers for supply chain collaboration (Zacharia, Nix, & Lusch, 2009) (Madlberger & Roztocki, 2009) (Kotler & Scheff, 1997).

## 2.4. Necessity of Collaboration

Traditionally supply chain partners followed some specific product flow strategies to increase profit, with time due to increasing competition it came to joint venture which increased information flow, further Global market needed more collaboration as ever before (Wilson, 1996). Collaboration in supply chain resolve hindrances like sharing responsibility and risk, and gain from the common goal by balancing between demand and supply (Andraski, 1998) (Christopher, 2005).

## 2.5. Research gaps

SCC has taking more and more attention as an important strategy in successful supply chain, in spite of that very few work has been done to understand and implement supply chain collaboration (Barratt, 2004) (Holweg, Disney, Holmstrom, et al., 2005) (Busi & Bititci, 2006) (S. Fawcett, Magnan, & Williams, 2004) (Braggins & Mehrjerdi, 2009) (S Min & Roath, 2005) . (Simatupang & Sridharan, 2002) concluded that there are barriers, which must be overcome for successful implementation of SCC; therefore the positive side is to see benefits which give momentum for understanding and application of SCC. Often, firms face challenges to implement collaboration within their supply chain partners. Literature shows that there are some benefits, have to be understand for getting benefits from collaboration (Irfan Sabir & Irfan, 2014) (S. E. Fawcett & McCarter, 2008). A gap in the literature exists to identify the benefits relevant to supply chain collaboration: these benefits must to be helpful to understand collaboration. Therefore identification of benefits and the relation among them and its importance is the direction for present study.

Often, firms face challenges to implement collaboration concept in their supply chain. Literature concluded that collaboration practices have some difficulty due to the presence of some challenge. Collaboration has visualized as an important strategy to add values in the overall supply chain. A gap in literature exists in the finding of benefits which are relevant to SCC. So these literature gaps have identified and arranged them in the form of model is the outcome of the research.

## 3. Problem description

The Indian automobile sector is one of the growing sectors. It acts as key component of industrial growth and employment sector and having greater importance (Narayanan, Vashisht, Narayanan, & Vashisht, 2008). These sector has been making efforts for shifting their aim from cost based to quality based by increasing focus towards customer focused supply chain strategies (Luthra, Garg, & Haleem, 2015). To cope with dynamic global market, today's businesses have more and more preparation to serve the customers (Mudgal & Shankar, 2009).

Automobile industry encouraged to design, produce and supply products, by providing values to customers and sustain in competitive global market. So the companies have been trying to practice new strategies in supply chain (Beske, Land, & Seuring, 2014). To remain highly competitive in today's business environment, collaboration among supply chain partners will effectively help Indian automobile sector by reducing the uncertainties between demand and supply. There is the strong need of Indian automobile sector to enhance collaboration among all supply chain partners and to do that the understanding the

benefits of collaboration and how to understand collaboration to enjoy the benefits from economic, environment, and social area. This study address to this need: we identify and analyses the benefits to understand and implement collaboration in the Indian automobile sector by using well established methodology of ISM and MICMAC analysis.

### 3.1. Benefits identification and data collection

From extensive literature review sixteen benefits were identified, for analyzing the benefits in supply chain collaboration. Twelve experts from Indian Automobile sector were contacted by direct visit, email, and phone, for explaining the concept of supply chain collaboration. After contacting only six experts showed interest in study. Similarly six out of the eleven academicians expressed interest and agreed to give feedback. To examine the SCC benefits a decision making team was formed of four professors and one from operations manager and decision

making. After discussing the problem and its applications the interpretive structural modeling technique was selected for the research. Extensive literature review done for identification of the sixteen benefits, which has been detailed in table 1.

In the ISM methodology, to find the contextual relationship within the benefits, the experts opinion is used, by arranging brain storming within the decision making experts team, all the identified benefits are rating on a scale of high to low towards supply chain collaboration and then a 'leads to' approach is chosen, means are benefits leads to another benefits in supply chain collaboration.

