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Effect of Green Supply Chain Management on Organization's Performance - An Empirical Evidence with reference to Automobile Industry using fuzzy AHP Method

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Abstract: Supply Chain Management plays an important role in the performance of an organization Green Supply Chain Management (GSCM) is an emerging concept & has gained its importance over the years because of increasing pollution levels & environmental concerns. Implementation of GSCM requires Investments, But there is No direct linkage between GSCM & Organizational performance that can justify the investments. This Study will help to find out the relationship between GSCM Activities & their impact on organizational performance, using Fuzzy AHP approach. Organizational Performance has been categorized in three aspects i.e. Environmental performance, Economic Performance & Operational performance. The study aims to find out the effectiveness of GSCM activities on these performance aspects using five GSCM performance criteria. Automobile Industry is one of the biggest industry segment in Indian Economy & therefore sample size of three Automobile organizations selected for the study. Questionnaire Survey was done in these organizations & Fuzzy AHP priority rankings were allocated to performance aspects based on GSCM performance criteria. Results concluded using rating weightages, normalized fuzzy ratings & coefficient of closeness.

Keywords: GSCM, Fuzzy AHP, Automobile Industry, Supply Chain Management, Organizational Performance

INTRODUCTION

In early 80's,the environmental thinking concept was virtually nowhere in existence. Clean Air and Water was the only needs in those days. "However today the environmental concept has acquired broader meaning that includes safe drinking water, safe food, healthy ecosystems, toxic-free communities, safe waste management and restoration of contaminated sites". Manufacturing operations are considered as the most significant root cause for environmental degradation. They destroy nature in form of industry waste, ecosystem imbalance and depletion of non renewable natural resources. The existing environmental state calls for the need of new thinking /ideas in manufacturing philosophy. "Sustainability is the key to the future". It can be achieved by significant reduction in consumption of non renewable natural resources, reducing waste generation and encouraging use of recyclable products in processes. The initial step in this drive is integration of current Supply Chain practices with environmental management and that is what is called Green Supply Chain. [18]

It's an emerging or rather burning concept to discuss and to act upon, specifically in Manufacturing Industries. Pollution in all facets of nature may it be Water, Air or Depletion of Natural Resources are all ill effects of Industrialization. Besides, there is huge pressure on industries to reduce carbon foot prints and green house gas emission [4]. But as evident, Industries are required and therefore must for economic growth & development, so need is essential. The emerging GSCM Concept is a vital tool to Industries that can help to reduce their ill effects on nature and can maintain balance among growth and social responsibilities. In addition, GSCM Implementation across organizations results in cost benefits, business growth and competitive edge.

"GSCM may be defined as one of the most effective method of controlling and reducing pollution and wastages which symbolizes ineffective and incomplete utilization of resources or inefficient conversion processes" [18]. " Green Supply Chain can be further expressed as induction and integration of environmental thinking into supply chains". Its scope includes organizational activities like waste reduction, reuse, recycling, Eco friendly packaging and alternate material usage. GSCM is gaining importance globally because of increasing environmental concerns, strict government regulations & enhanced public awareness.[24].Depletion of natural resources due to excess consumption and continuing environmental deterioration have put pressures on corporates operating in Global markets. The biggest challenge these corporate are facing is how to overcome & control the adverse environmental impacts of their end products as well as their manufacturing processes, throughout the complete life cycle of product. [18]

Researches in recent past depicts that Effective SCM is essential for business sustainability & growth. It has four paradigms namely Lean, Agile, Resilient and Green [5]. A lot has been done on first three paradigms But Not much is explored for fourth paradigm i.e. Green. Many studies in past reveals GSCM initiatives & its advantages with reference to organizational performance & global competitiveness, But No Study so far has been able to draw a clear cut relation between GSCM implementation and operational performance with financial payoffs. [13].GSCM is gaining attraction amongst professionals & academics.

It has significant potential for research and need further exploration for benefit to industry and society The three main focused areas in GSCM are green sourcing, green manufacturing and green logistics. [24]

Both Developed as well as developing countries are changing their environment policies in order to sustain ecological balance. Specifically in India, more emphasis is being given to Industries which contributes Major role in Indian economy and Automobile Industry is one of the biggest segment among this basket [14] The Key drivers for GSCM Implementations across the firms are government regulations, Customer pressure and competitive edge, followed by the intermediate important factors as social responsibility, business benefits and organizational factors [10]

The researches so far on GSCM has been non –structured in terms of defining constructs, variables and causal relationship among the constructs. This Paper will review the impact of GSCM on organization performance and will consolidate the most common practices used in Automobile sector.

