

Information Sharing Enablers in Supply Chain Modeling by MCDM Methods :

A Literature Review

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Abstract - Information sharing is vital aspect of coordination among all supply chain partners in supply chain. Information sharing can reduce inventories, bullwhip effect, lead time, smoothing the production and improves the firm performance. Information is power in supply chain. Supply chain efficiency is highly important in highly competitive environment among supply chain partners.

This paper attempts to provide the reader a complete picture of information sharing enablers in supply chain through systematic literature review. This paper also gives brief introduction of multi criteria decision making methods. The VIKOR and TOPSIS methods are reviewed in this paper.

Keywords - Supply Chain Management, Information sharing enablers, TOPSIS, VIKOR, MCDM methods

I. INTRODUCTION

Information sharing is basic to effective coordination in supply chain. Many studies have found that information sharing has great impact on supply chain performance especially in reducing bullwhip effect (Lee and Whang 2000, Xu, Dong et al. 2001, Yu, Yan et al. 2001). Information sharing enables companies to make better decision to utilize their resources and lower supply chain costs. Better management of information allows companies to be more responsive to customer demands (Lee 2000; Montzer 2004).

Simchi-Levi (2003) define a supply chain as network of companies comprising suppliers, manufacturers, warehousing centers, distributors and retailers, and raw materials and finished Products that flow between them. Supply chain comprises three important flows: material, information and finance. Managing, coordination and

integration of these flows within and across organization is essential to achieve effective supply chain management.

The performance of a supply chain could be influenced by many factors, among which information sharing is the crucial one. Inter-company integration and coordination via information technology play a key role in improving supply chain performance. The factors that improve performance of supply chain are known as enablers.

The rest of the paper is organized as follows. The section 2 provides the outline of objectives and research methodology. Section 3 provides a definition of supply chain and supply chain management. Section 4 gives brief introduction of MULTI CRITERIA DECISION MAKING method. Section 5 & section 6 gives literature review of information sharing enablers in supply chain and on multi criteria decision making methods. Section 7 gives literature review in tabular form. Section 8 shows different types of information sharing enablers in supply chain and terminology. Finally section 9 gives conclusion of information sharing enablers in supply chain.

II. OBJECTIVES AND RESEARCH METHODOLOGY

The purpose of the research is to (1) review the supply chain management in last decade (2) find out most critical enablers in supply chain management that improves the performance of firm and transfer either information or material accurately and in timely manner from upstream to downstream vice-versa.

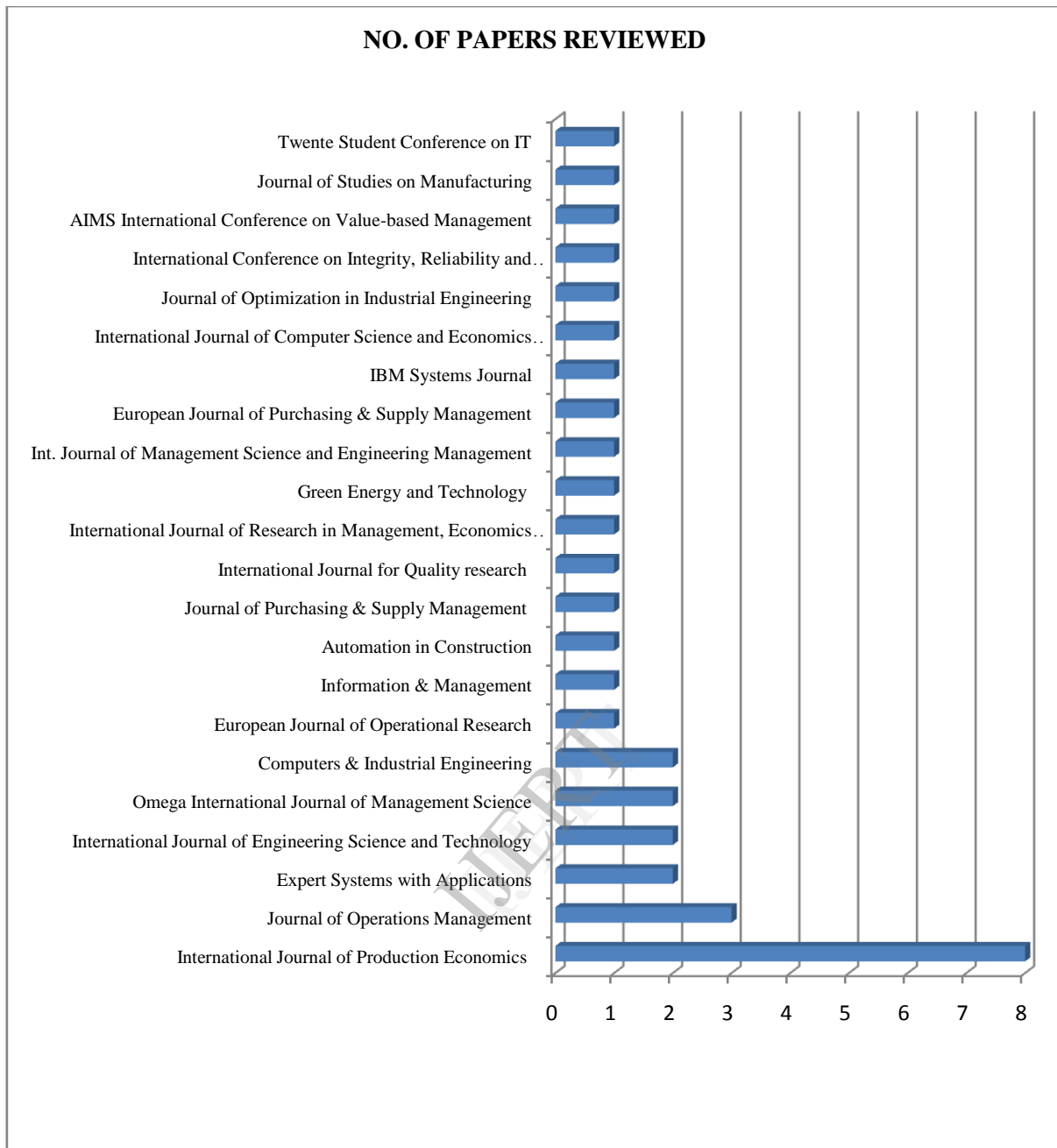


Fig.1. Distribution of reviewed papers by journal.