Table1. "Benefits of supply chain collaboration"

**Table 1** Benefits of supply chain collaboration

Benefits	Source
1. Reduce lost sales	(Simatupang & Sridharan, 2004) (Daugherty, Richey, Roath, & Min, 2006) (Smirnova, Henneberg, & Ashnai, 2011) (Nyaga, Whipple, & Lynch, 2010) (Chen, Sohal, & Prajogo, 2013) (Yazar Soyadı & Ince, 2015) (Tokman & Richey, 2007)
2. Increased revenues	(Attaran, 2004) (Ferdows, Lewis, & Machuca, 2004) (Leonard & Cronan, 2002) (S Min & Mentzer, 2000) (Zahedirad & Shivaraj, 2011) (Timme & Williams-Timme, 2000) (Tyndall, 2000) (Simatupang & Sridharan, 2004) (Soonhong Min et al., 2005) (Lau, Xie, & Zhao, 2008) (Flynn, Huo, & Zhao, 2010) (Nyaga et al., 2010) (Kache & Seuring, 2014) (D.-Y. Kim, 2013) (Yazar Soyadı & Ince, 2015) (Tokman & Richey, 2007)
3. Increased sharing information	(Callioni & Montgros, 2005) (Jayaram*, Kannan, & Tan, 2004) (Lee, 2004) (S Min & Mentzer, 2000) (Khan, Udin, & Zairi, 2006) (Daugherty et al., 2006) (Smirnova et al., 2011) (Nyaga et al., 2010) (K. Kim, Umanath, & Kim, 2005) (Sheu, Lee, & Niehoff, 2006) (Li, Ragu-Nathan, Ragu-Nathan, & Rao, 2006) (Kache & Seuring, 2014)
4. Time to market	(Lee, 2004) (S Min & Mentzer, 2000) (Tyndall, 2000) (Simatupang & Sridharan, 2004) (Nooteboom & Haverbeke, 2007)
5. Product availability	(Attaran, 2004) (Lee, 2004) (Leonard & Cronan, 2002)
6. On time delivery	(Ferdows et al., 2004) (Hult, Ketchen, & Slater, 2004) (Leonard & Cronan, 2002) (S Min & Mentzer, 2000) (Waller, 2000) (Simatupang & Sridharan, 2004) (Daugherty et al., 2006) (Smirnova et al., 2011) (Nyaga et al., 2010) (Lau et al., 2008) (Flynn et al., 2010) (Nyaga et al., 2010)
7. Accurate forecasting	(S Min & Mentzer, 2000) (Simatupang & Sridharan, 2004) (Sheu et al., 2006) (Lau et al., 2008) (Flynn et al., 2010) (Nyaga et al., 2010) (Chen et al., 2013)
8. Inventory turns	(Gupta, Whitman, & Agarwal, 2001) (Attaran, 2004) (Soonhong Min et al., 2005) (Ferdows et al., 2004) (Leonard & Cronan, 2002) (S Min & Mentzer, 2000) (Zahedirad & Shivaraj, 2011) (K. Kim et al., 2005) (Li et al., 2006) (Lau et al., 2008) (Flynn et al., 2010) (Nyaga et al., 2010)
9. Better relationship within chain	(Timme & Williams-Timme, 2000) (Simatupang & Sridharan, 2004) (Khan et al., 2006) (Simatupang & Sridharan, 2002) (Yazar Soyadı & Ince, 2015)

