Ranking of Drivers of Sustainable Manufacturing

Priyanka Pathak, M. P. Singh

Abstract: Sustainable manufacturing is important criterion nowadays in developing nations like India. Its implementation is made almost compulsory for all types of industries for the sake of the environment. It could be better implemented if its supporting factors are used at priority instead of wasting time with other less important factors that are not worthy in the process of implementation. So, here in this paper already identified drivers of sustainable manufacturing through a vast literature review of past articles are ranked to give them priority numbers, so that these could be used at first in comparison to the lower ones in the hierarchy table for implementation of sustainable manufacturing. As the ranking of factors is a decision-making process, here we used one of the Multi-Criteria Decision Model Techniques, named as a fuzzy linguistics approach of decision making for ranking or prioritization of factor, for ranking of drivers of sustainable manufacturing. Total 13 identified drivers have first categorized in four different criteria with four different decision variables using 5 point linguistic ratings and then has been ranked, from one to thirteen as one is for most supportive driver and thirteenth as least supportive driver of sustainable manufacturing. These are suggested to various industries for implementing sustainable manufacturing an easier task for them. It might be very helpful for them.

Keywords: Sustainable Manufacturing, Fuzzy TOPSIS, Fuzzy Linguistics, Drivers.

I. INTRODUCTION

The primary aim of Sustainable Manufacturing(SM) is to weaken down the harmful impacts of manufacturing over environment. But side by side concerns on finances and people has also been a big factor. Figure 1shows the relation for this:

1. Social or people issues are related to culture of society, poverty, lifestyle, peace, health, happiness, harmony, and education.
2. While the financial issues are employment, standards of living, productivity outcomes, Wealth, Competition and technology.
3. and the environmental issues are harmful emissions, ozone layer depletion, increasing temperature, and lack of natural resources.

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* Correspondence Author
Priytanka Pathak*, Research Scholar, Department of Mechanical Engineering, Jagannath University, Jaipur (Rajasthan) India.
E-mail: pathak.teena@gmail.com
M. P. Singh, Department of Mechanical Engineering, Jaipur (Rajasthan) India. E-mail: mssinghmpsingh@gmail.com

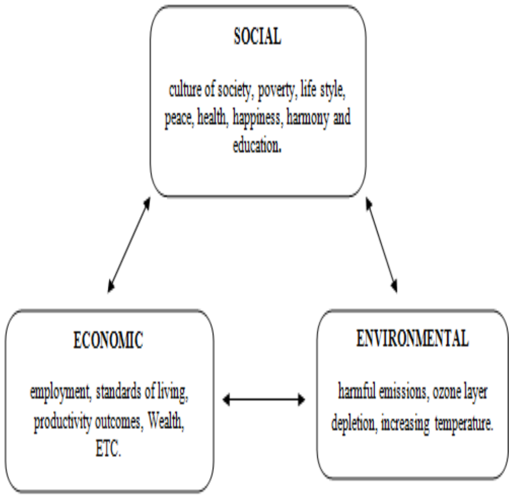

Fig 1: Relationship diagram for three aspects and their interconnections. [1]

II. IDENTIFICATION OF DRIVERS OF SM

Various drivers of sustainable manufacturing have been identified through a vast literature review of previous year papers, and total 13 drivers had identified, which are as follows:

1.Financial/Other Promotional Offers and Supporting. Aspects
2. Surrounding Agencies Pressure
3. Other Agencies Pressure
4. Expected Future Law and Rulings
5. At Present Law and Rulings
6. Industrial Resources
7. Technological Resources
8. Perception of Public
9. Dedication and Synergy among Manufacturers
10. Effects from Supply Chain
11. Monetary Benefits
12. Competition and Benchmarking
13. Expected Demand from Market [2].