The analysis of this research is based on secondary data, including online databases, digital libraries, books, journals, conference papers, review papers etc. SCM research papers are evolved from international journals, namely EMERALD, Science Direct, Springer Link etc. European Journal of Operational Research, Manufacturing and Service Operations Management, Production and Operations Management, International Journal of Production Economics and Expert Systems with Applications are some of these journals. Only the literature that has been published between 2004 and 2013 are adopted.

III. THEORETICAL BACKGROUND

A. Supply Chain

A supply chain is a partnership of firms who are involved in providing a product or service. There are a number of stages involved in the supply chain. Generally, more than one player is involved at each stage. A typical supply chain may involve a variety of stages. These supply chain stages include: (a) Customers, (b) Retailers, (c) Wholesalers/Distributors, (d) Manufacturers, and (e) Component/Raw material suppliers. The definition of a basic supply chain is: A set of three or more companies

directly linked by one or more of the upstream or downstream flow of products, services, finances and information from a source to a customer. [33]

With sharing information between trading partners and coordinating their replenishment and production decisions

under demand uncertainty, it could be possible to further reduce costs and

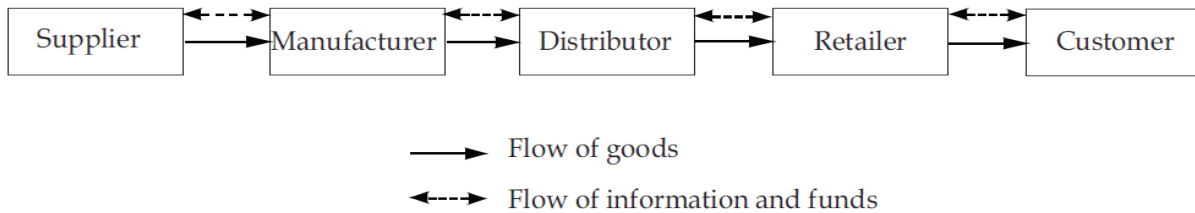


Fig.2. A basic supply chain (chopra and meindl, 2001)

A supply chain consists of all parties involved directly or indirectly to fulfill a customer request. The supply chain not includes only manufacturers and suppliers but also transporters, warehouses, retailers and customers themselves. Supply chains are relatively easy to define for manufacturing industries, where each participant in the chain receives inputs from a set of suppliers, processes those inputs, and delivers them to a different set of customers.

A supply chain is a logistics network, which consists of all stages (e.g. order processing, purchasing, inventory control, manufacturing, and distribution) involved in producing and delivering a final product or service. The entire chain connects customers, retailers, distributors, manufacturers and/or suppliers, beginning with the creation of raw material or component parts by suppliers and ending with consumption of the product by customers. Supply chain management (SCM) is related to the coordination of materials, products and information flows among suppliers, manufacturers, distributors, retailers and customers (Simchi-Levi, Kaminsky, & Simchi-Levi, 2000). SCM often needs the integration of inter- and intra-organizational relationships and coordination of different types of flows within the entire chain.

Improve customer service level. [34]

B. Supply Chain Management

Council of SCM Professionals (CSCMP), defined SCM as “SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with Channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies” Ballou, (2007).

Supply Chain Management is management of material, money, men, and information within and across the supply chain to maximize customer satisfaction and to get an edge over competitors. The integration of the processes, systems, and organizations that control the movement of goods from the supplier to a satisfied customer without waste (Ellram, 1991).

TABLE1. VARIOUS DEFINITIONS OF SUPPLY CHAIN MANAGEMENT (Rajendra Kumar Shukla et al. 2011)

Sr No.	Researchers	Year	Definition
1	Novak & Simco	1991	"The supply chain management covers the flow of goods from supplier through manufacturer and distributor to the end-user".
2	Scott & Westbrook	1991	"Supply chain is used to refer the chain linking each element of the process from, raw materials through to the end customer".
3	Towil, Naim, and Wikner	1992	"The supply chain is a system, the constituent parts of which include material supplier, production facilities, distribution services, customers linked together via the feed forward flow of materials and the feedback flow information".
4	Cavinato	1992	"The supply chain concept consists of actively managed channels of procurement and distribution. It is the group of firms that add value along product flow from original raw materials to final customer".
5	Cooper & Ellram	1993	"SCM is an integrative philosophy to manage the total flow of distribution channel from the supplier to ultimate user".
6	Ganeshan and Harrison	1995	"A supply chain is a network of facilities and distribution options that Performs the functions of procurement of materials, transformation of these materials intermediate and finished products, and the distribution of these finished products customers."
7	Lee & Corey	1995	"The integration activities taking place among a network of facilities that procure Raw material, transform them into intermediate goods and then final products, & deliver Products to customers through a distribution system"
8	Christopher	1998	"The supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of

			products and services in the hands of the ultimate customer”.
9	Handfield & Nichols	1999	“A supply chain encompasses all activities associated with the flow and transformation of goods from the raw material stage, through to the end user, as well as the associated information flows”.
10	Mentzer et al.	2001	“The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.”
11	Chopra and Meindl	2001	“A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request”.
12	Rai et al., Lin and Lin,	2006	SCM can be defined as an effective management on the three complementary flows, material, information, and finance, between a focal firm and its partners.
13	Stank et al. Lin and Lin	2006	The mechanism basically involves a large variety of flow activities across the whole supply chain, including material, subassembly, product, order, delivery, payment, and customer service.

IV. MULTI CRITERIA DECISION MAKING METHOD

The Multi Criteria Decision Making (MCDM) is process of finding best option among a set of feasible alternatives. In most of MCDM problems multiplicity of criteria used to judge alternatives. In industry, for example decision maker needs to take a decision based on multiple criteria to select an alternative from those feasible ones. Multi criteria often requires decision maker to provide quantitative /qualitative assessment to identify

value of each alternative with respect to each criterion. Such aspects will usually result in uncertain, indefinite and subjective data, which makes decision making process complex and challenging. Decision making often occurs in a fuzzy environment where available information is uncertain which may confuse decision makers in decision making process. Weights and ratings are difficulty to be precisely judged because of uncertainty. Such evaluations are fuzzy measures in nature. Real life applications of multi criteria decision making require processing of uncertain, qualitative or vague data.[35]