10. Improved quality	(Lee, 2004) (Simatupang & Sridharan, 2004) (Khan et al., 2006) (Daugherty et al., 2006) (Nyaga et al., 2010) (Yazar Soyadı & Ince, 2015) (Nooteboom & Haverbeke, 2007)
11. Enhanced competitiveness	(Lee, 2004) (S Min & Mentzer, 2000) (Simatupang & Sridharan, 2004) (Khan et al., 2006) (Daugherty et al., 2006) (Nyaga et al., 2010) (Smirnova et al., 2011) (Nyaga et al., 2010) (Yazar Soyadı & Ince, 2015) (Nooteboom & Haverbeke, 2007)
12. Capital utilization	(Leonard & Cronan, 2002) (Timme & Williams-Timme, 2000) (Simatupang & Sridharan, 2004)
13. Continuous process improvement	(Jayaram* et al., 2004) (Waller, 2000) (Wagner, Guralnik, & Phelps, 2002) (Soonhong Min et al., 2005)
14. SC cost reduction	(Kaas & Ohl, 2002) (Leonard & Cronan, 2002) (Rajib, Tiwari, & Srivastava, 2002) (Khan et al., 2006) (D.-Y. Kim, 2013) (Yazar Soyadı & Ince, 2015) (Tokman & Richey, 2007)
15. Responsiveness	(Gupta et al., 2001) (Jayaram* et al., 2004) (Lee, 2004) (Waller, 2000) (Wagner et al., 2002) (Simatupang & Sridharan, 2004) (Soonhong Min et al., 2005) (Khan et al., 2006) (Smirnova et al., 2011) (Nyaga et al., 2010) (K. Kim et al., 2005) (Sheu et al., 2006) (Li et al., 2006) (Lau et al., 2008) (Nyaga et al., 2010) (Chen et al., 2013) (D.-Y. Kim, 2013)
16. Customer satisfaction	(Hult et al., 2004) (Jayaram* et al., 2004) (Lee, 2004) (Waller, 2000) (S Min & Mentzer, 2000) (Simatupang & Sridharan, 2004) (Khan et al., 2006) (Daugherty et al., 2006) (Smirnova et al., 2011) (Nyaga et al., 2010) (D.-Y. Kim, 2013)

### 3. Research methodology

To develop structural relationship among benefits of the supply chain collaboration, we applied ISM methodology. ISM methodology has the following steps.

1. Identified the different benefits and noted.
2. From the benefits identified, contextual relationship among the benefits with respect to other pairs of benefits is examined.
3. Structural Self-Interaction Matrix (SSIM) is established for benefits, which provides pair wise relation among the benefits.
4. To develop the reach ability matrix from the SSIM, and check for transitivity.
5. Partitioning the levels of reach ability matrix.
6. Directed graph is developed from contextual relationships of reach ability matrix, and by replacing benefit nodes with statements in the graph, ISM model is developed.

#### 3.1 Structural Self-Interaction Matrix

To develop contextual relationship among benefits, Advice from experts based on management techniques was conducted. During brainstorming, 5 experts (3 from academia & 2 from industry) were participated. To express the relationship among benefits the four symbols (V, A, X, O) have been used for defining the direction of relation between two benefits (i and j).

V- Benefit i help to benefit j;

A- Benefit j help to Benefit i;

X- Benefits i and j help each other;

O- Benefits i and j are not helpful to each other.

By following above rules SSIM is formed as shown in table 2.

#### 3.2 Initial Reach Ability Matrix:

Binary matrix is formed from the SSIM, by replacing V, A, X, O with 1 and 0. The matrix formed is called initial reach ability matrix. The rule followed to substitute of 1s and 0s are as below-

If there is sign V in cell (i, j) in the SSIM, then the cell (i, j) entry change to 1 and the cell (j, i) entry change to 0 in the reach ability matrix.

If there is sign A in cell (i, j) in the SSIM, then the cell (i, j) entry change to 0 and the cell (j, i) entry change to 1 in the reach ability matrix.

If there is sign X in cell (i, j) in the SSIM, then the cell (i, j) entry change to 1 and the cell (j, i) entry change to 1 in the reach ability matrix.

If there is sign O in cell (i, j) in the SSIM, then the cell (i, j) entry change to 0 and the cell (j, i) entry change to 0 in the reach ability matrix.