III. RANKING PROCEDURE

The term ranking is all about **decision making** when working on a level of importance of factors. When it comes to the performance variables or drivers and performance obstacles or barriers of SM, it means the chapter is dealing with finding the most important to the least important drivers or barriers out of identified 13 drivers and 12 barriers in the previous chapters. So dealing with the different aspects of the same comparison method model is a tough task. It comes under very famous **'Multi-Criteria Decision Model Techniques'** in which utilization of a **fuzzy linguistics approach** is suggested to reduce subjectivity and vagueness in the ranking process for calculating the precedence of the performance factors. The simple purpose of finding the ranking is to mention the top management in manufacturing industries to work more deliberately with most important driver and diminishing the highest barrier in the hierarchy while implementing sustainable manufacturing in their area.

Eclecticism or resolution are decisive terms. These help someone to opt one out of many choices available and is known as a solution to the problem. But sometimes, a single option may not be the final or best solution, but there may be present some other better options too, which at a course of time prove as more valuable than the earlier ones. So, it shows many options or solutions or decisions for a single problem with all options present. "Multiple-criteria evaluation problems" have been presented with 'n' number of options as solutions. These consist of a finite number of alternatives, explicitly known at the beginning of the solution process. The numerous objective-based design approaches in mathematics, do not have options present in the beginning, but one has to solve them for finding such options. The present options are uncountable, these may present both continuous and discrete options to a problem. MCDM "multi-criteria decision problems or multi-criteria evaluation problems" have FUZZY LINGUISTICS as their subset or a type of methodology to solve such kind of alternative available.

A. Fuzzy linguistics or Fuzzy TOPSIS approach of MCDM

In fuzzy MCDM (Chen S. J.et al.;1992), weight and loading are present in form of fuzzy constructs. An option is found out aggregation of weights and ratings collectively. Fuzzy modeling deals with obscure and equivocates mathematical optimization problems and solutions. Fuzzy-sets are present to solve non-statistical uncertainties in a problem. Here, Fuzzy Linguistics approach is used for prioritizing (ranking) the various performance factors (drivers & barriers) of sustainable manufacturing. Figure 2 shows, One triangular fuzzy variable $\tilde{a}$ is presented in a triplet (a_1,a_2,a_3) with conversion scales applicable to change those linguistic constructs to the triplet variables. Member function $\mu_{\tilde{a}}(y)$ can be written in the equation as:

$$\mu_{\tilde{a}}(y) = \begin{cases} \dfrac{y - a_1}{a_2 - a_1}, & a_1 \le y \le a_2 \\ \dfrac{a_3 - y}{a_3 - a_2}, & a_2 \le y \le a_3 \\ 0, & otherwise \end{cases}$$

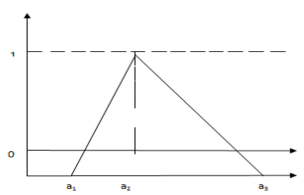

Fig 2: Fuzzy triangular numbers $(a_1, a_2$ and $a_3)$

B. Ranking of Drivers of SM using Fuzzy TOPSIS

The hierarchical structure for drivers of sustainable manufacturing, using four criteria used to rank the 13 drivers for SM. This structure with the assigned criteria and alternatives (the drivers) is given in Figure 3. Linguistic factors with fuzzy loadings to 13 driver options with 4 Major options(criteria) presented through Table I provided in Appendix A.

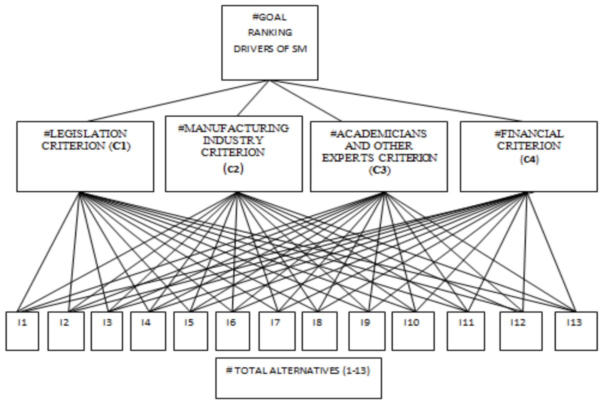

Fig 3: Hierarchy of Alternatives with Criteria for Drivers

Linguistic factors are those, which reveal the factors in their degree terms, usually on five levels or degrees, starting from as “HIGHLY CRUCIAL”, “CRUCIAL”, “important”, “FAIRLY CRUCIAL”, to “FAIRLY CRUCIAL”. Table II revealed these linguistic factors and their corresponding membership functions.