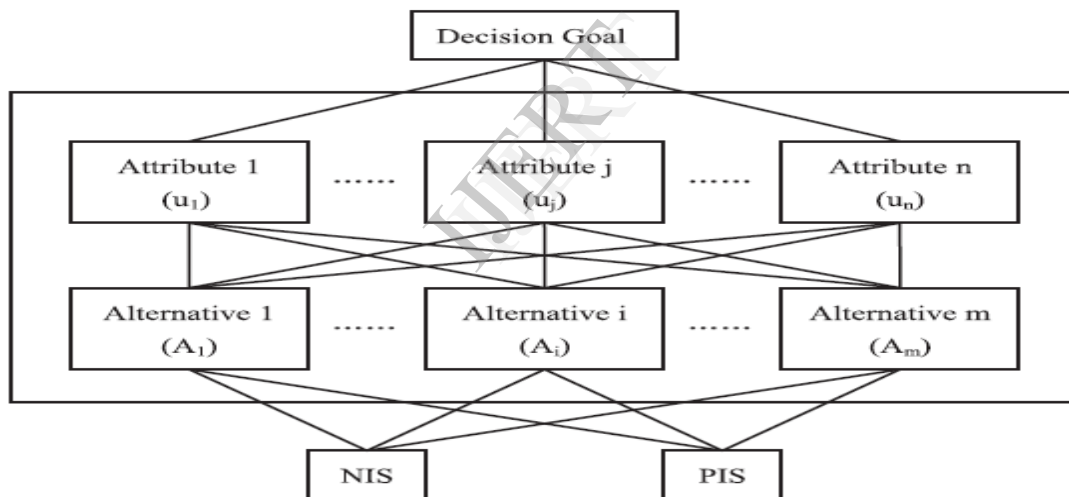


Fig.3. Multi Criteria Decision Making Tree

Where NIS- negative ideal solution and PIS- positive ideal solution

There are about 27 MCDM methods are available for different application but mainly following 5 methods are widely used to select best alternative.

1. TECHNIQUE FOR ORDER PREFERENCE BY SIMILARITY TO IDENTICAL SOLUTION (TOPSIS)

2. VLSEKRITERIJUMSKA OPTIMIZACIJA I KOMPROMISNO RESENJE (VIKOR)

3. SIMPLE ADDITIVE WEIGHTING (SAW)

4. ANALYTICAL HIERARCHY PROCESS (AHP)

5. WEIGHTED PRODUCT METHOD (WPM)

A. Steps of VIKOR Method [30]

Step1. Determine the normalized Decision Matrix

$$F = [f_{ij}]_{m \times n}$$

Where $f_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}}$, $i=1, \dots, m$, $j=1, \dots, n$, and x_{ij} is the performance of alternative A_j with respect to the j th Criterion.

Step2. Determine the ideal and negative ideal solutions

The ideal solution A^* and negative ideal solution A^- are as follows:

$$A^* = \{(\max f_{ij} | j \in J) \text{ or } (\min f_{ij} | j \in J) | i = 1, 2, \dots, m\} = \{f_1^*, f_2^*, \dots, f_j^*, \dots, f_n^*\}$$

$$A^- = \{(\min f_{ij} | j \in J) \text{ or } (\max f_{ij} | j \in J) | i = 1, 2, \dots, m\} = \{f_1^-, f_2^-, \dots, f_j^-, \dots, f_n^-\}$$

Where

$$J = \{j = 1, 2, \dots, n | f_{ij}, \text{ a larger respond is desired}\}$$

And

$$J' = \{j = 1, 2, \dots, n | f_{ij}, \text{ a smaller respond is desired}\}$$

Step3. Calculate the Utility and the Regret measure

$$S_i = \sum_{j=1}^n w_j \times (f_j^* - f_{ij}) / (f_j^* - f_j^-)$$

$$R_i = \max_j [w_j \times (f_j^* - f_{ij}) / (f_j^* - f_j^-)]$$

Where S_i represents the utility measure, R_i represents the regret measure, and w_j is the weight of the j th Criterion.

Step4. Calculate the VIKOR index.

$$Q_i = v \left[\frac{S_i - S^*}{S^- - S^*} \right] + (1 - v) \left[\frac{R_i - R^*}{R^- - R^*} \right]$$

Where Q_i represents the i th alternative VIKOR value

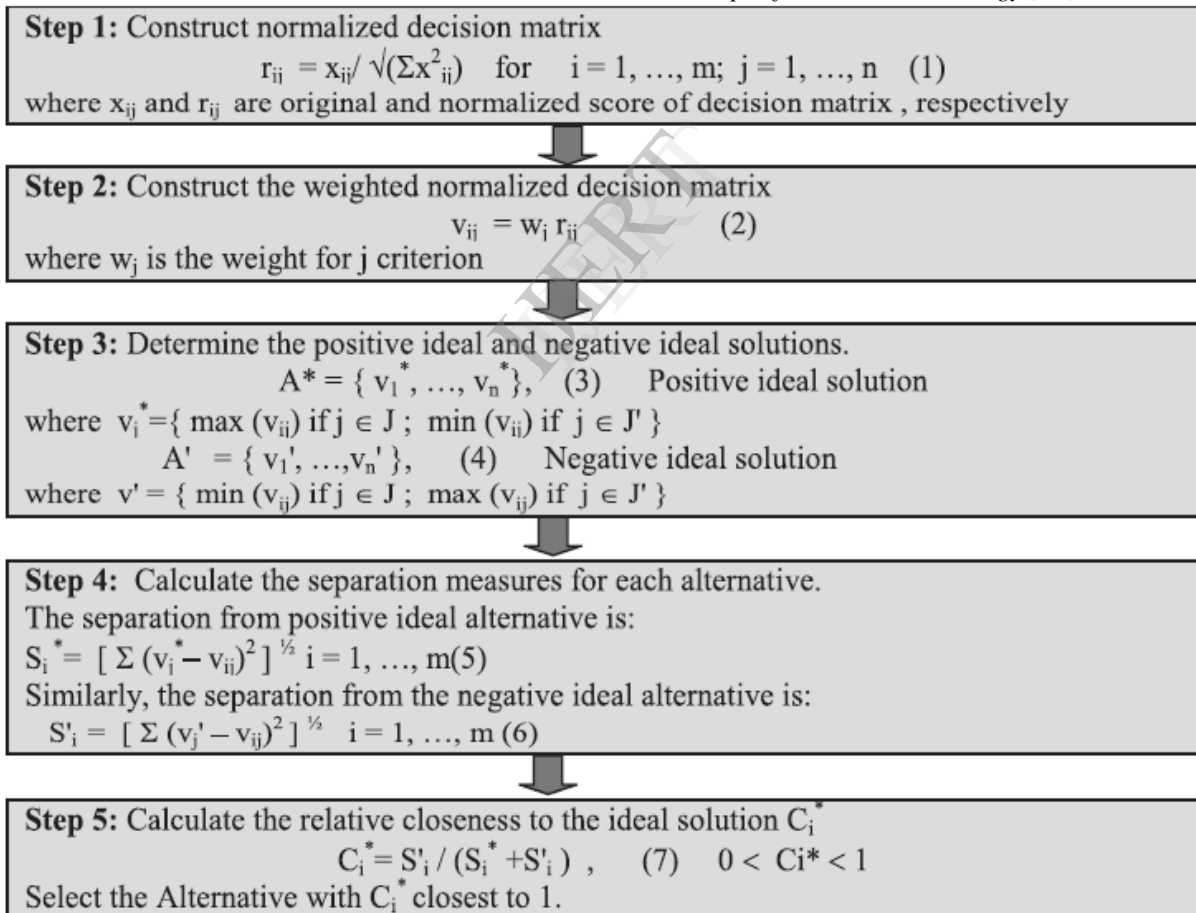
$$i=1, \dots, m; \quad S^* = \min_i S_i, \quad S^- = \max_i S_i, \quad R^* = \min_i R_i, \quad R^- = \max_i R_i$$

