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Abstract: Reverse supply chains represent an opportunity to create a value stream, not financial loss. Reverse supply chains deserve as much attention at the corporate level as forward supply chains and should be managed as business processes that can create value for the company. Many manufacturing firms have not yet adapted reverse supply chain but view it as the great nightmare to their organizational system. Like many other system, reverse supply chain has also its critical success factors. This research aims to identify the barriers of reverse supply chain management which invariably present in the system. Among the critical success factors, those perform below the threshold were identified as barrier using fuzzy logic technique.

1. Introduction-Reverse supply chain management

Retrieving the product from customers end this means end of the forward supply chain processes. It is just the safe and secure ways of challenges for the reverse supply chain that need implementation on a easy way so that people can easily trace the technology those who facing difficulties and and from unknown barriers, this paper is aims to works on its critical success factors barriers of RSCM and to go on a next level of Implementation on customer and corporate level to make it more barrier free environment in upcoming researches as reliable technology in this era.[1] To respond the increasing demands and decreasing life cycle of products, what companies are doing is appliying more RSCM in their firms to optimize their business effectively and increase their overall performance profitability in their firms. The streamlined task tool which optimally collecting end-of-life (EoL) products, repair them and sell them again to their customer this entire things referred as Reverse Supply Chain Management (RSCM)[12]. Reverse supply chain management is used to integrate effieciently, from various manufacturers, warehouses, retailers, and stores, so can help in merchandise and distributed in a right way, in order to minimize costs while satisfying service level requirement at both forward and reverse same chain. RSCM increases importance as a profitable and sustainable business strategy.[4] This chain describes a holistic view of reverse supply chain and presents its main attributes, success factors, barriers and other useful professional tools.A company faces problem when it has to manage the reverse supply chain efficiently. Unlike Supply chains, such important critical factors are yet not discoverd and developed for the reverse supply chain. As both supply chains have their different features and importance and cannot be treated as comprarable to each other[5]. In India, as Underdeveloped countries various things are unexplored the experience of the reverse supply chain is relatively new and there is lack of knowledgeand adaptation of this chain but in developed coutries they are started to implement this or this process is forwarded as in their limitations. Limited number of factors affecting reverse supply chain and availibility of these factors can become barriers of reverse supply chain implementation in an industry due to various rules and regulation or behavior of peoples in various countries.. Enumerated strategic factors government rules and regulations, consumer concerns, environmental issues and costs and with other operational factors such as cost-benefit analysis, logistics, warehousing, supply chain management, recycling, and packaging. Agrawal et al. [5] identified some major critical factors in the Indian industry a management awareness, resource management, economic factors, and contracts terms & conditions. These factors help the firms to take suitable action for adaptation and implementation.

Other cases of products direction in the supply chain are manufacturing returns,(B2B and B2C), product recalls, warranty returns, repair returns, returns and end-of-life products are reversed from the original supply chain. Reverse supply chains are categorised, and they lie in the different stages of the product life

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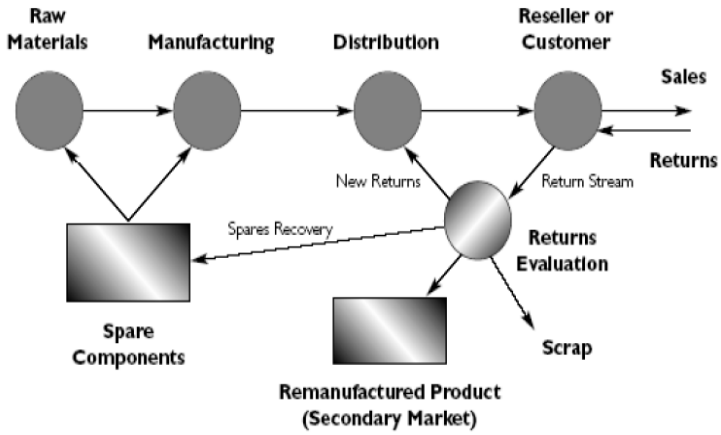

Reverse supply chain management

cycle; however, most chains are organized to carry out five key processes: (cognizant 20-20 insights | January 2011)

Product acquisition: Acquisition of products

- Product acquisition: Acquisition of products
- Reverse logistics: Processing logistics from company and customer.
- Inspection & disposition: Assessing the condition of the return and making the most profitable decision for reuse.
- Reconditioning: Recast into their original specifications
- Distribution & sales: Creating secondary markets for the recovered products

Once the products are analysed into different categories, they are disposed into other reuseable forms like reuse, or repairing, or remanufacturing, or recycling depending on factors [3]. Treatment should be industries or product specific and depends upon the number of factors including price/value / shelf life of the product, transportation cost, and the demand outlook. The consumer expects replacement of product as soon as possible while the manufacturer wants to recapturing the maximum value from it.[5].

Typical examples of reverse supply chain include: Printing industry,Computer industry,Automobiles,Electronic industry. The problem arrives when a company has to minimize its cost efficiently. Unlike forward supply chains, critical factors for the reverse supply chain are undeveloped and unexplored. Both have different characteristics and cannot be treated by the same methodology. Furthermore, there are many factors and problems in the implementation in the reverse supply. , reverse logistics plays a very important role in company's competitive advantage and help strategic decision making[12]

In this we see various barriers in reverse supply chain management and used to identified its critical factors and work on it to enhance the efficiency of any organisation reverse supply chain activities by reknowned fuzzy technology and use to rank critical factors in upcoming topics by clearly defined the topics.

2. Reverse logistics

Reverse Logistics is the kind of activity which led after an offer for an item to recover worth and end lifecycle of the item. It is a new pattern of enterprise strategy management and supply chain management. RL pursue a coordinated optimization of economic and social efficiency of the product. It is not only the foundation of a circular economy but also had become the synergism with the development of a sound domain. It is the way toward moving merchandise from their place of utilization to the point of root to catch esteem or legitimate removal. Turn around coordination is once in a while called secondary selling flexibly chain, reseller's exchange coordination or logistics. The natural and asset results of an item are surveyed and assessed through Life Cycle Analysis (LCA) through all the stages (removing and handling the crude material, creation, dispersion, use, remanufacturing, reusing and last removal) of its life. Ventures may utilize LCA to help item improvement with the goal that the general ecological effect of the item can be limited. The procedure includes moving returned merchandise to the area of recuperation or removal legitimately or thought testing, assessment and arranging offices (Guide and van Wassen hove, 2002; Krikke et al., 2004). The primary converse coordination activities are transportation, warehousing and stock administration.

In Reverse logistics the processes which have to undergo for the product consists:

* Remaking - revamping the item to reuse, fix or to make new parts
*Recondition - The general classification which incorporates client support, the administration and the return of the product
* Return management
* Management for waste and Recycling
* Management for Warranty
* Management for Warehouse

As indicated by Tibben Lembke and Rodgers (2002), turn around coordination is a basic issue for some organizations and records for four to 10% of all out coordination cost. Hence, the advancement of converse coordination framework and the viable administration of opposite coordination exercises give a likelihood to decrease cost, increment incomes, and create extra benefit (Poist, 2000) As indicated by Blackburn et al. (2004) because of various qualities of profits and various prerequisites for various sorts of profits (lead-time, costs), invert gracefully the chain normally comprises of a few converse coordination streams with various properties. Wu and Cheng (2006) expressed that there is an essential distinction in the objectives and necessities among forward and switch coordination. As indicated by Fleischmann et al. (1997) when contrasted with the forward coordination' streams the retrogressive streams typically experience the various streams. Moreover, various kinds and attributes of profits confuse operational parts of converse coordination (Guide et al., 2003).Then again, financial reasons have additionally had their commitment to this expanding significance of Reverse Logistics issues. Using returned items, organizations stand the chance of recuperating either constituent material [7]. For instance, produced products could go from customer to merchant or producer. These products, materials, and gear could be remanufactured, reused, recuperated, or reused. A great many PCs on the planet got obsolete. There are chances to reuse these PCs and make new qualities. E-squander contains PCs, TV sets, sound gear, batteries, and so on. E-squander contains aluminum, copper, plastics, glass, and so on. Inside the car business, waste could incorporate motors, alternators, starters, transmissions, and so on. Turn around coordination is as of now one of the most significant issues identified with PC makers, printers, car industry parts, shopper hardware, family unit synthetic compounds. There are different reasons why return streams exist. They could be identified with client support, ecological or monetary. Enormous world organizations effectively fit for taking care of converse coordination issues incorporate DHL, UPS, FedEx, and so on. Turn around coordination is getting significant in the cutting edge world, because of the expanding regard for the insurance of the earth. Clients and customers are facing difficulties in their logistics handling having barriers in their implementation and solving this issue using various tools [9].