Table- I: Linguistic Variables and Fuzzy Ratings

Name of criterion	Definition of criterion	Type of criterion
Legislation criterion	What is the view of law and order for sustainable manufacturing concepts	Importance for all
Manufacturing industry criterion	What is the view of manufacturing industrialists for sustainable manufacturing concepts	
Academicians and other experts criterion	What is the view of academic and other experts for sustainable manufacturing concepts	
Financial criterion	What is the view in terms of money conditions, funds inflow-outflow for sustainable manufacturing concepts	

Table- II: Linguistic Terms and Membership Function

Linguistic terms for alternative ratings	Linguistic terms for criteria ratings	Membership function
Not Crucial (NI)	Lowest (VL)	(1,1,3)
Low Crucial(LI)	Quite Low (L)	(1,3,5)
Fairly Crucial(FI)	Ok (M)	(3,5,7)
Crucial (I)	Good (H)	(5,7,9)
Highly Crucial (VI)	Very Good (VH)	(7,9,9)

Here, for defining Fuzzy linguistic factors, there are four major factors (criteria) & thirteen sub-choices (drivers) with four DV (decision-making variables). Table III-IV showing the linguistic adoption of all such factors concerning DV.

Data from all DV group's people are covered under one head (the respective DV) either as legislation, manufacturing-people, academicians & other experts or finances. Hence greater criteria data value means greater choices.

Table- III: Linguistic assignment to Criteria for drivers

	Name of criterion	DV1	DV2	DV3	DV4
R1	Legislation criterion	VH	L	M	L
R2	Manufacturing industry criterion	H	L	VL	M
R3	Academicians and other experts criterion	H	H	H	H
R4	Financial criterion	VH	H	H	H

Table- IV: Linguistic assignment to Alternatives for drivers

S. No./ Notation	Driving Factor	R1	R2	R3	R4
I1	Financial/other promotional offers and supporting aspects	I	VI	FI	VI
I2	Surrounding agencies pressure	VI	I	FI	LI
I3	Other agencies pressure	VI	I	FI	LI
I4	Expected future law and rulings	VI	I	I	FI
I5	At present law and rulings	VI	I	I	FI
I6	Industrial resources	FI	I	FI	I
I7	Technological resources	FI	I	FI	VI
I8	Perception of public	I	FI	I	LI
I9	Dedication and synergy among manufacturers	I	VI	FI	LI
I10	Effects from supply chain	LI	VI	FI	FI
I11	Monetary benefits	VI	VI	FI	LI
I12	Competition and benchmarking	FI	VI	VI	FI
I13	Expected demand from market	FI	VI	VI	I

IV. FUZZY TOPSIS APPROACH

The **procedural steps** for ranking of various 13 drivers sustainable manufacturing by Fuzzy TOPSIS approach is further given below:

A. Rating assignment for various major choices and options

If there are present 'k' options(drivers) as I= $\{I_1, I_2, I_3, \ldots\ldots, I_k\}$ which have been checked for criteria 'p' as R = $\{R_1, R_2, R_3, \ldots\ldots, R_p\}$. Criteria loadings presented with w_j = (1,2,3,........,p). Rating assignment for every DM_i = (1,2,3,.........,I) is as such to every choice D_k = (k = 1,2,3,.............,r) in context with criteria Cj = (j = 1,2,3,......................,p) is revealed as $\tilde{U}_i = \tilde{y}_{ijk}$ =(j = 1,2,3,......................,p; k = 1,2,3,.............,r; i = 1,2,3,.........,I) and membership function $\mu\ \tilde{U}_i\ (y)$. Ratings are already assigned in table III and IV for drivers of SM.