And v is the weight of the maximum group utility and usually set to 0.5 (Kacker, 1985 and Opricovic, 1994).

Step5. Rank the order of preference.

Rank is given to all criteria if it is related to cost than smallest VIKOR value is choose and if it is related to efficiency, performance than larger VIKOR value is choose.

B. Steps of TOPSIS Methodology [36]



V. LITERATURE REVIEW ON INFORMATION SHARING ENABLERS IN SUPPLY CHAIN

Kate bailey, Mark francis (2007), took a case study in U.K sheep meat market. They found that information sharing is not sufficient but also socio-technical factors are also important in supply chain. Demand amplification

reduced by collaborative practices and socio technical factors. Suhong li, Binshan lin (2006), found out factors that increase performance of supply chain and use 7 point likert scale and regression analysis. Based on 196 respondent and result they concluded that Shared vision and commitment bet supply chain partner are most important factors in sharing information. Mei cao, Qingyu zhang

(2010), Data were collected through a Web survey of U.S. manufacturing firms in various industries. The statistical methods used. The results indicate that supply chain collaboration improves collaborative advantage and indeed has a bottom-line influence on firm performance. Supply chain collaboration improves firm performance. Fei ye, Zhiqiang wang (2013), Data from 141 Chinese manufacturers is collected to test the relationships among IT alignment, information sharing, and operational performance. They took survey and used 5 point likert scale. The statistical methods used. The results show that (1) both IT alignment and information sharing have direct and positive effects on operational performance, (2) IT alignment has an indirect effect on operational performance through information sharing, and (3) IT alignment and information sharing have different emphases in operational performance improvement. Both have direct and positive impact on organizational performance. (Mu chen chen et al.2007), worked on Evaluating supply chain performance of IT based inter – enterprise collaboration. They study 4 CPFR scenarios. They used ARENA software simulator to find impact of CPFR. CPFR reduce bullwhip effect so ultimately reduce cost, inventory. It is also found that retailers play most important role in supply chain to reduce bullwhip effect. (Jindae kim et al. 2008) , worked on Value analysis of location –enabled RFID information on delivery chain performance. They found that RFID system provides real time information to reader to take appropriate action for planning and execution. RFID system accurately reports location of vehicle before it is shipped. It reduces lead time and labor cost. Simulation outputs are analyzed with ANOVA method.

(Emily boyle et al. 2008), worked on Reducing supply chain environmental uncertainty through e-intermediation. They took 3 case study in O.E.M electronic industry and toy wholesalers and retailers in U.S.A. They used in depth managers interviews they found that e-intermediation reduce environmental uncertainty. Juha miikka, Jouni kauremaa (2011), took case study in telecommunication industry in Europe, Used statistical analysis and compare EDI and Rosetta net for accuracy, timeliness and speed to transfer data (in telecommunication industry).Result yields that Rosetta net have slightly higher benefits than EDI. (Seung kyoon shin et al. 2007), Worked on An empirical investigation of socio-cultural factors of information sharing in china. They used survey technique. They studied 3 (guanxi, collectivism and Confucian dynamism) socio cultural factors that had positive effect on information sharing in china. Among them gunaxi had stronger impact on in group information sharing.

(Prashant r. nair et al. 2007), worked on Overview of information technology tools for supply chain management. All I.T tools like E.D.I, E.R.P, R.F.I.D and barcode reader improve information sharing in supply chain management.(Stanley Fawcett et al. 2007), worked on Information sharing and supply chain performance: the role of connectivity and willingness. They took mail survey and company interviews. Use 7 point likert scale and from result

concluded that both connectivity and willingness increase information sharing and supply chain performance. Nada r.sanders (2007), carried out an empirical study of the impact of e-business technologies on organizational collaboration and performance. They used questionnaire technique and statistical methods. Results shows that e-business tech. have direct impact on organizational performance, indirect impact on inter-organizational performance through intra-organizational performance. (Suhong li et al. 2004), had studied the impact of supply chain management practices on competitive advantage and organizational performance. From Questionnaire tech and statistical methods results shows that five S.C.M practices have direct and positive impact on competitive advantage and organizational performance. (Timon c.Du et al. 2011), studied Willingness to share information in a supply chain: A partnership data process perspective. From survey it is found that willingness plays very most important role to share data among supply chain partners. (Gang LI et al. 2008), worked on the impact of IT implementation on supply chain integration and performance. Using survey and statistical tech. it is found that IT implementation has direct and positive impact on supply chain integration but indirect positive effect on supply chain performance through supply chain integration.