The research is categorized into following sections :

Section 2 represents literature review on GSCM and fuzzy AHP.

Section 3 illustrates a Case Study of three Major Automobile Organizations.

LITERATURE REVIEW

Globally, All countries are emphasizing implementation of environmental practices like GSCM, across all industry types.With reference to Indian Industry, focus in on large scale industries that contribute majorly to the economy. GSCM initiatives have been started in India because of increased pollution, government regulations, gaining competitive edge, customer's demand and increasing pressures from society, Non-government organizations (NGO) and Media. Because of these pressures, mining and mineral industry, one of the major contributor in

Indian economy, has also started to focus on GSCM. Mathiyazhagan, Diabat, Al-Refaie, & Xu, (2015) investigated the role of external and internal pressures for GSCM implementation. He identified and Ranked these pressures through Analytical Hierarchy Process (AHP) technique in mining and mineral industry [14].

Tippayawong, Tiwaratreewit, & Sopadanga, (2015) recommended in his research, with reference to Thai electronic industry, that green logistics practices and green manufacturing practices were significantly related to financial performance,whereas Green Sourcing is not. Complexity in operations & Cost discovered as Major Hurdles in GSCM implementation. He recommended to develop better cost effective and easy ways to implement GSCM. [24]

Implementation of Green SCM is purely business. Apart from creating favouarble green corporate image, It yields increased production and cost benefits also to the organization. By implementing GSCM, Companies have been able to increase their operational performance and efficiencies. [9]. Subir Sen (2009) in his research pointed out, with reference to Reliance Industries that GSCM implementation is directly linked with the firms financial results. His study recommended that "GSCM Not only contributes positively to Corporate Social Responsibility (CSR), but also create value for its investors."[18]. The statistical results of the research conducted in japanese automotive companies suggested the existence of mix relationship between GSCM Implementation and financial performance. [1]. The research done by Chin, Tat, & Sulaiman,(2015) was focussed on deriving the relationship between GSCM, environmental integration and organization's performance & sustainability. [6].

The study done by Balon, Sharma, & Barua,(2016) identified thirteen barriers that need to be taken care of for effective implemention of GSCM. The analysis of defined relationship among these barriers may help organizations to overcome the hurdles of GSCM Implementation [3]. Masoumik, Abdul-Rashid, Olugu, & Raja Ghazilla, (2015) developed a conceptual model, with the combination of Analytical Network Process (ANP) and Structural equantion modelling (SEM), to prioritize GSCM initiatives strategically in order to get the maximum operational benefits [13]. The GSCM Theory to identify barriers & enablers,with the help of interpretive structural modelling technique, was proposed by Dubey, Gunasekaran, Wamba, & Bag, (2015).In his research He took expert openions from various academecians & industry professionals and derived the complex relationship between enablers and barriers [7].The coordination between the internal and external GSCM Practices is the key to reap maximum operational benefits [29].Vijayvargy & Agarwal, (2014) conducted his research on Indian manufacturing organizations and established the positive relationship between GSCM practices and organizational performance. [25]

From the survey of 249 korean enterprise respondents, it was found that "Planning and Implementation", followed by "collaboration with business partners" and "integration of infrastructure" are the key drivers for GSCM impact on Balanced scorecard performance of an enterprise [11]. Mitra, (2014) studied the impact of GSCM Practices on firm's performance and identified most commonly used practices across the industry. He also proposed new constructs, variables and their relationships. A conceptual framework was designed to highlight the linkages between GSCM practices and firms operational performance [16]. The research done by Wang & Chanb, (2013) proposed a fuzzy heirarchical TOPSIS approach to assess the improvement areas while implementing green practices. This tool also helps to evaluate different GSCM initiatives & their impact on organizations performance. [26]

Fuzzy Logic

"It is based on the principal of relative graded membership, as inspired by human perception and cognition" [8]. This logic can take care of uncertain, imprecise and vague informations. It provides an effective way of multi criteria problem solving and better assessments of available options. [20][12] "A fuzzy set is a class of objects with a continum of membership grades, where membershop grades can be taken as an intermediate value between