B. Computing fuzzy factor values to major options

Here, for computing fuzzy factor values for DV are presented with triplet $\tilde{U}_i = (a_i, b_i, c_i)$; i = 1,2,3,.........,I; so, Fuzzy factor values to major options revealed with Table V:

$$\tilde{U}_i = (a, b, c) \quad i = 1,2,3,\ldots\ldots,I;$$

where, $a = \min_i \{a_i\}$; $b = \frac{1}{i}\sum_{i=1}^{i} b_i$; and $c = \max_i \{a_i\}$

Fuzzy matrix of major options (Ñ) formed by:

$$\tilde{N} = (\tilde{N}_1, \tilde{N}_2, \ldots\ldots, \tilde{N}_r)$$

Table- V: Fuzzy loadings of major options

	DV1	DV2	DV3	DV4	Fuzzy Loading Values
R1	(7,9,9)	(3,5,7)	(1,3,5)	(1,3,5)	(3,5,7)
R2	(1,3,5)	(5,7,9)	(7,9,9)	(7,9,9)	(5,7,9)
R3	(5,7,9)	(5,7,9)	(5,7,9)	(5,7,9)	(5,7,9)
R4	(5,7,9)	(7,9,9)	(3,5,7)	(5,7,9)	(5,7,9)

C. Preparing fuzzy DM

Fuzzy matrix of sub-choices(drivers) Ã presented in Table VI with a given formula as:

$$\tilde{A} = \begin{array}{c} \\ B_1 \\ B_2 \\ \cdots \\ B_m \end{array} \begin{array}{c} \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{bmatrix} \tilde{y}_{11} & \tilde{y}_{12} & \cdots & \tilde{y}_{1n} \\ \tilde{y}_{21} & \tilde{y}_{22} & \cdots & \tilde{y}_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \tilde{y}_{m1} & \tilde{y}_{m2} & \cdots & \tilde{y}_{mn} \end{bmatrix} \end{array}$$

D. Normalizing fuzzy DM

Data in Table VI is normalized by applying "linear scale transformation", through which major options come to a countable stage. Matrix for this is presented in table VII as:

$$\tilde{U} = [\tilde{U}_{ij}]_{p*q} ; \qquad i = 1, 2, \ldots, p ; j = 1, 2, \ldots, q.$$

$$\text{Where,} \quad \tilde{U}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right)$$

c_j^* =max $\{c_{ij}\}$.....(Benefit or Importance Criteria)

Table- VI: Aggregate fuzzy weights of drivers

	R1	R2	R3	R4
I1	(5,7,9)	(7,9,9)	(3,5,7)	(7,9,9)
I2	(7,9,9)	(5,7,9)	(3,5,7)	(1,3,5)
I3	(7,9,9)	(5,7,9)	(3,5,7)	(1,3,5)
I4	(7,9,9)	(5,7,9)	(5,7,9)	(3,5,7)
I5	(7,9,9)	(5,7,9)	(5,7,9)	(3,5,7)
I6	(3,5,7)	(5,7,9)	(3,5,7)	(5,7,9)
I7	(3,5,7)	(5,7,9)	(3,5,7)	(7,9,9)
I8	(5,7,9)	(3,5,7)	(5,7,9)	(1,3,5)
I9	(5,7,9)	(7,9,9)	(3,5,7)	(1,3,5)
I10	(1,3,5)	(7,9,9)	(3,5,7)	(3,5,7)
I11	(7,9,9)	(7,9,9)	(3,5,7)	(1,3,5)
I12	(3,5,7)	(7,9,9)	(7,9,9)	(3,5,7)
I13	(3,5,7)	(7,9,9)	(7,9,9)	(5,7,9)