(Erkan Bayraktar et al. 2009), carried out a casual analysis of the impact of information systems and supply chain management practices on operational performance: Evidence from manufacturing SMEs in Turkey. Results indicate that SCM practices and IS practices have positive impact on operational performance of SMEs and negative relationship between SCM-IS inhibitors and SCM-IS enablers on operational performance of SMEs. (Aysegul sarac et al. 2010), studied a literature review on the impact of RFID technologies on supply chain management. Literature review shows that RFID technologies improve traceability and visibility of product, improve information accuracy and reduce bullwhip effect. (M.K.Khurana et al. 2010), proposed modeling of information sharing enablers for building trust in Indian manufacturing industry: an integrated ISM and Fuzzy MICMAC Approach. They have identified 13 trust based information sharing enablers in manufacturing industry. Among them Co-operative behaviors of chain members is most important key enablers in information sharing. Sebastiaan X. Koperberg (2007), studied the information flows and supporting technology in the automotive supply chain: A suppliers focus. This paper presents a summary of information flows and technology enabling the supply chain within the automotive industry. The use of EDI and internet, share the information very accurately and rapidly in automobile industry. Eleonora Bottani, Antonio Rizzi (2007), studied an Economical assessment of the impact of RFID technology and EPC system on the fast-moving consumer goods supply chain. They have studied integrated and non-integrated scenario as well as pallet level tagging and case level tagging. From results it is cleared that pallet level tagging provides positive revenues to all supply chain partners in both scenario while case level tagging gives negative results for manufacturer

side. Daniel Prajogo, Jan Olhager (2011), Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. Results shows that long term relationship have direct and indirect positive impact on SCM performance while logistics integration has direct positive effect on SCM performance.

(Ing-Long Wu et al. 2013), worked on Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. From the results It is cleared that the trust, commitment, reciprocity, power, information sharing and collaboration have positive impact on supply chain performance. Sufian Qrunfleh, Monideepa Tarafdar (2012), worked on Supply chain information systems strategy: Impacts on supply chain performance and firm performance. Data are collected through questionnaire and hypothesis test through structural equation model analysis, from results it is concluded that supply chain strategy(like lean and agile) and supply chain IS strategy for efficiency and flexibility have positive effect on supply chain performance and firm performance. (James Roh et al. 2013), carried out Implementation of responsive supply chain strategy in global complexity: the case of manufacturing firms. From statistical analysis, it is cleared that responsive supply chain strategy and practices likes collaboration with suppliers and use of advance manufacturing technologies have positive impact on pull production while negative effect of information sharing with customers on pull production. (Honggeng Zhou et al. 2013), studied Supply chain practice and information quality: A supply chain strategy study. The study shows that firms need to align supply chain practices (sourcing practice and delivery practice) with level of information quality in order to achieve good overall firm performance. Results also

shows that firms with high information quality but no effective supply chain practice tend to perform worst among all four supply chain strategic clusters.

VI. LITERATURE SURVEY ON MULTI CRITERIA DECISION MAKING METHODS

(Behnam vadhani et al. 2011), worked on Group decision making based on novel fuzzy modified TOPSIS method. The fuzzy modified TOPSIS method is used for robot selection problem for material handling and rapid prototype process selection. Chia-chi sun (2010), worked on a performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods. They evaluate different notebook computer companies based on performance criteria. (Ali shemshadi et al. 2011), worked on a fuzzy VIKOR method for supplier selection based on entropy measure for objective weighting. Fuzzy VIKOR evaluate different supplier based on supplier criteria. J.R. san Cristobal (2010), worked on Multi criteria decision making in the selection of a renewable energy project in Spain: the VIKOR method. Combined VIKOR and AHP methods are used to evaluate renewable energy project and to select best plan. Chien-Hua Wang, Chin-Tzong Pang (2011), Using VIKOR method for evaluating service Quality of online auction under fuzzy environment. In this paper, the VIKOR method is used to select best service Quality of online auction under fuzzy environment. (José Ramón San Cristóbal et al. 2009), Selection of materials under aggressive environments: the VIKOR method. In this paper, the VIKOR method is used to select best material under aggressive environment. Saurav Datta, Siba Shankar Mahapatra (2010), carried out comparative study on application of utility concept and VIKOR method for vendor selection. VIKOR method is used to select best vendor based on vendor criteria.

TABLE2. The Articles Resources – Journals

Title of Journals	Number of Articles
Journal of Operations Management	3
Omega International Journal of Management Science	1
Computers & Industrial Engineering	1
European Journal of Operational Research	1
Information & Management	1
International Journal of Production Economics	8
Automation in Construction	1
Expert Systems with Applications	2
Journal of Purchasing & Supply Management	1
International Journal for Quality research	1
International Journal of Research in Management, Economics and Commerce	1
Green Energy and Technology	1
International Journal of Management Science and Engineering Management	1
European Journal of Purchasing & Supply Management	2
IBM Systems Journal	1
International Journal of Computer Science and Economics Technology	1
International Journal of Engineering Science and Technology	2
Journal of Optimization in Industrial Engineering	1
International Conference on Integrity, Reliability and Failure, Porto/Portugal	1
AIMS International Conference on Value-based Management	1
Journal of Studies on Manufacturing	1
Twente Student Conference on IT	1

VII. LITERATURE REVIEW IN TABULAR FORM

Sr. No	Title	Author Name	Year Of Published	Summary
1	The impact of supply chain management practices on competitive advantage and organizational performance.	Suhong li, Bhanu Raghu Nathan, T.S.Raghu Nathan, S.Subba Rao	2004	From Questionnaire technique and statistical methods results shows that five S.C.M practices have direct and positive impact on competitive advantage and organizational performance.[13]
2	Assessing information sharing and information quality in supply chain management.	Suhong li, Binshan lin	2006	Shared vision and commitment between supply chain partners are most important factors in sharing information.[2]
3	Managing information flows for improved value chain performance.	Kate bailey, Mark francis	2007	Demand amplification reduced by collaborative practices and socio technical factors.[1]
4	Evaluating supply chain performance of IT based inter – enterprise collaboration.	Mu chen chen, Taho yang, Hsin chia li	2007	They used ARENA software simulator to find impact of CPFR. CPFR reduce bullwhip effect so ultimately reduce cost, inventory.[5]
5	An empirical investigation of socio-cultural factors of information sharing in china.	Seung kyoon shin, Micheal ishman, G.Lawrance sanders	2007	Use survey technique and They studied 3 (guanxi, collectivism and Confucian dynamism) socio cultural factors that had positive effect on information sharing in china. Among them guanxi had stronger impact on in group information sharing.[9]
6	Overview of information technology tools for supply chain management.	Prashant r. nair, Vankitaswamy raju, Anbudayashankar S P	2007	All I.T tools like E.D.I, E.R.P, R.F.I.D and barcode reader improve information sharing in supply chain management.[10]
7	Information sharing and supply chain performance: the role of connectivity and willingness.	Stanley Fawcett, Paul osterhaus, James c brau, Matthew Mc carter	2007	They took mail survey and company interviews. Use 7 point likert scale and from result concluded that both connectivity and willingness increase information sharing and supply chain performance.[11]