0 & 1". "A fuzzy subset A of a universal set X is deûned by a membership func-tion f(x) which maps each element x in X to a real number [0,1]". When the grade of membership for an element is 1, it means that the element belongs to that set. When the grade of member-ship is 0, it means that the element does not belongs to that set. Ambiguous cases are assigned values between 0 and 1. The fuzzy theory also allows mathematical operators such as addition, subtraction, multiplication and division, to be applied to the fuzzy sets. [12]

Analytical Hierarchy Process – AHP

AHP is one of the most efû-cient decision making techniques, was originally introduced by Thomas L. Saaty in 1980 [23]. AHP is a multi-objective, multi-criteria decision-making approach, that enables the decision maker to arrive at a scale of priority drawn from a set of alternatives. It facilitates decision makers to ûnd out the best alternates to suits their goal and their understanding of a complex problem with multiple conûicting and subjective criteria. With this method, a complex system is converted to a hierarchical system of elements. In each hierarchical level, pair-wise comparisons of the elements are done by using a nominal scale. These com-parisons creates a comparison matrix. To ûnd the weight of each element, or the score of each alternative, the eigenvector of this matrix is calculated. At the end, the consistency of the pair-wise comparisons is calculated by using a consistency ratio [8].

"Fuzzy AHP is a decision making approach for solving complex multi-criteria problems" [23]. During problem soving process, many a times it happens that decision makers provide subjective and uncertain answers, that are difficult to evalute [19]. lack of quantified & exact data values leads to No conclusion or vague results. (Zadeh, 1965) introduced fuzzy sets AHP approach to handle such uncertainties & vagueness in decision making [28].

(Zadeh, 1965) Formulates the fuzzy set theory which helps further to deal with the vagueness and uncertainty in decision making. He defined fuzzy set as "class of objects which comprises grades of membership. For membership function fa(x) then A is characterized in X where X is a real number of interval [0, 1]". [28] "Fuzzy numbers are fuzzy sets that are represents on R set of real numbers" [27].

Linguistic numbers

Linguistic variables are those variables which are represents in linguistic terms [22].

The basis steps involved in fuzzy AHP Approach, as mentioned by (Rezaie, Ramiyani, Nazari-Shirkouhi, & Badizadeh, 2014) are as follows.[17] :

I. Determine Criteria and establish hierarchal structure
II. Collect experts judgements based on fuzzy scale and establish fuzzy pair wise comparison matrices.
III. Defuzzying the fuzzy pair wise comparison matrices.
IV. Calculate consistency ratio and derive result.

Case Study

The study was conducted on sample size of three major Automobile Manufacturing organizations in India. The selected firms were :

O.E.M. engaged in Manufacturing of Tractors and farm equipments.

O.E.M. engaged in manufacturing of passenger cars.

O.E.M. engaged in manufacturing of Two Wheelers i.e. Scooter & Bikes.

The following Sample Questionnaire was prepared & feedback from three representatives (R1, R2 & R3) were evaluated, to find out major criteria for GSCM Performance:

The procured raw material are manufactured from excess and are environmental friendly.

Procurement and selection of raw materials based on cost, quality, and environmental impacts.

The monitoring & control of carbon dioxide releasing by provider.

The IT network is used instead of papers between vendor and factory

The distance between vendor and factory is minimized in order to reduce pollution and cost.

The provider has received ISO 14000.

Corporate strategy regarding renewable energy and its importance to support in manufacturing.

Reducing carbon dioxide emission in manufacturing process.

The pollution reducing system in producing process is operated.

The clean manufacturing technologies are adopted.

Pollution control of heavy metals into water resource.

Reducing energy consumption cost.

The delivering vehicles are well checked and maintenance plan are available.

The full truck load system is applied to increase the effectiveness of product delivering.

The delivering routes are determined to save the fuel and reduce the pollution.

The waste for production can be reused or recycled.

The used packaging are reused.

Strategic planning for optimizing waste treatment and disposal system based on legal procedure.

The wasted water generated from whole facilities are neutralized and reused.

The wastes from all manufacturing failure are well managed.

(Reference : [24])

From Feedback & Evaluation from above questionnaire, we could establish following five major criteria for GSCM performance in an organization, as mentioned below :

C1 : Pollution Control

C2 : Reduction in Material Purchasing Cost

C3: Reduction in energy consumption cost.