Table- VII: Normalized drivers

	R1	R2	R3	R4
I1	(0.56,0.78,1)	(0.78,1,1)	(0.33,0.56,0.78)	(0.78,1,1)
I2	(0.78,1,1)	(0.56,0.78,1)	(0.33,0.56,0.78)	(0.11,0.33,0.56)
I3	(0.78,1,1)	(0.56,0.78,1)	(0.33,0.56,0.78)	(0.11,0.33,0.56)
I4	(0.78,1,1)	(0.56,0.78,1)	(0.56,0.78,1)	(0.33,0.56,0.78)
I5	(0.78,1,1)	(0.56,0.78,1)	(0.56,0.78,1)	(0.33,0.56,0.78)
I6	(0.33,0.56,0.78)	(0.56,0.78,1)	(0.33,0.56,0.78)	(0.56,0.78,1)
I7	(0.33,0.56,0.78)	(0.56,0.78,1)	(0.33,0.56,0.78)	(0.78,1,1)
I8	(0.56,0.78,1)	(0.33,0.56,0.78)	(0.56,0.78,1)	(0.11,0.33,0.56)
I9	(0.56,0.78,1)	(0.78,1,1)	(0.33,0.56,0.78)	(0.11,0.33,0.56)
I10	(0.11,0.33,0.56)	(0.78,1,1)	(0.33,0.56,0.78)	(0.33,0.56,0.78)
I11	(0.78,1,1)	(0.78,1,1)	(0.33,0.56,0.78)	(0.11,0.33,0.56)
I12	(0.33,0.56,0.78)	(0.78,1,1)	(0.78,1,1)	(0.33,0.56,0.78)
I13	(0.33,0.56,0.78)	(0.78,1,1)	(0.78,1,1)	(0.56,0.78,1)

E. Applying loadings to normalized DM

After applying "loading", the matrix is revealed as $\tilde{I}$ for major options and it is calculated with the multiplication of Normalized DM $\tilde{U}_{ij}$ and load values ($\tilde{N}_k$).

$$\tilde{I} = [\tilde{I}_{ij}]_{p*q},$$

"i = 1,2,........,p ; j=1,2,........,q"

here, $\tilde{I}_{ij} = \tilde{U}_{ij}(.)\ \tilde{N}_k$

Loaded normalized DM was written as table VIII:

F. Deriving FPIS "positive ideal solution"& FNIS " fuzzy negative ideal solution"

"FPIS" & " FNIS" values are derived as (table VIII), by following procedure:

$Z^+ = (\tilde{I}_1, \tilde{I}_2, \ldots \tilde{I}_n)$ where $\tilde{I}_k = \max\ \{\tilde{I}_{ij}\}$, i= 1,2,....,m; j= 1,2,....,n

$Z^- = (\tilde{I}_1, \tilde{I}_2, \ldots \tilde{I}_n)$ where $\tilde{I}_k = \min\ \{\tilde{I}_{ij}\}$, i= 1,2,....,m; j= 1,2,....,n.

Table- VIII: Loaded normalized factors

	R1	R2	R3	R4
I1	(1.68,3.9,7)	(3.9,7,9)	(1.65,3.92,7)	(3.9,7,9)
I2	(2.34,5,7)	(2.8,5.46,9)	(1.65,3.92,7)	(.55,2.31,5)
I3	(2.34,5,7)	(2.8,5.46,9)	(1.65,3.92,7)	(.55,2.31,5)
I4	(2.34,5,7)	(2.8,5.46,9)	(2.8,5.46,9)	(1.65,3.92,7)
I5	(2.34,5,7)	(2.8,5.46,9)	(2.8,5.46,9)	(1.65,3.92,7)
I6	(0.99,2.8,5.46)	(2.8,5.46,9)	(1.65,3.92,7)	(2.8,5.46,9)
I7	(0.99,2.8,5.46)	(2.8,5.46,9)	(1.65,3.92,7)	(3.9,7,9)
I8	(1.68,3.9,7)	(1.65,3.92,7)	(2.8,5.46,9)	(.55,2.31,5)
I9	(1.68,3.9,7)	(3.9,7,9)	(1.65,3.92,7)	(.55,2.31,5)
I10	(0.33,1.65,3.92)	(3.9,7,9)	(1.65,3.92,7)	(1.65,3.92,7)
I11	(2.34,5,7)	(3.9,7,9)	(1.65,3.92,7)	(.55,2.31,5)
I12	(0.99,2.8,5.46)	(3.9,7,9)	(3.9,7,9)	(1.65,3.92,7)
I13	(0.99,2.8,5.46)	(3.9,7,9)	(3.9,7,9)	(2.8,5.46,9)
FPIS B+	(7,7,7)	(9,9,9)	(9,9,9)	(9,9,9)
FNIS B-	(0.33,0.33,0.33)	(1.65,1.65,1.65)	(1.65,1.65,1.65)	(0.55,0.55,0.55)