For any organization, key factors have a drawn out main concern sway. These factors must be overseen adequately, effectively and proactively — not strategically or responsively — for the feasibility of the organization. As of not long ago, most organizations focused uniquely on business capacities, for example, account or advertising as the vital factors. Coordination abilities were taken a gander at as key factors during the late 1970s and 1980s. Numerous organizations consider invert coordination as holding a significant key job, however this capacity still can't seem to pick up the status of a vital variable. The significance of opposite coordination is expanding for a few reasons expressed beneath:

a) Companies are seeing substantial advantages from a worth that can be recovered from ineffective resources coming about because of returned stock, for example, noteworthy decreases in inventories, improvement in income, diminished work and improved consumer loyalty.
b) Competitive weight has expanded to give a successful, effective returned products process. The expansion in inventory and e-business shopping has brought about the advancement of merchandise exchanges to pick up client trust and diminish chance.
c) The pressure of the item life cycle and an expanded accentuation on presenting new items have made a need to clear the appropriation channel all the more as often as possible, requiring the productive methods which brings back old things.
d) Increased administrative necessities identified with reusing and air of items—particularly for the items which are risky for the earth—have expanded the requirement for exactness record-keeping and following [3]. The case of Reverse coordination is Automotive Industry-The car business is perhaps the biggest business on the planet and manages the most costly of buyer products. In this way, it isn't astounding that opposite coordination is a significant subject for this industry. Reverse coordination assumes a critical job in three essential regions:
e) Recovering of goods and materials from the finish of life vehicles.
f) Stock adjusting returns of the new parts from sellers. The huge three automakers in the U.S. have combined to frame the Vehicle Recycling Development Centre to expand the conscious 20-20 bits of knowledge 3 aware 20-20 bits of knowledge 4 recyclability of vehicles. At VRDC, the emphasis is on figuring out how to assemble vehicles that can be dismantled all the more without any problem. The middle is researching one of the freshest patterns in building which is Design for Disassembly (DFD). From this step the dismantling of the product become simpler by just reducing the number of parts, fittings. In contrast to other ecological activities for assembling, DFD offers the chance of numerous unintended constructive outcomes, for example, remanufacturing. The car business might be the business with the longest history of utilizing old items. As per the Auto Parts Remanufacturers Association, the market for automobile parts that are remanufactured is evaluated at around $34 billion for every year. Additionally gauges that there are 12,000 remanufacturing firms which are engaged with the vehicle parts industry. A specific organization remanufactures in excess of 4,000,000 alternators, starters, and water siphons every year. Between, 90% to 95% of the considerable number of starters and alternators which are sold for substitution are remanufactured. Automakers need to keep up a shut circle framework by their parts. In the event that a vehicle needs another transmission, it is trusted that the shopper will carry the vehicle to the vendor that will supplant the old transmission with a remanufactured one. The seller will send old transmission to the automaker for remanufacturing. Along these lines, the

automaker will keep up a steady gracefully of transmission centers. The equivalent SCM and internet business advances engaged with moving items to buyers (known as forward coordination) are utilized backward coordination, including standardized identifications and scanners used to follow returns, materials taking care of frameworks in distribution centers and the exchange of electronic data records between gracefully chain suppliers. SCM and ERP programming merchants were at first delayed to help switch coordination, as indicated by certain specialists, however most dealers currently incorporate some opposite coordination includes in their suites.

3. Importance of Revesres supply chain management

The importance of reverse supply chain is increased in past few years by the peoples:

- Facing high return in some industries having more than 50%.
- increased sales opportunity
- End-of-life take-back regulations have flourished over the past decade demanding businesses to effectively bring about the entire life of the product.
- Consumers and government successfully pressured businesses to do something or take responsibility for disposals of their EOL products that are harmful to earth and living also.
- Landfill limited capacity and highly luxurious. Some items like, remanufacturing and recycling has become more predominant and feasible.

Fig.2: Reverse Supply Chain

- Return on Investment
- Increase in Public Perception
- Reuse Encourages Competition in Manufacturing

3. Literature review

3.1. Reverse supply chain management

The reverse supply chain is the forwarding goods from the end customer to the manufacturer again. Reverse logistics refers planning, implementing and controlling the efficient and effective flow of secondary goods and information.

Instances of the converse gracefully chain include:

- Remanufacturing and renovating
- Item return and the board of testimony
- The arrival flexibly chain is having five key procedures as:
- Item securing: This is the way toward acquiring the pre-owned item from the client by the producer.
- Invert coordination: This is the shipping items to an office for reviewing, arranging and mien.
- Investigation and mien: This incorporate the way toward surveying the returned item and settling on the choice for reuse.
- Remanufacturing/Repairing: It is the way toward making the returned item to its unique determination and capacities.
- Advertising: Making the market for recouped and remanufactured items.

Figure 3, shows invert flexibly chain for business item returns. The client restores the pre-owned item to affiliate (item obtaining), from where the items are dispatched to assessment focuses (turn around coordination's) and afterward assessment needs to happen (examination and attitude). Evaluator's tests are to be performed to decide the choices of brought items back.

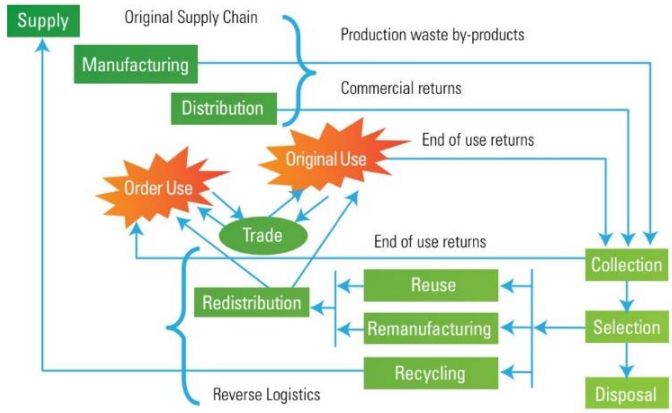

Fig.3: Reverse supply chain management

3.2 Centralized Efficient Reverse Supply Chain

A proficient converse flexibly chain centres around the handling of the arrival of items at a general lower cost. This flexibly chain model penances speed over cost proficiency and is commonly material to items that have shorter time/esteem devaluation. The retailer or affiliate doesn't partake in any item assessment at their end. The transportation cost minimization is furnished by the profits related to the delivery of the product in mass.

When the state of the item is resolved at the testing office, it is suitably discarded (i.e., sent for restocking, revamping, rescuing or rejecting). This model is utilized to accomplish economies of scale at each level, consequently empowering minimization of handling costs. It is likewise simpler on the retailer, which doesn't need to sort returns or boat them to different areas, just as the outsider credit guarantor, who needs to give the credit at once for various item returns.

3.3 Decentralized Reverse Supply Chain with Preponement

In the past model, it was seen that item separation is deferred until all profits are transported to the focal office. This can be thought of as a deferment system. On the other hand, for the items like PCs where the benefit esteem misfortune after some time is high, we can prepone the testing and assessment of the returned item utilizing a decentralized model with the goal that the unused items can be restocked right away. This testing can be performed at the purpose of return by the affiliate or the retailer, however it would should be in fact achievable, and it may require mastery advancement among affiliates. Besides, motivator would be given to affiliate through shared reserve funds contracts with the makers, or merchants could set up a seller oversaw stock procedure with enormous retailers and keep up their own specialists to test the brought items back.

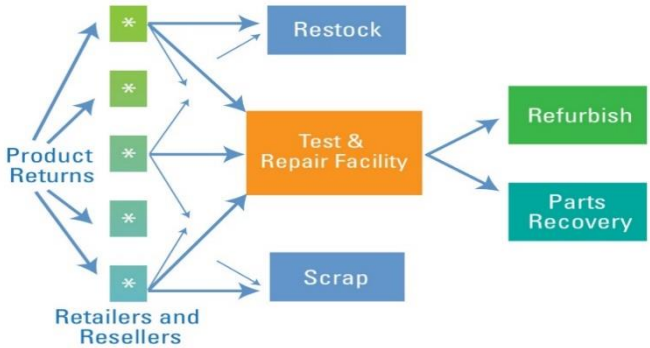

Fig.4: Reverse Supply Chain with Preponement

The alternatives are identified here is to improve these all alternatives to improve in industrial applications and further research Environment-friendly, reliable and Consistent product acquisition, inventory reduction, product analysis, reverse distribution, cost minimization, and criteria are analysis from various peer research

papers to obtain barriers in implementing successfully reverse supply chain management and identifying all critical factors in reverse supply chain which impact more and give them ranking based on fuzzy logic, here survey is analyzed, to appropriate use of coordination mechanism which expected to increase efficiency and effectiveness in the operation, the actors and coordination members, therefore the selection of criteria impact the performance of reverse supply chain management. Because of the multi-dimensional criteria, the selection of appropriate RSCM in a given situation remains a difficult task for managers. This paper is an endeavor to investigate different issues of opposite flexibly chain coordination and utilizations an incorporated methodology of Fluffy AHP and Fluffy TOPSIS to organize coordination components and afterward organize exchanging accomplices which depend on coordination instruments. [61]

To oversee unclearness and vulnerability in dynamic, Zadeh (1965) proposed a Fluffy set hypothesis. When displaying is finished utilizing Fluffy sets it has end up being an effective path for definition of choice issues, where the data accessible is emotional and loose (Zimmermann, 1992). The Fluffy numbers represent specific go for specific esteem. Because of this specific run, it is simpler for the evaluator to demonstrate his/her inclination. The inclination of the master is in numerous down to earth cases is unsure, which makes it difficult to make a numerical examination (Torfi, Farahani, and Rezapour, 2010). So, a solitary etymological rating will be converted into a Fluffy number comprising of various numbers. Along these lines, the phonetic rating is reflected as a range. Both triangular and trapezoidal fluffy numbers can be utilized for the Fluffy hypothesis however we are restricted here to triangular fluffy numbers. Balli and Korukoglu (2009) keep up that it is frequently helpful to utilize triangular Fluffy numbers (TFNs) as a result of the simplicity of computation.[61]

$$\mu_A(x) = \begin{cases} 0 & x < l; \\ \frac{x-l}{m-l} & l \le x \le m; \\ \frac{m-x}{u-m} & m \le x \le u; \\ 0 & x > u. \end{cases}$$