C4: Scrap / Waste Reduction

C5: Quality improvement.

S.No.	*Performance Criteria*	*Assigned GSCM Activity*
C1	Pollution Control	The delivering vehicles are well checked and maintenance plan are available The pollution reducing system in producing process is operated. Reducing carbon dioxide emission in manufacturing process. The monitoring & control of carbon dioxide releasing by provider. The provider has received ISO 14000. Pollutioncontrol of heavy metals into water resource. The delivering routes are determined to save the fuel and reduce the pollution.

C2 Reduction in materials purchasing cost	The procured raw material are manufactured from excess and are environmental friendly.. The distance between vendor and factory is minimized in order to reduce pollution and cost. Procurement and selection of raw materials based on cost, quality, and environmental impacts.
C3 Reduction in energy consumption cost	Reducing energy consumption cost. Corporate strategy regarding renewable energy and its importance to support in manufacturing.
C4 Scrap/ waste reduction	The wasted water generated from whole facilities are neutralized and reused. The used packaging are reused. The wastes from all manufacturing failure are well managed. The waste for production can be reused or recycled. Strategic planning for optimizing waste treatment and disposal system based on legal procedure
C5 Quality improvement	The clean manufacturing technologies are adopted. The IT network is used instead of papers between vendor and factory. The full truck load system is applied to increase the effectiveness of product delivering

The five performance criteria were evaluated under three aspects of organizations performance i.e.

Environmental Performance : P1

Economic Performance : P2

Operational Performance : P3

Organization Performance Aspects	**GSCM Performance Criteria**
Environmental performance (P1)	Pollution control (C1)
Economic performance (P2)	Reduction in materials purchasing cost (C2)
	Reduction in energy consumption cost (C3)
	Scrap/ waste reduction (C4)
Operational Performance (P3)	Quality improvement (C5)

Effect of Green Supply Chain Management on Organizational Performance was evaluated by linking each of the five GSCM Performance criteria with all of the three Organization Performance aspects. By using Fuzzy AHP Technique, The ratings and the weight of the ratings are calculated. Prior to the further steps the ratings are done on judgmental basis. Then the data is further summarized to calculate CI (consistency index) and CR (Consistency ratio).