G. Compute the distance of each alternative from FPIS and FNIS

The distance (d_i^+ , d_i^-) of each weighted alternative i= 1,2, ..., m from the FPIS and the FNIS is computed as follows:

Let,

$\tilde{\alpha}$= (a_1,a_2,a_3) and $\tilde{\upsilon} = (\nu_1, \nu_2, \nu_3)$ are two triplets, numeral gap in two is found with" relation using vertex method":

$$d\ (\tilde{\alpha}, \tilde{\upsilon}\ ) = \sqrt{\frac{1}{3}[(a_1 - \nu_1)^2 + (a_2 - \nu_2)^2 + (a_3 - \nu_3)^2]}$$

$$d_i^+ = \sum_{j=1}^{n} d$$

CCi of performance factors revealed through table IX.

H. Compute the closeness coefficient (CCi) of each alternative

CCi revealed the numeral gap in FPIS (Z^+) & FNIS (Z^-). Closeness coefficient for every sub-option (driver) is computed in table X & is shown in figure 4 :

$$CCi = \mathbf{I_i^-} / (\mathbf{I_i^-} + \mathbf{I_i^+}) \qquad i = 1, 2. . . m$$

I. Ranking the alternatives or sub-options

In this step, the Highest CCi valued driver or sub-option is prioritized at first position and others are also kept at 2,3,4.............etc. ranks as per their step by step decreasing values in comparison to the first one. The top-ranked driver value is very close to FPIS value in number and very far from FNIS number value.

Table- IX: Loaded normalized factors

	R1	R2	R3	R4	sum		R1	R2	R3	R4	sum
d(I1,I+)	3.55	3.16	5.28	3.16	15.15	d(I1,I-)	4.44	5.39	3.36	6.43	19.62
d(I2,I+)	2.92	4.12	5.28	6.63	18.95	d(I2,I-)	4.84	4.82	3.36	2.78	15.8
d(I3,I+)	2.92	4.12	5.28	6.63	18.95	d(I3,I-)	4.84	4.82	3.36	2.78	15.8
d(I4,I+)	2.92	4.12	4.12	5.28	16.44	d(I4,I-)	4.84	4.82	4.82	4.26	18.74
d(I5,I+)	2.92	4.12	4.12	5.28	16.44	d(I5,I-)	4.84	4.82	4.82	4.25	18.73
d(I6,I+)	4.32	4.12	5.28	4.12	17.84	d(I6,I-)	3.3	4.82	3.36	5.79	17.27
d(I7,I+)	4.32	4.12	5.28	3.16	16.88	d(I7,I-)	3.3	4.82	3.36	6.43	17.91
d(I8,I+)	3.55	5.28	4.12	6.63	19.58	d(I8,I-)	4.44	3.36	4.82	2.78	15.4
d(I9,I+)	3.55	3.16	5.28	6.63	18.62	d(I9,I-)	4.44	5.39	3.36	2.78	15.97
d(I10,I+)	5.25	3.16	5.28	5.28	18.97	d(I10,I-)	2.2	5.39	3.36	4.26	15.21
d(I11,I+)	2.92	3.16	5.28	6.63	17.99	d(I11,I-)	4.84	5.39	3.36	2.78	16.37
d(I12,I+)	4.32	3.16	3.16	5.28	15.92	d(I12,I-)	3.3	5.39	5.39	4.26	18.34
d(I13,I+)	4.32	3.16	3.16	4.12	14.76	d(I13,I-)	3.3	5.39	5.39	5.79	19.87
SUM	47.78	48.96	60.92	68.83		SUM	52.92	64.62	52.12	55.37	