#### 3.3 Final Reach Ability Matrix

By incorporating transitivity the Final reach ability matrix is developed as in table 4.

#### 3.4 Levels Partitioning

Antecedent and reach ability set for all considered benefits are calculated from the final reach ability matrix. Reach ability set for a benefit is the benefit itself and the other benefits, which it influences. Antecedent set is the benefit itself and other benefits, which may influence it. The antecedent and the reach ability set and the Intersection sets

are formed for the all benefits. Benefit having similar values for intersection set and reach ability set then it is assigned as top level benefit in the hierarchy of ISM or Level 1 as in Table 5. Then continue by discarding Level 1, and then finding other Levels. Continue iterative procedure until Level of other benefits has founded. All levels partitioning shown in Table 5.

**3.5 Model Formation**

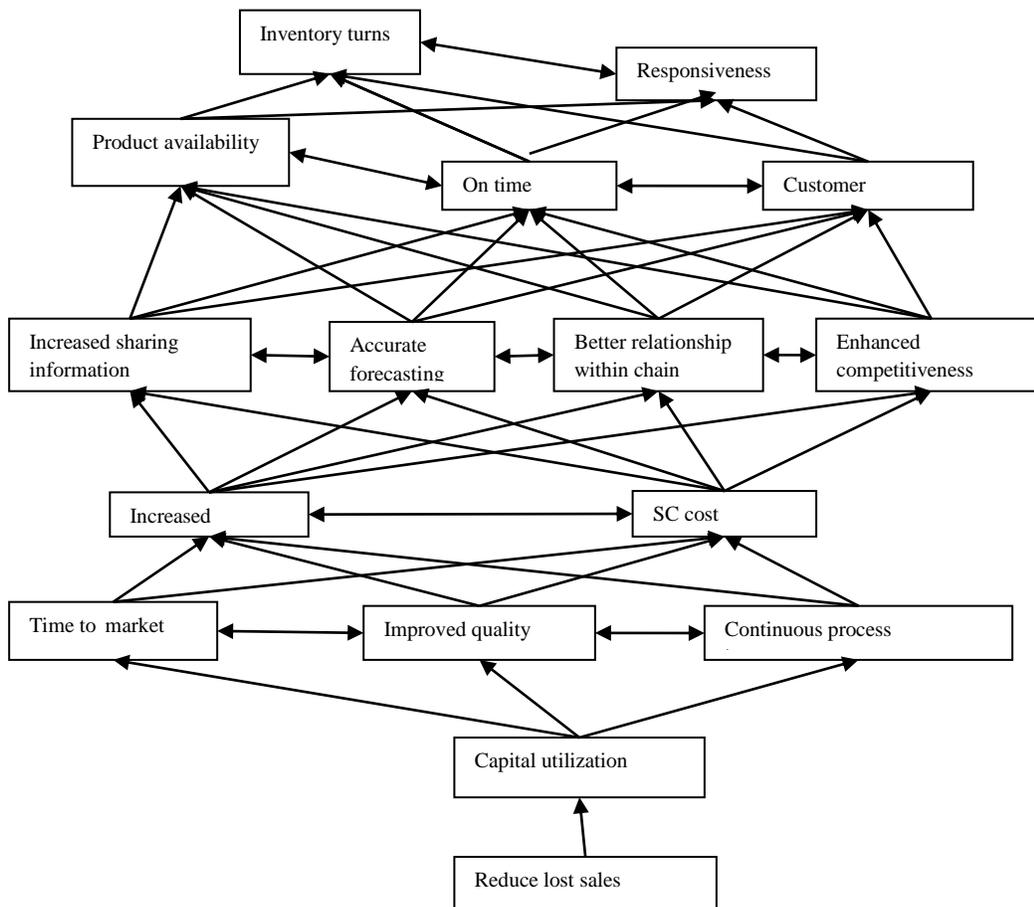
From final reach ability matrix a structural model as a diagraph is formed and by removing transitivity links and writing benefits in place of node numbers, model is formed, has been shown in figure 1.