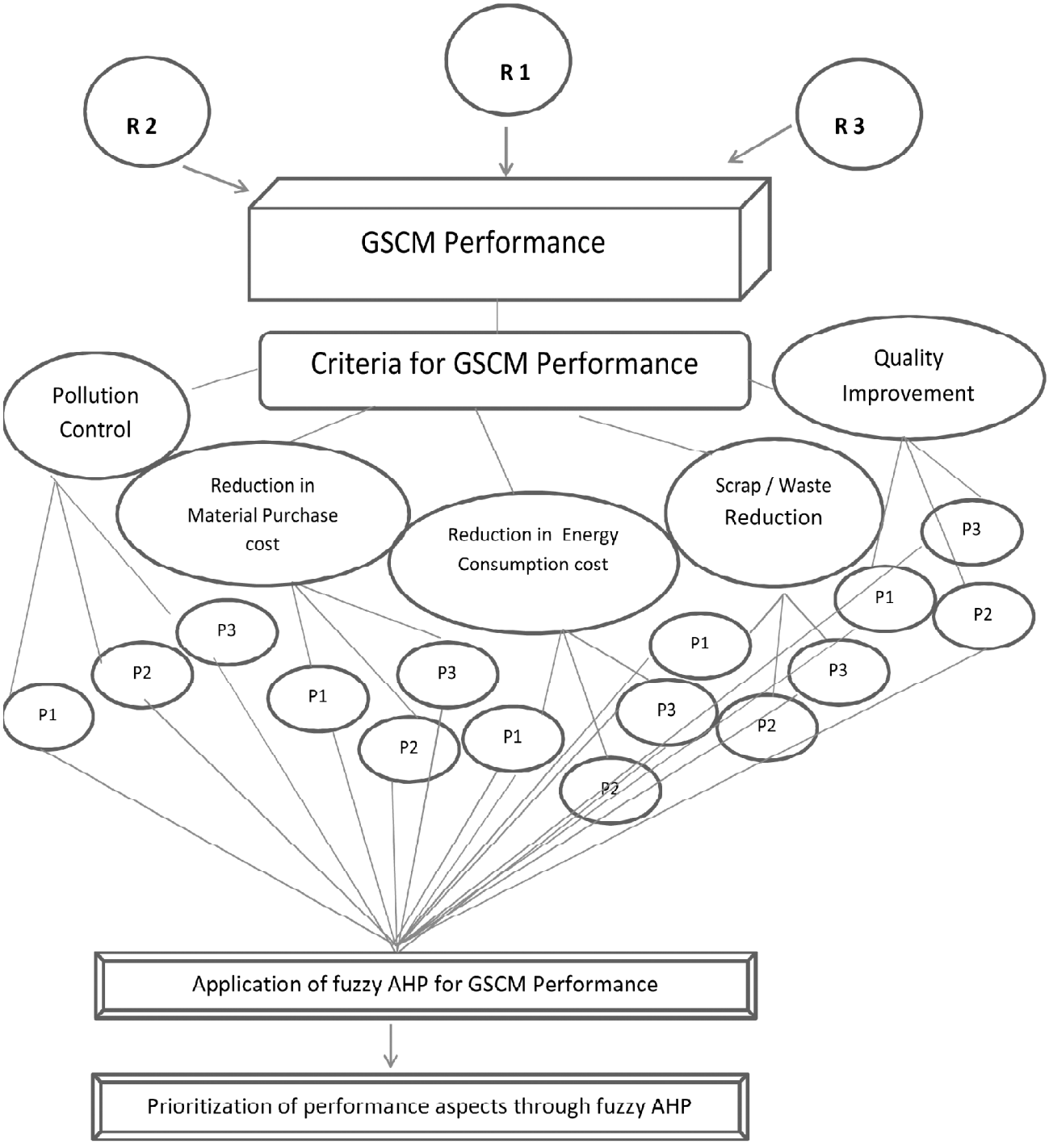
Step 1: Judgemental Ratings of Orgainzation Representatives

First step is to define the ratings of three representatives i.e. R1, R2 & R3 as illustrated in below table :

Table 1
Judgemental Rating

	R1	*R2*	*R3*
R1	1	2	3
R2	1/2	1	4
R3	1/3	1/4	1

The above matrix is solved by using AHP Method to get the Eigen vector value. The normalized eigen vector values obtained are 0.5119, 0.3601 & 0.1279. The CI (Consistancy index) value is 0.017393 and CR (Consistancy Ratio) value is 0.029987



Step 2 : Next step is to define the importance of Criteria on the scale of 1-4, based on the judgement of representatives.

Table 2
Criteria Importance Ratings by organisation's Representatives

Criteria	*Representatives*		
	R1	*R2*	*R3*
C1	VH	VH	MH
C2	MH	VH	MH
C3	H	H	MH
C4	VH	VH	VH
C5	MH	VH	VH

Step 3 : In this step, Performance Ratings are awarded to each of the criteria, by all three representatives. The six point linguistic scale is is used in this case namely poor, medium poor, fair, Medium good, good and very good.

Table 3
Criteria Performance Ratings by organisation's Representatives

Criteria	*Representatives*			
	Performance Aspects	*R1*	*R2*	*R3*
C1	P1	G	G	MG
	P2	MP	F	F
	P3	F	MP	MG
C2	P1	VG	VG	VG
	P2	MG	F	VG
	P3	VG	G	VG
C3	P1	MG	MG	G
	P2	G	G	MG
	P3	VG	G	MG
C4	P1	MG	VG	MG
	P2	G	F	MG
	P3	F	F	G
C5	P1	MG	F	VG
	P2	G	G	MG
	P3	G	F	MG

Table 4
Fuzzy Rating Criteria by organization representatives

Criteria	*Representatives*		
	R1	*R2*	*R3*
C1	(1.0,1.0,1.0)	(1.0,1.0,1.0)	(0.9,1.0,1.0)
C2	(0.9,1.0,1.0)	(1.0,1.0,1.0)	(0.9,1.0,1.0)
C3	(0.8,0.9,1.0)	(0.8,0.9,1.0)	(0.9,1.0,1.0)
C4	(1.0,1.0,1.0)	(1.0,1.0,1.0)	(1.0,1.0,1.0)
C5	(0.9,1.0,1.0)	(1.0,1.0,1.0)	(1.0,1.0,1.0)