Table- X: Aggregate CCi for alternatives

S. No./ notation	Driving factor	I+	I-	(I+)+(I-)	cci
I1	Financial/other promotional offers and supporting aspects	15.15	19.62	34.77	0.564
I2	Surrounding agencies pressure	18.95	15.8	34.75	0.454
I3	Other agencies pressure	18.95	15.8	34.75	0.454
I4	Expected future law and rulings	16.44	18.74	35.18	0.532
I5	At present law and rulings	16.44	18.73	35.17	0.532
I6	Industrial resources	17.84	17.27	35.11	0.491
I7	Technological resources	16.88	17.91	34.79	0.514
I8	Perception of public	19.58	15.4	34.98	0.44
I9	Dedication and synergy among manufacturers	18.62	15.97	34.59	0.461
I10	Effects from supply chain	18.97	15.21	34.18	0.444
I11	Monetary benefits	17.99	16.37	34.36	0.476
I12	Competition and benchmarking	15.92	18.34	34.26	0.535
I13	Expected demand from market	14.76	19.87	34.63	0.573

V. RESULTS AND DISCUSSIONS

From the point I of the above procedure, the Highest CCi valued driver or sub-option is prioritized at first position and others are ranked as their decreasing value of CCi, from highest to lowest among all 13 drivers. This ranking is shown in table XI, a graphical bar chart of showing CCi span is given in figure 4.And ranks are also shown with a RADAR chart or spider diagram in figure 5.

Table- XI : Ranking the SM drivers

Driver S. No.	Driver Name	Rank
D13	Expected demand from market	1
D1	Financial/other promotional offers and supporting aspects	2
D12	Competition and benchmarking	3
D4	Expected future law and rulings	4
D5	At present law and rulings	5
D7	Technological resources	6
D6	Industrial resources	7
D11	Monetary benefits	8
D9	Dedication and synergy among manufacturers	9
D2	Surrounding agencies pressure	10
D3	Other agencies pressure	11
D10	Effects from supply chain	12
D8	Perception of public	13

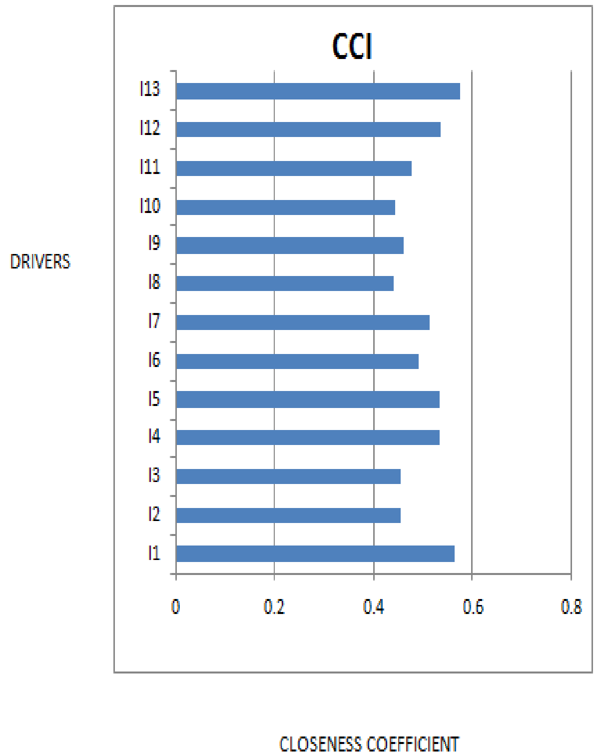

Fig 4: Closeness Coefficients of SM alternatives(drivers)