From model the benefits 'reduce lost sales' is the highly significant benefit for implementing supply chain collaboration as it acts the base of ISM model. All other benefits also show relationship between these benefits from bottom to top level in the model. The benefit 'inventory turns' and 'responsiveness' acted as a top level barrier in model.

**3.6 MICMAC Analysis**

In MICMAC analysis, the benefits are explained according to their driving and dependence power. The driving and dependencies are measured from final reach ability matrix, numbers sum of all 1s in the corresponding row and corresponding column of that benefit gives the driving and dependence. Driving is the power of a benefit influencing

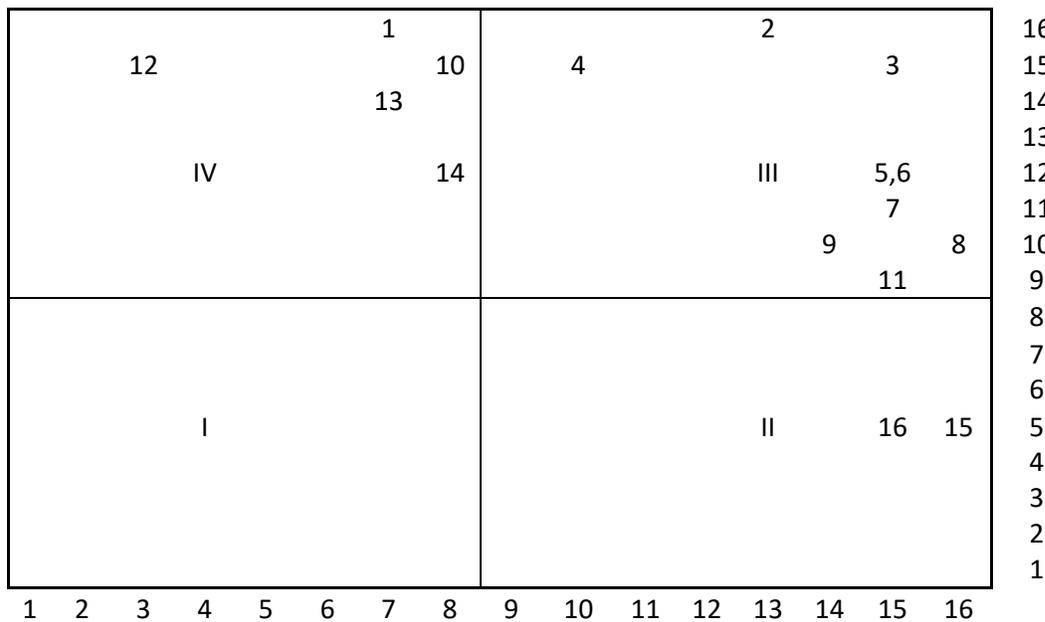
other benefits, and dependence is the power of a benefit influenced by other benefits. Driving power and dependencies of all identified benefits are shown in table 6. The driver-dependence diagram show clusters of benefits to implement collaboration in supply chain. The benefits are divided in four clusters. The first cluster has low driving and dependence power, also known as autonomous benefit. In this study, this cluster has no benefit. Second cluster having weak driving power and strong dependence power, the benefits 'customer satisfaction' and 'responsiveness' fall in this cluster, this is known as dependent benefit. Third cluster having strong driver as well as strong dependence power. The benefits 'increased revenue', 'increased sharing information', 'time to market', 'product availability', 'on time delivery', 'accurate forecasting', 'inventory turns', 'better relation within chain', 'enhanced competitiveness' are clustered in this group. Third cluster benefits are also known as linkage benefits. The fourth cluster has strong driving power and weak dependence power, these benefits are also known as driving benefits. The benefits, 'reduce lost sales', 'improved quality', 'capital utilization', 'continuous process improvement', 'SC cost reduction' are clustered in this group. The MICMAC analysis has been shown in figure 2, having dependence power in x axis and driving power in y axis.