Deng (1999) discusses this mathematical representation of a TFN M that is depicted by Balli and Korukoglu (2009) as shown in Figure 1. Next sections present an overview of both techniques including important steps and previous applications of these in the research work

3.4 Identifying goals and barriers of Reverse supply chain

After reviewing paper of peers, we have identified barriers in reverse supply chain which can cause certain issues while implementing this in the system we also have identified our alternatives as:

i. Environment-friendly
ii. Reliable and consistent product acquisition
iii. Inventory reduction
iv. Product analysis
v. Reverse distribution
vi. Cost minimization

These have been identified as the goals in reverse supply chain, so we need to find the priority order in this to see the most prominent way to find the critical factors in RSC. These are the major objectives that enhance the performance of RSC in implementing in any industry. The description of these factors is written as-

3.4.1 Environment-friendly

It has the topmost order from the objectives in today's scenario as we need to focus on our environment because it comes first in every aspect of technology. Reverse supply chain is the part of Supply chain which deals with the product return. Waste management, recycle and reuse, etc. related to the environment. This is the reason why researchers are preferring this potential area to observe how the reverse supply chain is can be used to enhance and protect the environment.

3.4.2 Reliable and consistent product acquisition

Product acquisition is exceptionally important in as the behaviour of the consumer and is very sensitive, how the product is recovering in stages whether it comes as repair or unused stage. In this paper, we want to shed light on the process consumers go through when making acquisitions by exploring the company acquisition process.

3.4.3 Inventory reduction

Stock spares our business conveying costs, stockpiling expenses, and transportation costs between stockroom offices. Stock decrease takes out of date stock, which if not sold/recoup under critical conditions, will go to finish waste and income down the channel.

3.4.4 Product analysis

The analysis is a very important factor in RSC. After all, it creates a benefit in the organization because it defines which product is going for disposal, reuse, recycles, secondary market because it recovers some revenue for this process and makes benefit to the company.

3.4.5 Reverse distribution

Conveyance has effect the general public it restores the item in the hands of a client or optional market it additionally the RSC and make a tremendous factor in recognizing the hindrances of RSC, it for the most part makes the procedure quicker and trustable according to clients.

3.4.6 Cost minimization

Minimization of cost is a strategy that is to achieve the most cost-effective path for delivering the goods and services to appropriate quality. It is an important aspect to consider that cost minimization is not about the degradation of quality; rather it is about to meet customers' needs to make a profit in the process. So, these some objectives/alternatives in RSC to which the attributes are taken.

The identification of these barriers is taken from various peer's review literature and other sources and from experts who are studying the reverse supply chain most prominently from the top organization of India.

3.5 Barriers

3.5.1 Environment driven legislation

Legislation refers to regulations or acts passed by the government authorities to minimize the effect of the end of life products on the environment. Cause in every state we are offering different rules and regulation of product, focusing on environmental concerns is partly enforced by government legislation (Prendergast and Pitt 1996). The government of India has established e-waste Rules (Management and Handling), which have come into effect from the year 2012. Experts mentioned that sooner or later Indian manufacturers will have to comply with these waste management regulations.

3.5.2 Provide facilities for assembling/disassembling

We don't know the nature of products so the company must have these types it becomes a barrier as it increases the cost of this process, so the company looks for an alternative solution for this process.

3.5.3 Revenue management

Revenue management is the application of disciplined analytics that predict product at the micro-market levels and optimize product price recovery to maximize revenue growth. The main goal of revenue management is selling the right product to the right customer at the right time with the right packaging. In this field of work, the company has to get the right perception of the customer about the product and deciding the value price accordingly and make sure about the appropriate availability of the product.

3.5.4 Customer awareness and responsibility

For the return of EOL products the process in the customer is very important cause most of the customers are don't want to return the product and after so long they make the products orphan.in that case, the company not recognized its analytics process of recovery, so, customer awareness is a very critical factor in this procedure.

3.5.5 Waste Management

Waste management involves taking difficult decisions at strategic and operating levels.. Disposal may include transportation, landfilling, and incineration steps. Disposal is required for products

that cannot be reused for technical or economic reasons or they are completely consumed.

3.5.6 Forecasting return

In the wake of investigating obtainment choices, scope organization, and removal the executives. At an each operational level, nitty gritty forecasts of the amounts to be returned in every period, just as the changeability of these amounts, is valuable, particularly for stock administration and creation arranging.

3.5.7 Location routing

It incorporates the issue of coordinating the area choices of dispersion focuses (DCs), the approaches of opened appropriation places, and the vehicle directing choice in serving clients, in which new merchandise are to be produced and harmed products are to be fixed by the assembling unit and afterward must be shipped to open dissemination habitats (DC).Vehicles that start from and end in the same DC distribute recovered goods to satisfy the demands of customers and retrieve damaged goods. The ultimate goal is to make the total cost of manufacturing and remanufacturing the goods to a minuscule level, establishing new DCs, recovery of the goods between manufacturer and DCs and appropriate distribution.

3.5.8 Network structure of EOL

The stressed stock control of returned streams and converse appropriation, yet in addition featured the absence of a general structure and numerical model to help the opposite coordinations condition. Guide et al. (2000) checked on the writing on stock frameworks with returns and Guide (2000) recognized and portrayed seven confounding qualities of creation arranging and control exercises for remanufacturing firms..

3.5.9 Integration of reverse logistics activities in reverse supply chain

To minimize the cost they proper need of integration of RL into RSC but due to this the problem is facing companies to double spending barriers.

3.5.10 Coordination of information

Proper coordination is required for the successful recovery of EOL products.

3.5.11 Inventory management

The objective of inventory management is to control external component orders and the internal component recovery process to guarantee a required service level and to minimize fixed and variable costs.

3.5.12 Coordination between company and customer

For successful implementation of RSC proper coordination between C2C is needed to overcome barriers.

4. Research Methodology

4.1 Analytics hierarchy process (AHP)

AHP is a multi-rules dynamic technique which is valuable to structure the choice issues dependent on pairwise examinations in the wake of getting phonetic based information from master's decisions in fuzzyfied structure. The AHP found by Saaty in 1980 out of one of the most well-known multi-models dynamic strategies. In association numerous issues couldn't be comprehended on account of fragmented or no accessibility of data. This strategy consolidates the pairwise examination lattice of chiefs' choices and makes a Fuzzy set to deal with the vulnerability. This Fuzzy AHP utilizes the pair-wise examination framework with the assortment of (n-1)/2 correlations. As the quantity of quality and choice inquiry builds, the pair-wise correlation questions and the multifaceted nature of the grid increment and plausibility of respondents answering with incorrect data, which makes irregularities in the outcomes despite the fact that the consistency proportion may not be under 0.1 textures must be check before heading off to the arrangement.

An appropriate connection can be utilized to conquer this issue and for the adequacy in choices and a pragmatic dynamic procedure can be made.

The inclination relations in the AHP improve the consistency of Fuzzy AHP. With the assistance of CFPR, the lessening the quantity of pairwise correlations from n(n-1) to (n-1) examinations figured through the Fuzzy information. This makes procedure increasingly proficient, and leaders require less exertion to consideration more on making the pair-wise correlations of properties. Subsequent to deciding consistency we move to organize the components under same procedure follows in TOPSIS which used to rank the elective significance from the Euclidean separation at this stage it organize the variables and give an appropriate motivation to the business to actualize.

4.2 Fuzzy TOPSIS technique

TOPSIS stands for The Technique for Order Preference by Similarity to Ideal Solution was proposed first by Hwang and Yoon (1981) and Fuzzy TOPSIS strategy by Chen and Hwang (1992). The essential thought for Fuzzy TOPSIS is to pick the other option, as indicated by the closeness level of FPIS and FNIS beyond what many would consider possible. The positive perfect arrangement is an augmented arrangement.

Advantage elective and limited cost rules. In FNIS the cost standards are boosted and advantage models are limited. As indicated by Chan and Kumar (2007), there are some genuine circumstances where human inclination is questionable and leaders may be hesitant or incapable to allot fresh qualities to their decisions. The Fuzzy TOPSIS is capable in managing multi-measures dynamic by appropriate semantic qualities into Fuzzy numbers and in this way permitting leader to consolidate fragmented or inaccessible data into the choice model. Fuzzy TOPSIS to rank the elective request to the client's inclination. In true information are not all that deterministic, it is loose or Fuzzy in nature. Along these lines, an all-encompassing TOPSIS for Fuzzy information as proposed by Chen (2000) and Chen et al. (2006) is talked about underneath.

The calculation of the Fuzzy TOPSIS technique can be portrayed as follows:

Stage 1: Form a group of master to assess the other options.

Stage 2: Identify the assessment models.

Stage 3: Choose the fitting semantic factors for assessing options regarding recognized rules.