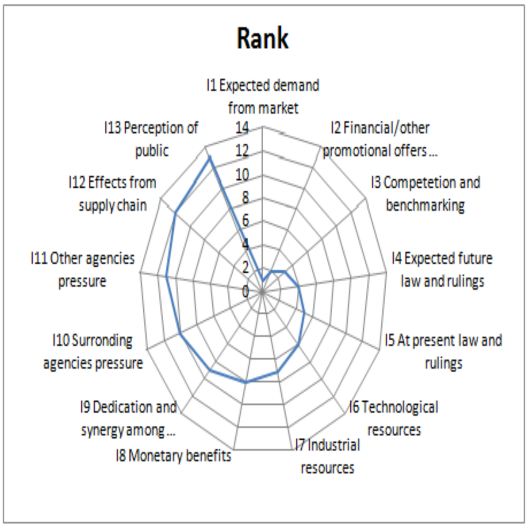

Fig 5: Ranking the SM drivers through a spider diagram

The **analysis** of these results for this linguistics approach applied to SM drivers reveals that 'Expected demand from market' is at top priority. 'Financial/other promotional offers and supporting aspects ' is next preferred which leads to ' Competition and benchmarking '. So, the top three alternatives are found, as those are very advantageous for any industry to help in adopting the SM. Top choice driver; ' Expected demand from market', from all the thirteen, can give any industry high support. If the others in hierarchy get their weight-age at same time' then 'Expected future law and rulings' on number four provide, spread of SM in companies with help of 'At present law and rulings', and both can provide more motivation for implementation.

Also, the ' Technological resources ' at rank six and ' Industrial resources ' at rank seven help in adopting SM. ' Monetary benefits at eight and 'Dedication and synergy among manufacturers' at nine are supporters in industries, perhaps because ' Surrounding agencies pressure ' at ten and ' other agencies pressure' at eleven, provide less motivation for implementation. and at last ' Effects from supply chain' at twelve and ' Perception of public' at rank thirteen got the least priority in small economies as India because of the lack of thinking environment in common people about the value of SM kind of practices.

VI. CONCLUSION

Ranking of drivers of sustainable manufacturing through Fuzzy TOPSIS technique has been done in this research paper. Through this, most fruitful to least worthy drivers are ranked among available 13 drivers and accordingly, these could be used for implementation in manufacturing industries for ease of adoption in developing countries.

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AUTHORS PROFILE

Priyanka Pathak is presently a part-time research scholar at Jagannath University, Jaipur. She has completed her Masters in Technology from Malviya National Institute of Technology, Jaipur (Rajasthan) in Manufacturing Systems Engineering with 8.6 CGPA in 2014. She had pursued her Post Graduate Diploma in Business Administration(PGDBA) with specialization in human resources from Symbiosis Center for Distance Learning in 2010 with 'A' grade. She has completed her Bachelor's of Engineering from Rajasthan University Jaipur in 2006 with honors grade. She is working as lecturer mechanical engineering in private engineering colleges between 2006 to 2008 and later in the technical education department, Government of Rajasthan since 2009. Earlier she was working as Her areas of interest for research are Sustainability, Sustainable production, optimization Techniques, Supply chain management, Simulation, and Modelling.

M. P. Singh is working as Head of the Department in the mechanical engineering department. He has done his Doctor of Philosophy from Jagannath University, Jaipur in 2014. He has completed his Masters in Technology from Malviya National Institute of Technology in 2004, Jaipur in Manufacturing Systems Engineering. He has completed his Bachelor of Engineering from Govt. Engineering College, Kota in 1999. He is having more than 19 years of teaching experience in mechanical engineering. He is having approx 45 research papers in international and national journals, and attended and presented about 28 papers in international and national conferences. His areas of interest for research are Sustainability, Sustainable production, optimization Techniques, Supply chain management, Simulation and Modelling, Advance manufacturing techniques, etc.