**Fig. 1**  
ISM based model of benefits in supply chain collaboration

**Table 2:** Structured self Intersection Matrix for benefits

S no.	Benefits	Factor no.															
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	Reduce lost sales	V	V	V	V	V	V	A	O	V	V	A	A	X	V	O	-
2	Increased revenues	V	V	A	X	X	V	A	X	A	O	A	O	A	V	-	
3	Increased sharing information	V	A	O	A	A	A	A	O	A	A	A	A	A	-		
4	Time to market	V	O	V	A	O	V	A	V	O	X	A	O	-			
5	Product availability	A	O	O	A	A	V	A	V	V	V	X	-				
6	on time delivery	A	O	O	A	A	V	A	V	V	X	-					
7	Accurate forecasting	V	A	O	A	O	V	A	O	A	-						
8	Inventory turns	A	A	A	A	A	V	A	O	-							
9	Better relationship within chain	V	V	A	A	A	A	A	-								
10	Improved quality	V	V	X	X	O	V	-									
11	Enhanced competitiveness	V	A	O	A	A	-										
12	Capital utilization	V	V	O	V	-											
13	Continuous process improvement	V	V	V	-												
14	SC cost reduction	V	V	-													
15	Responsiveness	A	-														
16	Customer satisfaction	-															



**Fig.2** MICMAC analysis of benefits

**Table 3** Initial Reach ability Matrix

S no.	Benefits	Factor no.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Reduce lost sales	1	0	1	1	0	0	1	1	0	0	1	1	1	1	1	1
2	Increased revenues	0	1	1	0	0	0	0	0	1	0	1	1	1	0	1	1
3	Increased sharing information	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1
4	Time to market	1	1	1	1	0	0	1	0	1	0	1	0	0	1	0	1
5	Product availability	1	0	1	0	1	1	1	1	1	0	1	0	0	0	0	0
6	on time delivery	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0
7	Accurate forecasting	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1
8	Inventory turns	0	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0
9	Better relationship within chain	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1
10	Improved quality	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
11	Enhanced competitiveness	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1
12	Capital utilization	0	0	1	0	1	1	0	1	1	0	1	1	1	0	1	1
13	Continuous process improvement	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
14	SC cost reduction	0	1	0	0	0	0	0	1	1	1	0	0	0	1	1	1
15	Responsiveness	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0
16	Customer satisfaction	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	1

**Table 4** Final Reach ability Matrix for benefits

S no.	Benefits	Factor no.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Reduce lost sales	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Increased revenues	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Increased sharing information	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
4	Time to market	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
5	Product availability	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1
6	on time delivery	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1
7	Accurate forecasting	0	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1
8	Inventory turns	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	1
9	Better relationship within chain	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	1
10	Improved quality	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
11	Enhanced competitiveness	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	1
12	Capital utilization	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	Continuous process improvement	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
14	SC cost reduction	0	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1
15	Responsiveness	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0
16	Customer satisfaction	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	1