8	An empirical study of the impact of e-business technologies on organizational collaboration and performance.	Nada r.sanders	2007	Used questionnaire technique and statistical methods. Results shows that e-business technologies have direct impact on organizational performance, indirect impact on inter-organizational performance through intra-organizational performance.[12]
9	The information flows and supporting technology in the automotive supply chain: A supplier focus.	Sebastiaan X. Koperberg	2007	This paper presents a summary of information flows and technology enabling the supply chain within the automotive industry. The use of EDI and internet, share the information very accurately and rapidly in automobile industry.[19]
10	Economical assessment of the impact of RFID technology and EPC system on the fast-moving consumer goods supply chain.	Eleonora Bottani, Antonio Rizzi	2007	They have studied integrated and non-integrated scenario as well as pallet level tagging and case level tagging. From results it is cleared that pallet level tagging provides positive revenues to all supply chain partners in both scenario while case level tagging gives negative results for manufacturer side.[20]
11	Value analysis of location – enabled RFID information on delivery chain performance.	Jindae kim, kaizhi tang, sounder kumara, shang tae yee, jaffrey tew	2008	RFID system provides real time information to reader to take appropriate action for planning and execution. RFID system accurately reports location of vehicle before it is shipped. It reduces lead time and labor cost. Simulation outputs are analyze with ANOVA method.[6]
12	Reducing supply chain environmental uncertainty through e-intermediation.	Emily boyle, Paul Humphreys, Ronan Mcivor	2008	The e-intermediation reduces environmental uncertainty.[7]
13	The impact of IT implementation on supply chain integration and performance.	Gang LI, Hongjiao Yang, Linyan Sun, Amrik.S Sohal	2008	Using survey and statistical tech. it is found that IT implementation has direct and positive impact on supply chain integration but indirect positive effect on supply chain performance through supply chain integration.[15]
14	A casual analysis of the impact of information systems and supply chain management practices on operational performance: Evidence from manufacturing SMEs in Turkey.	Erkan Bayraktar, Mehmet Demirbag, S.C Lenny Koh, Ekrem tatoglu, Halil Zaim	2009	Results indicate that SCM practices and IS practices have positive impact on operational performance of SMEs and negative relationship between SCM-IS inhibitors and SCM-IS enablers on operational performance of SMEs.[16]
15	Selection of materials under aggressive environments: the VIKOR method.	José Ramón San Cristóbal, M. Victoria Biezma, Ruth Martínez, Ramón Somoza	2009	In this paper, the VIKOR method is used to select best material under aggressive environment.[31]
16	Supply chain collaboration impact on collaborative advantage and firm performance.	Mei cao , Qingyu zhang	2010	Supply chain collaboration improves firm performance by supply information.[3]
17	A literature review on the impact of RFID technologies on supply chain management.	Aysegul sarac, Nabil absi, Stephane Dazere Peres	2010	Literature review shows that RFID technologies improve traceability and visibility of product, improve information accuracy and reduce bullwhip effect.[17]
18	Modeling of information sharing enablers for building trust in Indian manufacturing industry: an integrated ISM and Fuzzy MICMAC Approach.	M.K.Khurana, P.K.Mishra, Rajeev Jain, A.R.Singh	2010	They have identified 13 trust based information sharing enablers in manufacturing industry. Among them Co-operative behaviors of chain members is most important key enablers in information sharing.[18]
19	A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods.	Chia –chi sun	2010	Fuzzy AHP and TOPSIS methods used to evaluate different notebook computer companies based on performance criteria.[27]
20	Multi criteria decision making in the selection of a renewable energy project in Spain: the VIKOR method.	J.R. san Cristobal	2010	Combined VIKOR and AHP methods are used to evaluate renewable energy project and select best plan.[29]
21	Comparative study on application of utility concept and VIKOR method for vendor selection.	Saurav Datta, Siba Shankar Mahapatra	2010	VIKOR method is used to select best vendor based on vendor criteria.[32]

22	Business to business integration: applicability, benefits, and barriers in telecommunication industry.	Juha miikka, Jouni kauremaa	2011	Used statistical analysis and compare EDI and Rosetta net for accuracy, timeliness and speed to transfer data(in telecommunication industry) Rosetta net has slightly higher direct benefits than EDI. Where indirect benefits are significantly higher than E.D.I.[8]
23	Willingness to share information in a supply chain : A partnership data process perspective.	Timon c.Du, Vincent S.Lai, Waimen cheung, Xiling Cui	2011	From survey it is found that willingness plays very most important role to share data among supply chain partners.[14]
24	Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration.	Daniel Prajogo, Jan Olhager	2011	Results shows that long term relationship have direct and indirect positive impact on SCM performance while logistics integration has direct positive effect on SCM performance.[21]
25	Group decision making based on novel fuzzy modified TOPSIS method.	Behnam vadhani, Meysam mousavi, Reza tavakkoli-moghaddam	2011	The fuzzy modified TOPSIS method is used for robot selection problem for material handling and rapid prototype process selection.[26]
26	A fuzzy VIKOR method for supplier selection based on entropy measure for objective weighting.	Ali shemshadi, Hossein shirazi, Mehran toreihi, M.J Tarokh	2011	Fuzzy VIKOR method used to evaluate different supplier based on supplier criteria.[28]
27	Using VIKOR method for evaluating service Quality of online auction under fuzzy environment.	Chien-Hua Wang , Chin-Tzong Pang	2011	In this paper, the VIKOR method is used to select best service Quality of online auction under fuzzy environment.[30]
28	Supply chain information systems strategy: Impacts on supply chain performance and firm performance.	Sufian Qrunfleh, Monideepa Tarafdar	2012	Data are collected through questionnaire and hypothesis test through structural equation model analysis, from results it is concluded that supply chain strategy (like lean and agile) and supply chain IS strategy for efficiency and flexibility have positive effect on supply chain performance and firm performance.[23]
29	Effects of I.T alignment and information sharing on supply chain operational performance.	Fei ye, Zhiqiang wang	2013	I.T alignment and information sharing Both have direct and positive impact on organizational performance. IT alignment is more useful for customer responsiveness, whereas information sharing is more useful for cost efficiency.[4]
30	Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective.	Ing-Long Wu, Cheng-Hung Chuang, Chien-Hua Hsu	2013	From the results It is cleared that the trust, commitment, reciprocity, power, information sharing and collaboration have positive impact on supply chain performance.[22]
31	Implementation of responsive supply chain strategy in global complexity: the case of manufacturing firms.	James Roh, Paul Hong, Hokey Min	2013	From statistical analysis, it is cleared that responsive supply chain strategy and practices likes collaboration with suppliers and use of advance manufacturing technologies have positive impact on pull production while negative effect of information sharing with customers on pull production.[24]
32	Supply chain practice and information quality: A supply chain strategy study.	Honggeng Zhou, Yongyi Shou, Xin Zhai, Ling Li, Craig Wood, Xiaobo Wu	2013	The study shows that firms need to align supply chain practices (sourcing practice and delivery practice) with level of information quality in order to achieve good overall firm performance. Results also shows that firms with high information quality but no effective supply chain practice tend to perform worst among all four supply chain strategic clusters.[25]