Stage 4: Determine the collected load of choices as for every standard. The Fuzzy rating are portrayed as TFNs:

Where,

Rk = (ak, bk, ck) k =1; 2; 3… . K, Fuzzy rating decided as R = (a, b, c), k = 1, 2, 3,... K. Here,

$$a = \min_k(a_k), b = \frac{1}{K}\sum_{k=1}^{K} b_k, c = \max_k(c_k).$$

Stage 5: make the Fuzzy choice framework

Stage 6: Normalized the Fuzzy choice framework. For standardization, the straight scale trans-development can be utilized to change the different rules scales into an equivalent scale. We can get standardized Fuzzy choice network R~ (Chen, 2000).

$$\tilde{R} = [r_{ij}]_{m\times n} \quad i = 1, 2, 3, \ldots, m; \quad j = 1, 2, 3, \ldots, n$$

$$\text{where } \tilde{r}_{ij} = \left(\frac{a_{ij}^*}{c_j}, \frac{b_{ij}^*}{c_j}, \frac{c_{ij}}{c_j^*}\right) \quad \text{and } C_j^* = \max_i C_{ij}.$$

Stage 7: Construct the weighted Fuzzy matrix which is standardized.

$$V = [\tilde{v}_{ij}]_{m\times n} \quad i = 1, 2, \ldots, m \quad \text{and } j = 1, 2, \ldots, n$$

$\tilde{v}_{ij} = \tilde{r}_{ij}W$, where W is the weighted vector of evaluating criteria.

Stage 8: Determine positive ideal and negative ideal solution

$$\text{FPIS(P*)} = (\tilde{V}_1^*, \tilde{V}_2^*, \tilde{V}_3^*, \ldots, \tilde{V}_n^*) \quad \text{and FNIS}(P^-) = (\tilde{V}_1^-, \tilde{V}_2^-, \tilde{V}_3^-, \ldots, \tilde{V}_n^-)$$
$$\text{where } \tilde{V}_j^* = \max_i\{v_{ijk}\} \text{ and } \tilde{V}_j^- = \min_i\{v_{ijk}\}; i = 1, 2, \ldots m; j = 1, 2, \ldots, n.$$

Stage 9: Find the distance between positive and negative ideal solution

$$d_i^* = \sum_{j=1}^{n} d_v(\tilde{v}_{ij} v_j^*); \quad i = 1, 2, 3, \ldots, m \quad \text{and } d_i^- = \sum_{j=1}^{n} d_v(\tilde{v}_{ij} \cdot v_j^-); \quad i = 1, 2, 3, \ldots, m$$

i= 1,2,3…. where, (dv) = distance of both

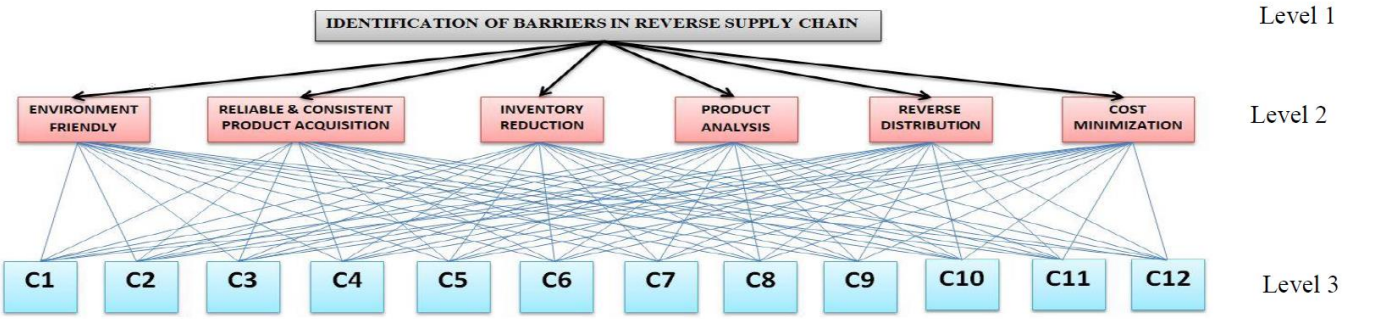

Fig.5: Barriers in Reverse Supply Chain

4.3 Fuzzy numbers

Step 10: Calculating the closeness coefficient for each alternative Closeness Coefficient (CCi) is defined as rank alternatives. The closeness coefficient represents the distance to the FPIS (P*) and Fuzzy negative ideal solution (P−). By using this formula we measure closeness coefficient for each alternative:

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*}, \quad i = 1, 2, 3, \ldots, m.$$

Step 11: Ranking according to the closeness coefficient, the ranking of the alternatives can be determined. According to equation, would be closer to FPIS and farther from FNIS as CCi approaches to one.

4.4 The Proposed model

The structure of the model is shown in Fig.1 taken from our traits and afterward choices, at first arranged for the dynamic procedure by means of AHP. Be that as it may, before the database is gathered from peer looked into writing papers, specialists' decisions and the indexes of various producers. Some gathering are taken for getting a few thoughts regarding venture from specialists for the other options and properties.

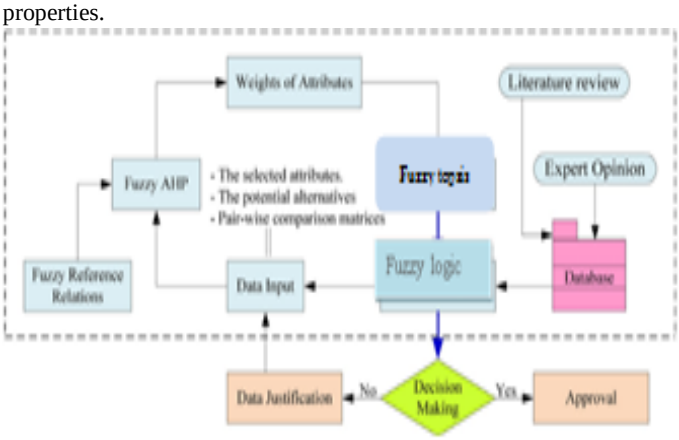

Fig 6: Scheme of the proposed model.

The understanding further information inputs we utilized the fluffy AHP with the inclination relations. The rules loads of characteristics are determined by the improved fluffy AHP with the pair-wise examination lattice dependent on the specialists' decisions and fluffy inclination relations. The consequences of the improved fluffy AHP are the inputs of the fuzzy topsis for determining the ranking of alternatives. After analyzing the data results, rank the variables. In the event that the outcome is agreeing from AHP or on the off chance that not, at that point information support ought to be completed for contributions to improved fluffy AHP and after conclusive outcomes might be reported.

The qualities in the choice help model are extricated from the writing, inventories and from converses with specialists in assembling. It contains three top-down levels: At the first level (level 1), the reverse supply chain goal is determined for critical factors: the middle level (level 2) consists of attributes for the decision- making process, level 3 alternatives such as The RSCM alternatives are as (A1, A2, A3, A4, A5, A6) are listed in the bottom level (level 3) for the ranking process.

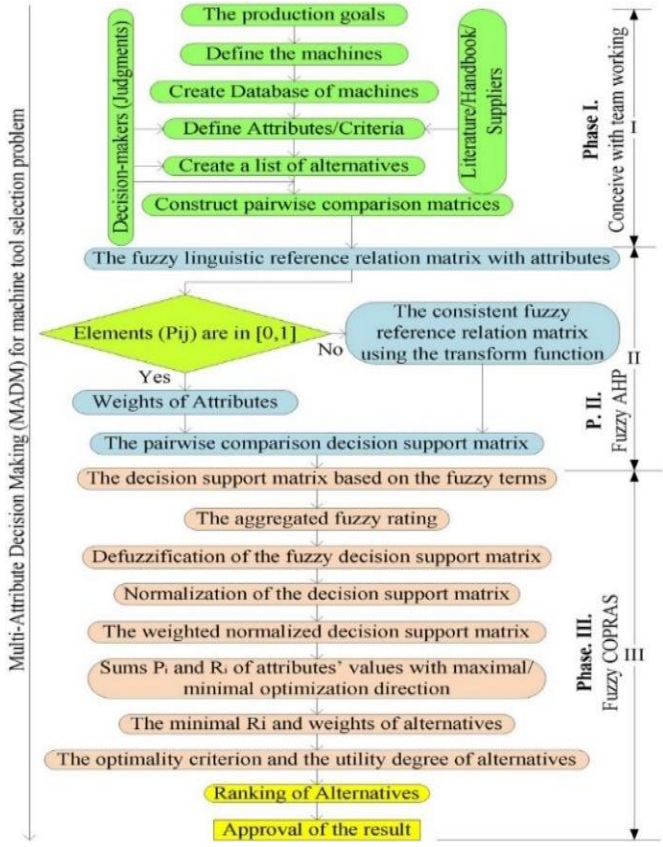

Fig 7: Activities series

4.5 Priority weight for decision criteria

After findings of all barriers in the literature we all need to do prioritize all factors on basis of alternatives or attributes of using Fuzzy AHP is to determine important weight of the criteria that will later in Fuzzy TOPSIS method. As per the process we do pairwise comparison by matrix that matches linguistic statement of data is formed by our decision makers to fill it. A group matrix will be obtained by calculating average of Fuzzy numbers for all samples. Following steps explain the method of determining priority weights for decision criteria: which are described [14]

Step 1: A panel of three decision makers from the organization is selected as per their experience in the area of reverse supply chain management and role in the organization.