Table 5
Performance Rating of Sub Criteria

Criteria	*Representatives*			
	Performance Aspects	*R1*	*R2*	*R3*
C1	P1	(8,9,10)	(8,9,10)	(9,10,10)
	P2	(6,7,8)	(7,8,9)	(7,8,9)
	P3	(7,8,9)	(6,7,8)	(9,10,10)
C2	P1	(10,10,10)	(10,10,10)	(10,10,10)
	P2	(9,10,10)	(7,8,9)	(10,10,10)
	P3	(10,10,10)	(8,9,10)	(10,10,10)
C3	P1	(9,10,10)	(9,10,10)	(8,9,10)
	P2	(8,9,10)	(8,9,10)	(9,10,10)
	P3	(10,10,10)	(8,9,10)	(9,10,10)
C4	P1	(9,10,10)	(10,10,10)	(9,10,10)
	P2	(8,9,10)	(7,8,9)	(9,10,10)
	P3	(7,8,9)	(7,8,9)	(8,9,10)
C5	P1	(9,10,10)	(7,8,9)	(10,10,10)
	P2	(8,9,10)	(8,9,10)	(9,10,10)
	P3	(8,9,10)	(7,8,9)	(9,10,10)

Table 6
Fuzzy Rating of Sub Criteria with weight of Representatives

Criteria	*Fuzzy rating criteria with weight of Representatives*		
	R1	*R2*	*R3*
C1	(0.5119,0.5119,0.5119)	(0.3601,0.3601,0.3601)	(0.1151,0.1279,0.1279)
C2	(0.4607,0.3601,0.5119)	(0.3601,0.3601,0.3601)	(0.1151,0.1279,0.1279)
C3	(0.4095,0.4607,0.5119)	(0.2881,0.3241,0.3601)	(0.1151,0.1279,0.1279)
C4	(0.5119,0.5119,0.5119)	(0.3601,0.3601,0.3601)	(0.1279,0.1279,0.1279)
C5	(0.4607,0.5119,0.5119)	(0.3601,0.3601,0.3601)	(0.1279,0.1279,0.1279)

Table 7
Performance Fuzzy Rating of Sub Criteria with weight of Representative

Criteria	*Performance Aspects*	*R1*	*R2*	*R3*
C1	P1	(4.0955,4.6075,5.1194)	(2.8811,3.2412,3.6013)	(1.1512,1.2791,1.2791)
	P2	(3.0716,3.5836,4.0955)	(2.5209,2.8811,3.2412)	(0.8954,1.0233,1.1512)
	P3	(3.5836,4.0955,4.6075)	(2.1608,2.5209,2.8811)	(1.1512,1.2791,1.2791)
C2	P1	(5.1194,5.1194,5.1194)	(3.6013,3.6013,3.6013)	(1.2791,1.2791,1.2791)
	P2	(4.6075,5.1194,5.1194)	(2.5209,2.8811,3.2412)	(1.2791,1.2791,1.2791)
	P3	(5.1194,5.1194,5.1194)	(2.8811,3.2412,3.6013)	(1.2791,1.2791,1.2791)
C3	P1	(4.6075,5.1194,5.1194)	(3.2412,3.6013,3.6013)	(1.0233,1.1512,1.2791)
	P2	(4.0955,4.6075,5.1194)	(2.8811,3.2412,3.6013)	(1.1512,1.2791,1.2791)
	P3	(5.1194,5.1194,5.1194)	(2.8811,3.2412,3.6013)	(1.1512,1.2791,1.2791)
C4	P1	(4.6075,5.1194,5.1194)	(3.6013,3.6013,3.6013)	(1.1512,1.2791,1.2791)
	P2	(4.0955,4.6075,5.1194)	(2.5209,2.8811,3.2412)	(1.1512,1.2791,1.2791)
	P3	(3.5836,4.0955,4.6075)	(2.5209,2.8811,3.2412)	(1.0233,1.1512,1.2791)
C5	P1	(4.6075,5.1194,5.1194)	(2.5209,2.8811,3.2412)	(1.2791,1.2791,1.2791)
	P2	(4.0955,4.6075,5.1194)	(2.8811,3.2412,3.6013)	(1.1512,1.2791,1.2791)
	P3	(4.0955,4.6075,5.1194)	(2.5209,2.8811,3.2412)	(1.1512,1.2791,1.2791)

Step 4: Establishing Fuzzy Ratings Under Various Criteria.