VIII. INFORMATION SHARING ENABLERS IN SUPPLY CHAIN MANAGEMENT

A. Terminology

1. **VENDOR MANAGED INVENTORY**- The practice of retailers' making suppliers responsible for determining when to order and how much to order.

2. **SHARED VISION AND COMMITMENT** – shared vision means common goals, objectives or

policies among supply chain partners. Commitment means contract and willingness between supplier and buyer about their confidential data, close relationship among them,

3. **I.T alignment** – IT alignment means similarity, connectivity and compatibility of IT infrastructure between supply chain partners. IT alignment is a useful resource in

realizing efficiency and effectiveness in information management (Wu et al., 2006).

4. *RFID system* - Radio frequency identification (RFID) is the generic name for technologies that use radio waves to automatically identify individual items. RFID, system consists of a reader and a tag, the latter being made up of two main components, namely an antenna and a chip. The reader sends out electromagnetic waves that form a magnetic field when they join with the antenna on the RFID tag. The tag draws power from the magnetic field and uses it to power the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader and the reader converts the new waves into digital data. Data are

stored into the tag chip in the form of an electronic product code (EPC). (Muller-Seitz et al.2009)

5. *E-INTERMEDIATION* – means matcher or acts as aggregators.

6. *ELECTRONIC DATA INTERCHANGE* - Electronic data interchange is defined as computer to computer exchange of structured data for automatic processing. It is utilized for sending invoices, bills of lading, confirmation of dispatch, shipping details and any information that the linked organizations choose to exchange (Rushton et al., 2000).

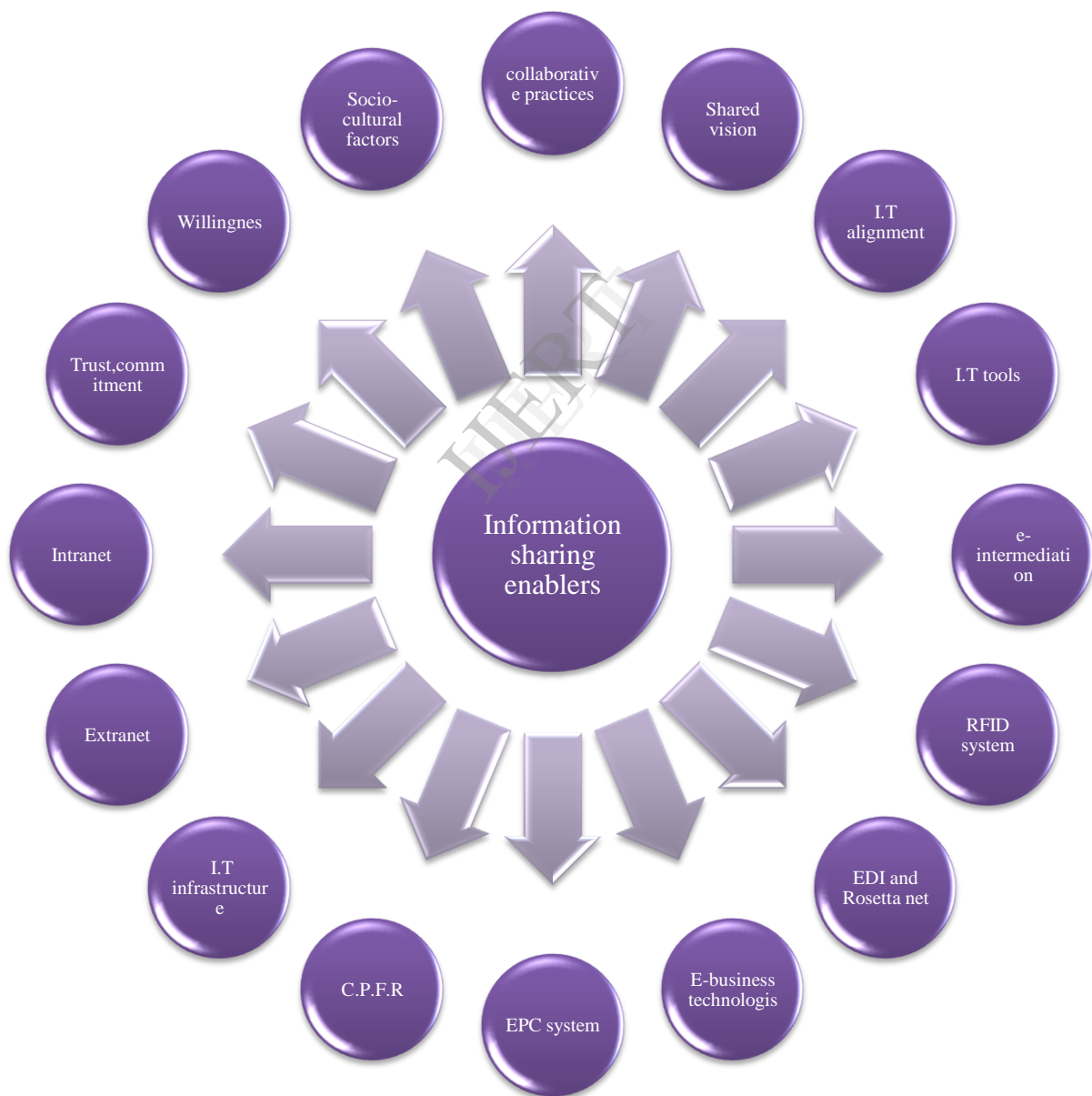


Fig.4. Information sharing enablers in supply chain

7. *SOCIO- CULTURAL FACTORS* – guanxi refers to concept of drawing on connections in order to secure favors in personal relationship. Collectivism means degree to which people prefer to act as members of groups rather than as individuals. Confucian Dynamism means degree to which an individual associate with such values as persistence ordering relationship by status, thrift and having a sense of shame.