Step2: Environmental-driven legislation, provide-facilities-disassembling, revenue-management, customer-awareness and responsibility, waste management ,forecasting return ,location routing, network structure of eol, integration of rl activities into rsc, coordination of information system, inventory management, Coordination between customer and company been identified as barriers in the reverse supply chain coordination mechanisms. These are shown in Figure.

Step 3: The DMs were asked to give the relative weight to each criterion according to the linguistic variable as per Table, (Tolga, Demircan, and Kahraman, 2005). After the criteria have been determined as given in Figure, a questionnaire has been prepared to determine the importance levels of these criteria. To evaluate the questions, experts only select the related linguistic variable. Further, for calculations they are converted into the corresponding TFNs.

Step 4: Fuzzy important weight of the criteria is calculated by taking average mean of the responses of the experts, this is shown in Table.

Step 5: Crisp relative important weight for identified criteria is calculated using the extent analysis method proposed by Chang (1996) as explained previously in this paper by equations number. The Fuzzy values of paired comparison are converted to crisp value via the Chang's extent analysis (1996) given by table 4 to table 9.

Table 1: Level 3, detail for barriers

C1	Environmental-Driven Legislation
C2	Provide Facilities Dissassembling
C3	Revenue Management
C4	Customer Awareness And Responsibiity
C5	Waste Management
C6	Forecasting Return
C7	Location Routing
C8	Network Structure Of Eol
C9	Integration Of Rl Activities Into Rsc
C10	Coordination Of Information System
C11	Inventory Management
C12	Coordination Between Cunsumer &Company

Table 2: Linguistic variables and triangular fuzzy numbers

Equal Importance (EI)	(0,0,0.1)
Moderate Importanance (MI)	(0,0.1,0.3)
Strong Importance (SI)	(0.1,0.3,0.5)
Very Strong Importance (VI)	(0.3,0.5,0.7)
Extreme Importance (EXI)	(0.5,0.7,0.9)
Intermediate Values B/W Two Adjacent Judgement (JU)	(0.7,0.9,1)
Must (MU)	(0.9,1,1)

CR (consistency ratio) 0.034673435 < 0.10

As need to check the consistency should be less than 0.1

As per above situation we are going in the direction and after this is weight of all creteria

So all creteria weights are defined as priotrise the alternatives so in next stage we need to find the critcal factors as per the alternatives by fuzzy topsis method and after this we see the rank of all alternatives.

Table 3: Criteria alternatives

CRETERIA	CW
C1	0.43760398
C2	0.14752839
C3	0.81446377
C4	0.63310862
C5	0.88238631
C6	0.57329769
C7	0.96984507
C8	0.65857717
C9	0.18533562
C10	0.70959777
C11	0.65223759
C12	0.33601801

Table 4: Decision maker's vs. rating for attributes

DECISION MAKERS	RATING FOR ATTRIBUTES											
DM	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
DM1	MU	VI	VI	MU	SI	MI	VI	MU	JU	EXI	SI	SI
DM2	JU	EXI	SI	MU	EXI	SI	EXI	JU	JU	MI	SI	MI
DM3	JU	VI	MI	MU	JU	SI	MI	MU	EXI	SI	EXI	MI
DM1	(0.9,1,1)	(0.3,0.5,0.7)	(0.3,0.5,0.7	(0.9,1,1)	(0.1,0.3,0.5)	(0,0.1,0.3)	(0.3,0.5,0.7)	(0.9,1,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)
DM2	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.1,0.3,0.5	(0.9,1,1)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(0,0.1,0.3)	(0.1,0.3,0.5)	(0,0.1,0.3)
DM3	(0.7,0.9,1)	(0.3,0.5,0.7)	(0,0.1,0.3)	(0.9,1,1)	(0.7,0.9,1)	(0.1,0.3,0.5)	(0,0.1,0.3)	(0.9,1,1)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0,0.1,0.3)
AVERAGE=	(0.7,0.9,1)	(0.4,0.6,0.7)	(0.1,0.3,0.5	(0.9,1,1)	(0.5,0.6,0.8)	(0.1,0.2,0.4	(0.3,0.4,	(0.8,0.9,1)	(0.6,0.8,0.9))	(0.2,0.4,0.6))	(0.2,0.4,0.6)	(0,0.2,0.4)

Table 5: linguistic triangular fuzzy numbers

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1,1,1	(1.75,1.5,1	(7,3,1.4)	0.7,0.9,1	1.4,1.5,1.25	7,4.5,2.5	2.3,2.2,2.3	0.8,1,1	1.1,1.1,1.1	3.5,2.2,1.6	3.5,2.2,1.6	0,4.5,2.5
C2	0.5,0.6,0.7	1,1,1	4,2,1.4	0.9,0.6,0.7	0.8,1,1.75	4,3,1.75	1.3,1.5,2.3	0.5,0.6,0.7	0.6,0.7,0.7	2,1.5,1.1	2,1.5,1.6	0,3,1.75
C3	0.1,0.3,0.5	0.2,0.5,0.7	1,1,1	0.1,0.3,0.5	0.2,.5,.6.25	1,1.5,1.2	0.3,0.7,1.6	0.1,0.3,0.5	0.1,0.3,0.5	0.5,0.75,0.8	0.5,0.75,0.8	0,1.5,1.25
C4	1.2,1.1,1	2.2,1.6,1.4	9,3.3,2	1,1,1	1.8,1.6,1.25	9,5,2.5	3,2.5,3.3	1.1,1.1,1	1.5,1.25,1.1	4.5,2.5,1.6	2.5,1.6	0,5,2.5
C5	0.7,0.6,0.8	0.7,1,1.1	5,2,1.6	0.5,0.6,0.8	1,1,1	5,3,2	1.6,1.5,2.6	0.6,0.6,0.8	0.8,0.75,0.8	2.5,1.5,1.3	2.5,1.5,1.3	0,3,2
C6	0.1,0.2,0.4	0.25,0.3,0.	1,0.6,0.8	0.1,0.2,0.4	0.2,0.3,0.5	1,1,1	3.3,0.5,1.3	0.1,0.25,0.4	0.6,0.2,0.4	0.5,0.5,0.6	0.5,0.5,0.6	0,1,1
C7	0.4,0.4,0.3	0.7,0.6,0.4	0.3,1.3,0.6	0.3,0.4,0.3	0.6,0.6,0.3	3,2,0.7	1,1,1	0.3,0.4,0.3	2,0.5,0.3	1.5,1,2	1.5,1,2	0,2,0.7
C8	1.1,1,1	2,1.5,1.4	8,3,2	0.8,0.9,1	1.6,1.5,1.25	8,4.5,2.5	2.6,1.8,0.3	1,1,1	1.3,1.1,1.1	4,2.25,1.6	4,2.2,1.6	0,4.5,2.5
C9	0.8,0.8,0.9	1.5,1.3,1.2	6,2.6,1.8	0.6,1.3,0.9	1.2,1.3,1.1	6,4,2	2,2,3	0.75,0.8,3	1,1,1	3,2,1.6	3,2,1.5	0,4,2
C10	0.2,0.4,0.6	0.5,0.6,0.8	2,1.3,1.2	0.2,0.4,0.6	0.4,0.6,0.7	2,2,1.5	0.6,1,2	0.2,0.4,0.6	0.3,0.5,0.6	1,1,1	1,1,1.5	0,2,1.5
C11	0.2,0.5,0.6	0.5,0.6,0.8	2,1.3,1.2	0.2,0.4,0.6	0.4,0.6,0.7	0.2,1,1.5	0.4,1,2	0.2,0.5,0.6	0.6,0.5,0.6	1,1,1	1,1,1	0,2,1.5
C12	0,0.6,0.4	0,0.2,0.5	0,0.2,0.8	0,0.2,0.4	0,0.3,0.5	0,1,1	0,0.5,0.8	0,0.2,0.4	0,0.5,0.5	0,0.5,0.6	0,0.5,0.6	1,1,1

Table 6: linguistic rating by decision makers and solved fuzzy matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1	1.2	4	0.6	1.6	4.2	3.2	0.9	1.1	2.1	0.6	0.9
C2	0.6	1	2.3	0.7	1.1	2.75	1.5	0.6	0.6	1.5	1.2	2.7
C3	0.3	0.4	1	0.3	2	3.3	0.8	0.3	0.3	0.7	1.7	1.6
C4	1.1	1.6	5	1	1.6	5.2	2.6	1.1	1.2	2.6	0.5	0.6
C5	0.7	0.9	2.8	0.6	1	1	1.1	0.6	0.8	0.5	1.2	0.3
C6	0.2	0.5	0.8	0.2	0.3	1	1	0.2	0.4	1.5	1.5	0.9
C7	0.3	0.5	0.7	0.3	0.5	5.6	1	0.3	0.3	2.2	2.8	2.3
C8	1	1.6	4	0.9	1.6	4	2.1	1	1.1	2.3	2.2	2
C9	0.8	1	3.3	0.4	1.2	4	1.02	0.7	1	2.2	1.2	1.2
C10	0.4	0.6	1.5	0.4	0.5	1.3	1.2	0.4	0.4	1	1.2	1.2
C11	0.4	0.6	1.5	0.4	0.5	0.9	1.1	0.4	0.5	1	1	0.6
C12	0.3	0.2	0.3	0.2	0.2	0.7	0.4	0.2	0.3	0.3	0.3	1
SUM=	7.1	10.1	27.2	6	12.1	33.95	17.02	6.7	8	17.9	15.4	15.3

Table 7: Pairwise comparison of criteria via linguistic variables
TFN by decision makers average approach.