**Table 5** Levels partitioning table

S no.	Reach ability set	Antecedent set	Intersection set	level
1	1	1		7th
2	1,2,4,10,12,13,14	1,2,4,10,12,13,14	1,2,4,10,12,13,14	4th
3	1,2,3,4,7,9,10,11,13,14	1,2,3,4,7,9,10,11,12,13,14	1,2,3,4,7,9,10,11,13,14	3rd
4	1,4,10,13	1,4,10,12,13	1,4,10,13	5th
5	1,2,3,4,5,6,7,9,11,16	1,2,3,4,5,6,7,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,9,11,16	2nd
6	1,2,3,4,5,6,7,9,11,16	1,2,3,4,5,6,7,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,9,11,16	2nd
7	2,3,4,7,9,11	1,2,3,4,7,9,10,11,12,13,14	2,3,4,7,9,11	3rd
8	2,3,5,6,7,8,9,11,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	2,3,5,6,7,8,9,11,15,16	1st
9	2,3,7,9,11	1,2,3,4,7,9,10,11,12,13,14	2,3,7,9,11	3rd
10	1,4,10,13	1,4,10,12,13	1,4,10,13	5th
11	3,7,9,11	1,2,3,4,7,9,10,11,12,13,14	3,7,9,11	3rd
12	12	1,12	12	6th
13	4,10,13	1,4,10,12,13	4,10,13	5th
14	2,10,14	1,2,4,10,12,13,14	2,10,14	4th
15	3,7,8,11,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	3,7,8,11,15	1st
16	5,6,16	1,2,3,4,5,6,7,9,10,11,12,13,14,15,16	5,6,16	2nd

**Table 6** Driving and dependence power based ranks of benefits

S no.	Benefits	Driving power	Driving based rank	Dependence power	Dependence based rank
1	Reduce lost sales	16	I	07	VII
2	Increased revenues	16	I	13	IV
3	Increased sharing information	15	II	15	II
4	Time to market	15	II	10	V
5	Product availability	12	IV	15	II
6	on time delivery	12	IV	15	II
7	Accurate forecasting	11	V	15	II
8	Inventory turns	10	VI	16	I
9	Better relationship within chain	10	VI	14	III
10	Improved quality	15	II	08	VI
11	Enhanced competitiveness	09	VII	15	II
12	Capital utilization	15	II	03	VIII
13	Continuous process improvement	14	III	07	VII
14	SC cost reduction	12	IV	08	VI
15	Responsiveness	05	VIII	16	I
16	Customer satisfaction	05	VIII	15	II

#### 4. Discussions

The focus of this research is to identify and analyses of benefits in SCC implementation. By knowing the behavior of benefits, we may extend these analyses to further understanding the effect of those benefits. Several interesting findings for SCC benefits arise from the ISM model application; these are classified into different levels by applying ISM modeling. 'Reduce lost sales', 'Improved quality', 'Capital utilization', 'Continuous process improvement', and 'SC cost reduction', are the important benefits due to its less dependence and more driving power among the other benefits taken in this study, these benefits positioned at the lower side in the hierarchy of model. The benefits 'inventory turns' and 'responsiveness' followed by 'product availability' and 'on time delivery' and 'customer satisfaction' is at the upper side of model due to its high dependence and low driving power. The driving power and dependence power diagram gives valuable information about the importance as well as interdependencies of these benefits. There is no autonomous benefit in the study, so the suggestion for management is to pay attention to all SCC benefits.

#### 5. Conclusions

Several supply chain managements trying to implement right strategy for its supply chain, supply chain collaboration is one of them. There all large numbers of benefits for the application of supply chain collaboration, some of the benefits from literature are taken in this study. The sixteen benefits identified in study have some

significant relationships and overlaps that difficult to observe. A more understanding of benefits and relations among them by a logical model will be helpful for supply chain decision makers to better target the application of supply chain collaboration. The levels of benefits are important in the supply chain collaboration implementation practices. From the figure 1, 'Reduce lost sales', 'Improved quality', 'Capital utilization', 'Continuous process improvement', and 'time to market' are the important benefits due to its less dependence and more driving power. The benefits 'inventory turns', 'responsiveness', 'product availability', 'on time delivery' and 'customer satisfaction' have high dependence and low driving power. The driving power and dependence power diagram gives valuable information about the importance as well as interdependencies of these benefits. On the basis of this study, on average all sixteen benefits have importance in varying degrees for the purpose of SCC application. In the study only sixteen benefits are considered to make the relationship among them by using ISM methodology. Contribution of the research lies in the linkage development of various benefits of SCC through a systematic procedure, which provide great value to the decision makers.

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