8. *IT tools* – Electronic data interchange is defined as computer to computer exchange of structured data for automatic processing. It is utilized for sending invoices, bills of lading, confirmation of dispatch, shipping details and any information that the linked organizations choose to exchange (Rushton et al., 2000). Enterprise Resource

Planning (ERP) System is Enterprise-wide Information System used for automating all activities and functions of a business and improves internal efficiency by integrating business. Bar Codes are the representation of a number or code in a form suitable for reading by machines (Rushton et al., 2000). Bar codes are widely used throughout the supply chain to identify and track goods at all stages in the process.

9. *WILLINGNESS* - Willingness to share reflects the quality of the information shared, including its timeliness, accuracy, adequacy, completeness, and reliability. (S. Gosain et al.2000)

10. *TRUST* – Trust (Moorman et al. 1993) is the willingness to rely on an exchange partner in whom one has confidence. Or trust as a belief, a sentiment or an expectation about an exchange partner and results from the partner's expertise, reliability & intentionality. Trust is the extent to which the buyer believes that the supplier has the necessary expertise to perform the activity effectively & reliably (Ganeshan 1994).

11. *TOP MANAGEMENT SUPPORT* - top management support is characterized in terms of time and resources contributed by the top management to strategic purchasing, supplier relationship development and adoption of advanced information technology (Hahn et al., 1990; Monczka et al., 1993; Krause and Ellram, 1997; Krause, 1999).

12. *ELECTRONIC FUND TRNASFER* – EFT transfers of certain amount of money from one account to other account through internet.

13. *INTRANET* - Intranet is to use Internet technology and protocol for the internal communications. A LAN or WAN that uses internet technology and use to share internal information in organization.

14. *EXTRANET* - Extranet is to use Internet technology and protocol for the internal and suppliers' communications.

15. *IT infrastructure support* - The extensive use of infrastructural facilities like Intranet, Internet, EDI or more

advanced techniques have paved the ways of efficient and comprehensive sharing of information.

16. *COLLABORATIVE PLANNING FORECASTING AND REPLENISHMENT* - suppliers and retailers collaborate in their planning and demand forecasting to optimize flow of materials along the supply chain.

17. *E-BUSINESS technologies* - e-business technologies like internet, intranet, extranet and other web based application, have significant impact on managerial practices due to their interoperability and open-standard settings for the transfer of data among organizations (Bailey and Rabinovich, 2001; Rabinovich et al., 2003)

18. *SCM practices* - Strategic partnerships with suppliers enable organizations to work more effectively with a few important suppliers who are willing to share responsibility for the success of the products. Customer relationship comprises the entire array of practices that are employed for the purpose of managing customer complaints, building long-term relationships with customers, and improving customer satisfaction (Claycomb C et al.1999) (Tan KC et al.1998) Level of information sharing refers to the extent to which critical and proprietary information is communicated to one's supply chain partner (Monczka RM et al.1998) Quality of information sharing includes such aspects as the accuracy, timeliness, adequacy, and credibility of information exchanged (Moberg CR et al.2002) Postponement is defined as the practice of moving forward one or more operations or activities (making, sourcing and delivering) to a much later point in the supply chain (Van Hoek RI. 1998).

19. *IT implementation* – Implementation of IT in SCM can integrate and coordinate the flow of materials, information, and finances among suppliers, manufacturers, wholesalers, retailers and end consumers. (Clemons et al.,1993; Frohlich and Westbrook, 2001; Sanders and Premus, 2002; Vickery et al., 2003; Kelle and Akbulut, 2005).

20. *IS Practices* - These practices include material requirements planning (MRP) (Koh, 2004), manufacturing resource planning (MRPII) (Stevenson et al., 2005), enterprise resource planning (ERP) (Koh et al., 2006), supplier relationships management (SRM) (Choy et al., 2004), customer relation- ships management (CRM) (Tang et al., 2005) and advanced planning systems (APS) (Lockhamy III and McCormack, 2004).

21. *EPC system* – EPC system is defined as “a way of leveraging the internet to access a large amount of logistics information that can be shared among authorized partners” (EPC Global, 2004). The EPC network provides a global network model and infrastructure support for identifying, locating and managing inventory in the global multi-supply chain by RFID (EPCglobal, 2004a, 2004b; Shih, Sun, & Lin, 2005).

22. *LONG TERM RELATIONSHIP* - close relationships, supply chain partners are more willing to (1) share risk and reward and (2) maintain the relationship over a longer period of time (Landeros and Monczka et al.1993).

23. *TRUST, COMMITMENT, POWER, COLLABORATION* – Trust can be defined as a firm's expectation that their partners will perform a particular action to benefit their interests irrespective of their ability to monitor or control their partner (Mayer et al.,1995). Commitment is defined as “a partner's exchange belief that an ongoing relationship with another is so important as to warrant maximal efforts at maintaining it, that is, the committed party believes that the relationship endures indefinitely” (Morgan and Hunt,1994). Power refers to the relative dependence between exchange members, where power gained by one member can influence the decisions and behaviors of other member (Gaski, 1984). Collaboration defines all partners in the supply chain that are actively working together as one toward common objectives. Tan et al. (2002),

24. *SUPPLY CHAIN COLLABORATION* - SCC is defined as a partnership process where two or more autonomous firms work closely to plan and execute supply chain operations toward common goals and mutual benefits. SCC consists of information sharing (Manthou et al., 2004), goal congruence (Angeles and Nath, 2001), decision synchronization (Stank et al., 2001), resource sharing (Sheu et al., 2006), and incentive alignment (Simatupang and Sridharan, 2005) among independent supply chain partners.

IX. CONCLUSION

From the literature review it is concluded that the information sharing is very most important in supply chain. By sharing the correct information between supply chain partners, the performance of firm is increased because every supply chain partners get the necessary and right information in timely manner with great accuracy and quality. So, the amplification in demand or say BULLWHIP effect is greatly reduced with help of information sharing enablers. It is not possible to eliminate this effect totally but greatly reduced by sharing the true information among the supply chain partners through supply chain enablers.

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