E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	CRETERIA V
C1	0.14084507	0.11881	0.1470588	0.1	0.132231	0.12371134	0.1880141	0.134328358	0.1375	0.11731844	0.038961	0.0588235	0.437604
C2	0.08450704	0.09901	0.0845588	0.116666667	0.090909	0.08100147	0.08813161	0.089552239	0.075	0.08379888	0.0779221	0.1764706	0.147528
C3	0.04225352	0.0396	0.0367647	0.05	0.165289	0.09720177	0.04700353	0.044776119	0.0375	0.03910615	0.1103896	0.1045752	0.814464
C4	0.15492958	0.15842	0.1838235	0.166666667	0.132231	0.15316642	0.15276146	0.164179104	0.15	0.1452514	0.0324675	0.0392157	0.633109
C5	0.09859155	0.08911	0.1029412	0.1	0.082645	0.02945508	0.06462985	0.089552239	0.1	0.02793296	0.0779221	0.0196078	0.882386
C6	0.02816901	0.0495	0.0294118	0.033333333	0.024793	0.02945508	0.05875441	0.029850746	0.05	0.08379888	0.0974026	0.0588235	0.573298
C7	0.04225352	0.0495	0.0257353	0.05	0.041322	0.16494845	0.05875441	0.044776119	0.0375	0.12290503	0.1818182	0.1503268	0.969845
C8	0.14084507	0.15842	0.1470588	0.15	0.132231	0.11782032	0.12338425	0.149253731	0.1375	0.12849162	0.1428571	0.130719	0.658577
C9	0.11267606	0.09901	0.1213235	0.066666667	0.099174	0.11782032	0.05992949	0.104477612	0.125	0.12290503	0.0779221	0.0784314	0.185336
C10	0.05633803	0.05941	0.0551471	0.066666667	0.041322	0.03829161	0.07050529	0.059701493	0.05	0.05586592	0.0779221	0.0784314	0.709598
C11	0.05633803	0.05941	0.0551471	0.066666667	0.041322	0.02650957	0.06462985	0.059701493	0.0625	0.05586592	0.0649351	0.0392157	0.652238
C12	0.04225352	0.0198	0.0110294	0.033333333	0.016529	0.02061856	0.02350176	0.029850746	0.0375	0.01675978	0.0194805	0.0653595	0.336018
													1

Table 8: Normalised matrix

STEP :3 CALCULATING THE CONSISTENCY															
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	WEIGHTED SUM VALU	CRETERIA WEIGHT	λ_{max}
C1	0.43760398	0.52512	1.7504159	0.26256239	0.700166	1.83793673	1.40033275	0.393843585	0.481364382	0.91896837	0.2625624	0.3938436	9.364725251	17.29184652	0.541569
C2	0.08851704	0.14753	0.3393153	0.103269876	0.162281	0.40570309	0.22129259	0.088517037	0.088517037	0.22129259	0.1770341	0.3983267	2.441594931	3.794672825	0.643427
C3	0.24433913	0.32579	0.8144638	0.244339132	1.628928	2.68773046	0.65157102	0.244339132	0.244339132	0.57012464	1.3845884	1.303142	10.34368994	20.44304074	0.505976
C4	0.69641948	1.01297	3.1655431	0.633108618	1.012974	3.29216482	1.64608241	0.69641948	0.759730342	1.64608241	0.3165543	0.3798652	15.2579177	28.81941592	0.529432
C5	0.61767042	0.79415	2.4706817	0.529431788	0.882386	0.88238631	0.97062495	0.529431788	0.705909051	0.44119316	1.0588636	0.2647159	10.14744261	19.6772148	0.515695
C6	0.11465954	0.28665	0.4586382	0.114659539	0.171989	0.57329769	0.57329769	0.114659539	0.229319078	0.85994654	0.8599465	0.5159679	4.873030402	9.631401266	0.505952
C7	0.29095352	0.48492	0.6788915	0.29095352	0.484923	5.43113237	0.96984507	0.29095352	0.29095352	2.13365915	2.7155662	2.2306437	16.29339712	32.29584072	0.504505
C8	0.65857717	1.05372	2.6343087	0.59271945	1.053723	2.63430867	1.38301205	0.658577167	0.724434884	1.51472748	1.4488698	1.3171543	15.67413657	29.68969598	0.527932
C9	0.14826849	0.18534	0.6116075	0.074134246	0.222403	0.74134246	0.18904233	0.129734931	0.185335616	0.40773836	0.2224027	0.2224027	3.339747804	5.531227114	0.603799
C10	0.28383911	0.42576	1.0643966	0.283839107	0.354799	0.9224771	0.85151732	0.283839107	0.283839107	0.70959777	0.8515173	0.8515173	7.16693744	14.05003577	0.510101
C11	0.26089504	0.39134	0.9783564	0.260895038	0.326119	0.58701383	0.71746135	0.260895038	0.326118797	0.65223759	0.6522376	0.3913426	5.804914586	11.34893414	0.511494
C12	0.1008054	0.0672	0.1008054	0.067203602	0.067204	0.23521261	0.1344072	0.067203602	0.100805403	0.1008054	0.1008054	0.336018	1.478479247	2.856153092	0.517647
SUM=	3.94254832	5.7005	15.067424	3.457116307	7.067895	20.2307061	9.70848673	3.758413926	4.420666348	10.1763735	10.050948	8.6049399	102.1860136	195.4294789	6.417529

Table 9: Finding consistency of the weghted matrix

CONSISTENCY	0.507497394												
CR	N	1	2	3	4	5	6	7	8	9	10	11	12
	RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54

5. Using Topsis

5.1 Prioritizing critical factor alternatives using Fuzzy TOPSIS technique

The objective of using Fuzzy TOPSIS technique is to find critical factors in RSCM based on identified coordination criteria for improving Reverse supply chain performance. After finding the important weights of the criteria, we will now use the Fuzzy TOPSIS technique to rank the reverse supply chain alternatives. To validate the proposed model, has been conducted to identify critical factors. Here, we have considered three most significant alternatives of the RSCM A1, A2, A3, A4, A5 and A6 TO RANK them of their attributes. The evaluation criteria environment-friendly, product acquisition, inventory reduction, product analysis, reverse distribution, cost minimization.

In the present case, a committee of three Decision makers DM1, DM2 and DM 3 is constituted to make their judgments for criteria based on SIX coordination alternatives environment-friendly, product acquisition, inventory reduction, product analysis, reverse distribution, cost minimization.

Then, the proposed methodology, which is integration of Fuzzy AHP and Fuzzy TOPSIS, is used to prioritize identified critical factor based on 12 coordination criteria, Environmental-Driven-Legislation, Provides Facilities, Dissassembling, Revenue, Management, Customer Awareness and -Responsibility, Waste Management, Forecasting Return, Location Routing, Network Structure of Eol, Integration of Rl Activities Into Rsc, Coordination of Information System, Inventory Management, Coordination Between Consumer.

Fig 10: Linguistic variables for rating.

Linguistic variables	**Triangular fuzzy numbers (TFN**
Equal Importance (EI)	(0,0,0.1)
Moderate Importanance (MI)	(0,0.1,0.3)
Essential Or Strong Importance (SI)	(0.1,0.3,0.5)
Very Strong Importance (VI)	(0.3,0.5,0.7)
Extreme Importance (EXI)	(0.5,0.7,0.9)
Intermediate Values B/W 2 Judgement (JU)	(0.7,0.9,1)
Must(MU)	(0.9,1,1)

The performance rating of three DMs on Reverse supply chain alternatives for each criterion, in linguistic variables are obtained and shown in Table 11**.**

Linguistic variables shown in Table 11 are converted into their corresponding TFNs, according to Table 12. This rating of the Reverse supply chain alternatives in TFNs is presented in Table 13. To form Fuzzy decision matrix, aggregated rating for the alternatives is calculated according to the steps suggested in algorithms of Fuzzy TOPSIS method. Table 14 report the Fuzzy rating of alternatives for each criterion.

Fuzzy decision matrix is normalized according to method suggested by Chen (2000) and shown in Table: Normalized Fuzzy decision matrix, with corresponding weight for each criterion is presented.

After normalization, a weighted normalized Fuzzy decision matrix is formed by multiplying the corresponding weight of each criterion as shown in Table: and weighted normalized Fuzzy decision matrix is shown in Table:

Table 11: Linguistic variables, to rate the alternatives with respect to each criterion.