This step discussed the calculation of fuzzy weights $\tilde{W}_j$ of each criteria.

$$\tilde{W}_j = (wj1, wj2, wj3)$$

As w j1 = min {wjk1}

$$Wj2 = 1/K \sum_{k=1}^{K} Wjk2$$

W j3 = max {*wjk3*}

For criteria C11

W j1 = min {*wjk1*}
= min { 0.5119, 0.3601,0.1151}
= 0.1151

W j2 = 1/3 {0.5119+0.3601+0.1279}

= 0.3333

W j3 = max {*wjk3*}

= max { 0.5119,0.3601,0.1279}

= 0.5119

Similarly weights are calculated from the above method for all criteria, that are represented in the below table :

Table 8
Weights of Criteria

C1	*C2*	*C3*	*C4*	*C5*
(0.1151,0.3333,0.5119)	(0.1151,0.2827,0.5119)	(0.1151,0.3042,0.4095)	(0.1279,0.3333,0.5119)	(0.1279,0.3333,0.5119)

Step 5: Fuzzy Ratings Under Various Criteria For Each Performance Aspects

After calculating the aggregate weights of each criteria, aggregate fuzzy rating of each criteria for every performance aspect. The ratings are shown in table 9 which are defined as,

$$\tilde{R} = (a, b, c)$$

Where,

a = min{ak}

$$b = 1/K \sum_{k=1}^{K} bk$$

c = max {*ck*}

So, for Performance Aspect 1 (P1) on the basis of criteria 1,

a = min{ak}
= min { 4.0955,2.8811,1.1512}
= 1.1512

$$b = 1/K \sum_{k=1}^{K} bk$$

b = 1/3 { 4.6075+3.2412+1.2791)
= 3.0426

c = max {ck}

c = max{5.1194,3.6013,1.2791}
= 5.1194

Similarly all the values of the other criteria for each performance aspect were calculated which is shown in the table 9.

Table 9
Fuzzy Performance ratings & Weights

Performance Aspects	*C1*	*C2*	*C3*	*C4*	*C5*
P1	(1.1512,3.0426, 5.1194)	(1.2791,3.3333, 5.1194)	(1.0233,3.2907, 5.1194)	(1.1512,3.3333, 5.1194)	(1.2791,3.0932, 5.1194)
P2	(0.8954,2.4960, 4.0955)	(1.2791,3.0932, 5.1194)	(1.1512,3.0426, 5.1194)	(1.1512,2.9226, 5.1194)	(1.1512,3.0426, 5.1194)
P3	(1.1512,2.6319, 4.6075)	(1.2791,3.2133, 5.1194)	(1.1512,3.2133, 5.1194)	(1.0233,2.7093, 4.6075)	(1.1512,2.9226, 5.1194)
Weights	(0.1151,0.3333, 0.5119)	(0.1151,0.2827, 0.5119)	(0.1151,0.3042, 0.4095)	(0.1279,0.3333, 0.5119)	(0.1279,0.3333, 0.5119)

Step 6 : Calculating Normalized Fuzzy Ratings Under Various Criteria For Each Performance Aspects

Table 10
Normalized Fuzzy Performance ratings & Weights

	C1	*C2*	*C3*	*C4*	*C5*
P1	(0.2248,0.5943, 1.0000)	(0.2498,0.6511, 1.0000)	(0.2498,0.8035, 1.2501)	(0.2248,0.6511, 1.0000)	(0.2498,0.6042, 1.0000)
P2	(0.1749,0.4875, 0.8000)	(0.2498,0.6042, 1.0000)	(0.2811,0.7386, 1.2501)	(0.2248,0.5709, 1.0000)	(0.2248,0.5943, 1.0000)
P3	(0.2248,0.5141, 0.9000)	(0.2498,0.6277, 1.0000)	(0.2811,0.7846, 1.2501)	(0.1999,0.5292, 0.9000)	(0.2248,0.5709, 1.0000)
weights	(0.1151,0.3333, 0.5119)	(0.1151,0.2827, 0.5119)	(0.1151,0.3042, 0.4095)	(0.1279,0.3333, 0.5119)	(0.1279,0.3333, 0.5119)