DECISION MAKERS RATINGS									
CRITERION	ALTERNATIVES	DM1	DM2	DM3	CRITERION	ALTERNATIVES	DM1	DM2	DM3
C1	A1	MU	JU	MU	C7	A1	EXI	VI	EI
	A2	EXI	EXI	VI		A2	EXI	JU	JU
	A3	MI	SI	EI		A3	EXI	EXI	EXI
	A4	EI	MI	EI		A4	EXI	EXI	EXI
	A5	SI	SI	MI		A5	JU	JU	MU
	A6	MI	MI	MI		A6	JU	MU	MU
C2	A1	SI	SI	MI	C8	A1	JU	JU	JU
	A2	EXI	EXI	VI		A2	(0.9,1,1)	JU	MU
	A3	JU	JU	VI		A3	MU	MU	MU
	A4	MU	MU	JU		A4	JU	EXI	VI
	A5	VI	JU	EXI		A5	MU	JU	EXI
	A6	JU	MI	SI		A6	JU	EXI	EXI
C3	A1	MI	MI	MI	C9	A1	JU	MU	VI
	A2	JU	EXI	EXI		A2	EXI	JU	MU
ANY	A3	JU	JU	JU		A3	JU	MU	MU
	A4	MI	SI	SI		A4	JU	MU	MU
	A5	JU	MU	MU		A5	EXI	JU	EXI
	A6	MU	MU	MU		A6	JU	JU	EXI
C4	A1	MI	EI	SI	C10	A1	JU	EXI	EXI
	A2	MU	JU	JU		A2	MU	MU	JU
	A3	EI	EI	EI		A3	JU	EXI	VI
	A4	EXI	JU	VI		A4	EXI	VI	EXI
	A5	EI	EI	EI		A5	JU	EXI	EXI
	A6	SI	VI	SI		A6	EXI	EXI	JU
C5	A1	JU	JU	EXI	C11	A1	MI	VI	MI
	A2	EXI	EXI	VI		A2	EXI	VI	SI
	A3	JU	JU	EXI		A3	JU	JU	EXI
	A4	EXI	VI	EXI		A4	JU	EXI	JU
	A5	EI	EI	EI		A5	EI	EXI	VI
	A6	SI	VI	EI		A6	JU	EXI	VI
C6	A1	SI	VI	EXI	C12	A1	JU	EXI	VI
	A2	MU	MU	JU		A2	JU	JU	EXI
	A3	SI	VI	SI		A3	EI	EI	EI
	A4	EXI	EXI	EXI		A4	SI	VI	SI
	A5	EXI	EXI	EXI		A5	SI	SI	VI
	A6	SI	VI	VI		A6	JU	EXI	VI

Table 12: Fuzzy rating of alternatives for each criterion.

	A1	A2	A3	A4	A5	A6
C1	0.7,0.9,1	0.3,0.6,0.9	0,0.1,0.5	0,0.03,0.3	0,0.2,0.5	0,0.1,0.3
C2	0,0.2,0.5	0.3,0.6,0.9	0.3,0.7,0.9	0.7,0.9,1	0.3,0.7,1	0,0.4,1
C3	0,0.1,0.3	0.5,0.7,1	0.7,0.9,1	0,0.2,0.5	0.7,0.9,1	0.9,1,1
C4	0,0.1,0.5	0.7,0.9,1	0,0,0.1	0.3,0.7,1	0,0,0	0.1,0.3,0.7
C5	0.5,0.8,1	0.3,0.6,0.9	0.5,0.8,1	0.3,0.7,0.9	0,0,0.1	0,0.2,0.4
C6	0.1,0.5,0.9	0.7,0.9,1	0.1,0.3,0.5	0.5,0.7,0.9	0.5,0.7,0.9	0.1,0.4,0.6
C7	0,0.4,0.9	0.5,0.8,0.9	0.5,0.7,0.9	0.5,0.7,0.9	0.7,0.9,1	0.8,0.9,1
C8	0.7,0.9,1	0.7,0.9,1	0.9,1,1	0.3,0.7,1	0.5,0.8,1	0.5,0.7,1
C9	0.3,0.8,1	0.9,0.8,1	0.7,0.7,1	0.3,0.7,0.9	0.5,0.7,1	0.5,0.8,1
C10	0.5,0.8,1	0.7,0.9,1	0.3,0.7,1	0.3,0.6,0.9	0.5,0.7,1	0.5,0.8,1
C11	0,0.2,0.7	0.1,0.5,0.9	0.3,0.7,1	0.3,0.7,0.9	0.5,0.7,1	0.3,0.7,1
C12	0.3,0.7,1	0.5,0.8,1	0,0,0.1	0.1,0.3,0.7	0.1,0.3,0.7	0.3,0.7,1

Table 13: C

Table 14: Weighted fuzzy decision matrix

		DECISION MAKERS RATINGS							
CRETERION	ALTERNATIVES	DM1	DM2	DM3	CRITERION	ALTERNATIVES	DM1	DM2	DM3
C1	A1	(0.9,1,1)	(0.7,0.9,1)	(0.9,1,1)	C7	A1	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0,0,0.1)
	A2	(0.5,0.7,0.9	(0.5,0.7,0.9)	(0.3,0.5,0.7)		A2	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)
	A3	(0,0.1,0.3)	(0.1,0.3,0.5)	(0,0,0.1)		A3	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)
	A4	(0,0,0.1)	(0,0.1,0.3)	(0,0,0.1)		A4	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)
	A5	(0.1,0.3,0.5	(0.1,0.3,0.5)	(0,0.1,0.3)		A5	(0.7,0.9,1)	(0.7,0.9,1)	(0.9,1,1)
	A6	(0,0.1,0.3)	(0,0.1,0.3)	(0,0.1,0.3)		A6	(0.7,0.9,1)	(0.9,1,1)	(0.9,1,1)
C2	A1	(0.1,0.3,0.5	(0.1,0.3,0.5)	(0,0.1,0.3)	C8	A1	(0.7,0.9,1)	(0.7,0.9,1)	(0.7,0.9,1)
	A2	(0.5,0.7,0.9	(0.5,0.7,0.9)	(0.3,0.5,0.7)		A2	(0.9,1,1)	(0.7,0.9,1)	(0.9,1,1)
	A3	(0.7,0.9,1)	(0.7,0.9,1)	(0.3,0.5,0.7)		A3	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)
	A4	(0.9,1,1)	(0.9,1,1)	(0.7,0.9,1)		A4	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)
	A5	(0.3,0.5,0.7	(0.7,0.9,1)	(0.5,0.7,0.9)		A5	(0.9,1,1)	(0.7,0.9,1)	(0.5,0.7,0.9)
	A6	(0.7,0.9,1)	(0,0.1,0.3)	(0.1,0.3,0.5)		A6	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)
C3	A1	(0,0.1,0.3)	(0,0.1,0.3)	(0,0.1,0.3)	C9	A1	(0.7,0.9,1)	(0.9,1,1)	(0.3,0.5,0.7)
	A2	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)		A2	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.9,1,1)
	A3	(0.7,0.9,1)	(0.7,0.9,1)	(0.7,0.9,1)		A3	(0.7,0.9,1)	(0.9,1,1)	(0.9,1,1)
	A4	(0,0.1,0.3)	(0.1,0.3,0.5)	(0.1,0.3,0.5)		A4	(0.7,0.9,1)	(0.9,1,1)	(0.9,1,1)
	A5	(0.7,0.9,1)	(0.9,1,1)	(0.9,1,1)		A5	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.5,0.7,0.9)
	A6	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)		A6	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)
C4	A1	(0,0.1,0.3)	(0,0,0.1)	(0.1,0.3,0.5)	C10	A1	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)
	A2	(0.9,1,1)	(0.7,0.9,1)	(0.7,0.9,1)		A2	(0.9,1,1)	(0.9,1,1)	(0.7,0.9,1)
	A3	(0,0,0.1)	(0,0,0.1)	(0,0,0.1)		A3	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)
	A4	(0.5,0.7,0.9	(0.7,0.9,1)	(0.3,0.5,0.7)		A4	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)
	A5	(0,0,0.1)	(0,0,0.1)	(0,0,0.1)		A5	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)
	A6	(0.1,0.3,0.5	(0.3,0.5,0.7)	(0.1,0.3,0.5)		A6	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)
C5	A1	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	C11	A1	(0,0.1,0.3)	(0.3,0.5,0.7)	(0,0.1,0.3)
	A2	(0.5,0.7,0.9	(0.5,0.7,0.9)	(0.3,0.5,0.7)		A2	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.1,0.3,0.5)
	A3	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)		A3	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)
	A4	(0.5,0.7,0.9	(0.3,0.5,0.7)	(0.5,0.7,0.9)		A4	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.7,0.9,1)
	A5	(0,0,0.1)	(0,0,0.1)	(0,0,0.1)		A5	(0,0,0.1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)
	A6	(0.1,0.3,0.5	(0.3,0.5,0.7)	(0,0,0.1)		A6	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)
C6	A1	(0.1,0.3,0.5	(0.3,0.5,0.7)	(0.5,0.7,0.9)	C12	A1	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)
	A2	(0.9,1,1)	(0.9,1,1)	(0.7,0.9,1)		A2	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)
	A3	(0.1,0.3,0.5	(0.3,0.5,0.7)	(0.1,0.3,0.5)		A3	(0,0,0.1)	(0,0,0.1)	(0,0,0.1)
	A4	(0.5,0.7,0.9	(0.5,0.7,0.9)	(0.5,0.7,0.9)		A4	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.1,0.3,0.5)
	A5	(0.5,0.7,0.9	(0.5,0.7,0.9)	(0.5,0.7,0.9)		A5	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)
	A6	(0.1,0.3,0.5	(0.3,0.5,0.7)	(0.3,0.5,0.7)		A6	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)