Table 11
Weighted Normalized Fuzzy Performance ratings matrix

Criteria/Performance Aspects	*C1*	*C2*	*C3*	*C4*	*C5*
V1	(0.0258,0.1980, 0.5119)	(0.0287,0.1840, 0.5119)	(0.0287,0.2444, 0.5119)	(0.0287,0.2170, 0.5119)	(0.0319,0.2013, 0.5119)
V2	(0.0201,0.1624, 0.4095)	(0.0287,0.1708, 0.5119)	(0.0323,0.2246, 0.5119)	(0.0287,0.1902, 0.5119)	(0.0287,0.1980, 0.5119)
V3	(0.0258,0.1713, 0.4607)	(0.0287,0.1774, 0.5119)	(0.0323,0.2386, 0.5119)	(0.0255,0.1763, 0.4607)	(0.0287,0.1902, 0.5119)

Step 7: Finding Fuzzy Positive Ideal and Fuzzy Negative Ideal Solution

Step 7 describes the calculation of fuzzy positive (FPIS) and fizzy negative (FNIS) ideal solution.

Table 12
Distance between Pi (i=1, 2, 3) and P+

	C1	*C2*	*C3*	*C4*	*C5*	*Sum*
d1+ =d(P1,v+)	0.334017804	0.337098977	0.15779047	0.185686834	0.330038	1.344632
d2+= d(P2,v+)	0.266239685	0.394488706	0.157962286	0.207790307	0.332623	1.359104
d3+= d(P3,v+)	0.140648011	0.339258153	0.197677074	0.182813642	0.185687	1.046084

Table 13
Distance between Pi (i=1, 2, 3) and P-

	C1	*C2*	*C3*	*C4*	*C5*	*Sum*
d1- =d(P1,v-)	0.2977	0.293004	0.305484	0.299374	0.293859	1.4894211
d1- =d(P2,v-)	0.235145	0.290753	0.301025	0.294122	0.29323	1.4142755
d1- =d(P3,v-)	0.264729	0.291858	0.304154	0.263561	0.291788	1.4160901

Step 8: Calculating Coefficient of Closeness (CCI)

In this step, closeness of coefficient is calculated for each performance indicator. This coefficient measures the distance to FPIS (V+) and FNIS (V-) by taking the closeness to FPIS.

The closeness coefficient can be calculated as:

$$CCi = \frac{d^{-}}{di^{-} + di^{+}}$$

where i = 1, 2,……., m

Table 14
Computation of V+, V- and CCi

	D+	*D-*	*D+ + D-*	*Cci*
P1	1.3446	1.4894	2.8341	0.5255
P2	1.3591	1.4143	2.7734	0.5099
P3	1.0461	1.4161	2.4622	0.5751

Based on the values obtained of CCi, P3>P1>P2 that means by implementing GSCM Practices, Organizational operational performance is highly improved, followed by environmental performance & then economic performance.

CONCLUSION

The Paper was aimed at finding out effect of GSCM activities on Organizational Performance, using fuzzy AHP approach. We catagorized the common GSCM activities into five important performance Criteria & linked these criteria to organizational performance aspects. Fuzzy approach was applied to give weightage to each of the criteria & the representatives. This study helps the organization to find the linkage between GSCM Activities & the organizational performances in priority order, by using the concept of FPIS and FNIS. The three performance aspects namely environmental performance, economic performance & the operational performance are ranked according to the closeness coefficient and the ranks are found to be P3>P1>P2. So P3 i.e. Operational Performance is found to be highly effected with the implementation of GSCM Activities, followed by environmental performance & then economic performance. This study throws a light on tangible & intangible benefits of implementing GSCM practices & proves a positive realtionship with the performance of organization.

The Study draws a framework for accessement of GSCM activities & its performance criteria. It helps to justify the investments on account of GSCM Implementation, by drawing a positive influential relationship with the Organization performance. It provides guidelines to decision makers, for adopting GSCM practices. Greening the supply chain is the demand of time & this paper gives an insight that by implementing GSCM, Organizations not only contribute to society, But they are also benefitted in terms of improved operational performance & economic performance. Although this research was done in context of Automobile Industry, But its results can be horizontally deployed across other industries as well.

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