CW		A1	A2	A3	A4	A5	A6
0.437604	C1	0.2,0.3,0.4	0.1,0.2,0.3	0,0.04,0.2	0,0.1,0.1	0,0.8,0.2	0,0.04,0.1
0.147528	C2	0,0.02,0.03	0.03,0.06,0.0	0.03,0.07,0.09	0.07,0.09,0	0.03,0.07,0.1	0,0.04,0.1
0.814464	C3	0,0.08,0.23	0.4,0.5,0.8	0.56,0.7,0.8	0,0.1,0.4	0.5,0.7,0.8	0.7,0.8,0.8
0.633109	C4	0,0.06,0.3	0.4,0.5,0.6	0,0,0.06	0.1,0.7,1	0,0,0	0.1,0.3,0.7
0.882386	C5	0.5,0.8,0.8	0.3,0.6,0.9	0.5,0.8,1	0.3,0.4,0.5	0,0,0.06	0,0.1,0.2
0.573298	C6	0.05,0.2,0.	0.3,0.4,0.5	0.05,0.1,0.2	0.2,0.3,0.4	0.2,0.3,0.4	0.05,0.2,0.3
0.969845	C7	0,0.3,0.8	0.4,0.7,0.8	0.4,0.6,0.8	0.4,0.6,0.8	0.6,0.8,0.9	0.7,0.8,0.9
0.658577	C8	0.4,0.5,0.6	0.4,0.5,0.6	0.5,0.6,0.6	0.01,0.4,0.6	0.3,0.4,,6	0.3,0.4,0.6
0.185336	C9	0.03,0.08,0	0.09,0.08,0.1	0.07,0.07,0.1	0.03,0.07,0	0.05,0.07,0.1	0.05,0.08,0.1
0.709598	C10	0.3,0.5,0.7	0.4,0.6,0.7	0.2,0.4,0.7	0.2,0.4,0.6	0.3,0.4,0.7	0.3,0.5,0.7
0.652238	C11	0,0.1,0.4	0.06,0.3,0.5	0.1,0.4,0.6	0.1,0.4,0.6	0.3,0.4,0.6	0.1,0.4,0.6
0.336018	C12	0.9,0.2,0.3	0.1,0.2,0.3	0,0,0.3	0.03,0.09,0	0.03,0.09,0.2	0.9,0.2,0.3

P=(0,0,0,0,0,0,0,0,0,0,0,),(0.03,0.030,0.03,0.03,0.03,0.03,0.0

3,0.03,0.030.030.03,0.3)(0,0,0,0,0,0,0,0,0,0,0,)(0,0,0,0,0,0,0,0,0,0,0,)(0,0,0,0,0,0,0,0,0,0,0,)(0,0,0,0,0,0,0,0,0,0,0,)

P*=(0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,),(0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,)(0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,

Closeness Coefficient of Alterntives and Ranking					
	di*	di-	di* + di-	Cci= di-\di+di*	Rank
A1	3.16	2.98	6.14	0.48	1
A2	3.9	2.3	6.2	0.387	5
A3	5.59	3.99	9.58	0.416	2
A4	6	4.02	10.02	0.401	4
A5	5.22	2.8	8.02	0.34	6
A6	6.4	4.47	10.87	0.411	3

0.8,0.8,)(0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,)(0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,)(0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9,0.9)

Now, both Fuzzy positive ideal solution (FPIS) and Fuzzy negative ideal solution (FNIS) are calculated after determining FPIS and FNIS, the distances of each alternative from FPIS and FNIS with respect to each criterion are calculated using Vertex method (Chen, 2000) as

$$d_1^* = d(P_1, P^*)$$

$$d_1^- = d(P_1, P^-)$$

Table 15: Distance between Pi (I=1, 2, 3...6) and P* w.r.t each criterion (C1, C2, C3, C4……C12)

Creteria Weight	Creteria	D1*	d2*	d3*	d4*	d5*	6*
CW		A1	A2	A3	A4	A5	A6
0.43760398	C1	0.03	0.4	0.7	0.7	0.06	0.8
0.14752839	C2	0.06	0.2	0.7	0.7	0.7	0.9
0.81446377	C3	0.06	0.3	0.2	0.6	0.2	0.4
0.63310862	C4	0.03	0.4	0.7	0.4	0.9	0.5
0.88238631	C5	0.02	0.3	0.2	0.4	0.9	0.6
0.57329769	C6	0.06	0.4	0.6	0.5	0.6	0.4
0.96984507	C7	0.5	0.3	0.2	0.3	0.1	0.2
0.65857717	C8	0.4	0.4	0.2	0.5	0.06	0.4
0.18533562	C9	0.4	0.1	0.59	0.7	0.3	0.6
0.70959777	C10	0.4	0.4	0.4	0.4	0.3	0.7
0.65223759	C11	0.7	0.3	0.4	0.5	0.4	0.5
0.33601801	C12	0.5	0.4	0.7	0.3	0.7	0.4
	SUM	3.16	3.9	5.59	6	5.22	6.4

Table 16: Distance between Pi (i=1, 2, 3...6) and P w.r.t each criterion (C1, C2, C3, C4..C12).

		d1-	d2-	d3-	d4-	d5-	d6-
CW		A1	A2	A3	A4	A5	A6
0.43760398	C1	0.3	0.4	0.2	0.4	0.7	0.2
0.14752839	C2	0.09	0.3	0.4	0.3	0.02	0.2
0.81446377	C3	0.21	0.03	0.3	0.2	0.5	0.7
0.63310862	C4	0.02	0.2	0.05	0.05	0.2	0.4
0.88238631	C5	0.7	0.1	0.4	0.4	0	0.02
0.57329769	C6	0.03	0.1	0.6	0.6	0.1	0.03
0.96984507	C7	0.4	0.2	0.5	0.7	0.2	0.8
0.65857717	C8	0.03	0.01	0.7	0.5	0.6	0.4
0.18533562	C9	0.1	0.3	0.04	0.2	0.4	0.02
0.70959777	C10	0.4	0.02	0.4	0.07	0.02	0.6
0.65223759	C11	0.2	0.04	0.2	0.2	0.03	0.4
0.33601801	C12	0.5	0.6	0.2	0.4	0.03	0.7
	sum	2.98	2.3	3.99	4.02	2.8	4.47

Table 17: Closeness coefficient of alternatives and their ranking

Similarly, other values of di* for six alternatives with respect to each criterion have been calculated. These values are shown in Table. Further, values of di− for six alternatives with respect to each criterion have been calculated. These values are shown. Then, the closeness coefficient of six alternatives CCi (i=1, 2, 3…..) are calculated by using and results are presented in Table.

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*}$$

The closeness coefficient represents the distance to the FPIS (P*) and Fuzzy negative ideal solution (P−). Table provides the values of closeness coefficients for all alternatives. The value of closeness coefficient for first alternative is 0.48, for second 0.416, and for third is 0.411, 0.401, 0.387, and 0.34**).** This indicates that first alternative is closest to FPIS and should be given first critical factors. Based on closeness coefficients given in the Table, the ranking order of alternatives have been determined, the priorities of the alternatives are A1 >A3 >A6>A4>A2>A5. The first alternatives determined as most appropriate critical factor for the RSCM under consideration, because the first alternatives is closer to the FPIS and farther from the FNIS. Similarly, 5th alternatives for which closeness coefficient value is lowest, identified as the least preferred because it farther to FPIS and close to FNIS [13].

5. Conclusions

In this paper, we worked on various peer-reviewed papers for identifying the barriers while implementing reverse supply chain management in any organization and after that find its critical factors using multi-criteria decision-making model which has been developed for identifying the critical factors in reverse supply chain management. This approach is used in various research paper after checking all the suitability of vagueness associated with the independent perception of decision-makers which has been applied. The Role of the decision makers is to prioritization of the factor's crucial strategic way for survival of the firm, because the profitability of a firm and environmental satisfaction is directly proportional to the effectiveness of the prioritization process on their judgment level. It has been detected from the various literature that decision-makers face the uncertainties from subjective perceptions and experiences in the decision-making process. We take help from decision makers who are expert in their field and calculate their process alternatives Using Fuzzy AHP and Fuzzy TOPSIS, uncertainty and vagueness can be effectively handled and reached efficiently. As a result, Fuzzy AHP helps in identifying consistent information between the decision

makers is determined as the most important criterion for coordination, because this criterion has highest weight priority. Then, the alternatives are ranked based on closeness coefficient level, which is calculated for each partner using Fuzzy TOPSIS. It has been distinguished from the different literary works that chiefs face the vulnerabilities from abstract observations and encounters in the dynamic procedure. Utilizing Fuzzy AHP and Fuzzy TOPSIS, vulnerability and dubiousness can be viably taken care of and reached effectively. Accordingly, Fuzzy AHP helps in recognizing steady Information exchanges between the chiefs is resolved as the most significant rule for coordination, since this measure has most elevated weight need. At that point, the options are positioned depends upon the coefficient of closeness, that is determined for each accomplice utilizing Fuzzy TOPSIS.

Alternatives 'A4' is the most appropriate accomplice for the task is viewed as most basic components. The fourth option is resolved as most fitting option for the Reverse flexibly chain viable, in light of the fact that the fourth option is closer to FPIS than the FNIS as shown in the results. So also, for that coefficient of esteem is most reduced identified third option the least liked, in light of the fact that it is farther to FPIS and near FNIS. The concept is valuable in tackling the commonsense issue, since ambiguity and imprecision can be successfully dealt with in this model. On the off chance that the measures and options are obviously defined, the current model can be received in any industry.

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