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RESEARCH ARTICLE

Performance Mapping of a Firm under Green Supply Chain Architectures-Integrated Operations

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Abstract

Objective: To measure the GSCM-Overall Fuzzy Performance Index (GSCM-OFPI) of industry under integrated operations based GSCM module. **Method:** The author aids the Green Entrepreneurs (GEs) with Overall Fuzzy Performance Index (OFPI) approach to estimation the GSCM-OFPI of industry in the terms of Generalized Trapezoidal Fuzzy Set (GTFs), Crisp Value (CV) and % under proposed module. **Finding:** A hypothetical case research of gear manufacturing industry is exhibited to reveal the real life usage of presented research work. The GEs proposed the ideal limit of GSCM-OFPI such as 1 or 100% for benchmarking perspective. The findings are synchronized only with computation of GSCM-OFPI i.e., 0.80 in the terms of CV and 80 in %. GE is advised to accelerate GSCM-OFPI=0.20 to maintain future GSCM-OFPI. Work model is useful for finding GSCM-OFPI and work is limited only for mapping GSCM-OFPI of an individual firm. **Novelty:** A novel approach has been proposed to evaluate the GSCM-OFPI of a case study firm by overcoming the drawbacks of previous presented research forum, which added the unique features in research work.

Keywords: Module; Linguistic Information; Performance Measurement (PM); Overall Fuzzy Performance Index (OFPI); Green Supply Chain (GSC)

1 Green Supply Chain Management (GSCM) Overview

The GSCM overview reflects various aspects of GSCM. The overview included the GSCM insights at sub-section-1.1, identified research gaps at sub-section-1.2 and structure of model at sub-section-1.3.

1.1 GSCM insights

Supply chain (SC) is considered as a most significant network of organizations, where organizations conclave with each-other for max own business and expand mutual profit. SC dealt with the different processes, which produce the value for firm in the forms of goods and services, to be served to the ultimate customers. SC is said to be a complex network, which performs the procurement of raw material, transforming raw materials into intermediate and then into end-products for distribution and selling of the

products to customers. SC is considered as integrated process, which focus on processing the raw materials into finished products and making it available for end users. SC is a worldwide network of vendors, production firm, warehouses, distributors and retailers via which raw materials are procured, transformed and dispatched to the end users. SC is prioritized as a value-adding alliance between entities that corporate for procuring and transforming the raw materials into finished products through sequential manners. To manage and address the challenges of SC is called as SCM. SCM is ensuring the practices of SC with aiming to provide the materials to collaborated partners at right time and quality**.** SCM is a continuous process to ensure the delivery of raw materials to finished goods at right time by performing the function such as forecasting, purchasing, manufacturing, distribution, and sales and marketing. SCM is an integration of suppliers, manufacturers, warehouses and stores so that good products can be produced and distributed to the customers at right quantities, at right locations at right time under minimizing the system cost. SCM is concerned as practice to integrate the logistic, procurement, operations and marketing functions with other supply chain members, so that material, information as well as finished product may flow up from point of origin to point of consumption under least cost.

It is perceived that nowadays, Green (G) SCM thought is on swing and global researchers are contributing works over GSCM in purpose to build the cleaner and pollution free global industries. GSCM is found as one of the important Operation in the context of modern SCM to win the satisfaction of clients. It is observed that it is necessity to manage the GSC of individual organization. It is only possible today via mapping GSCM in the extent of significant GSCM operations under linked architectures and can be mapped by executing the Performance Measurement (PM) decision support system/tool. PM materializes the efficiency and effectiveness of GSC industry against their practices, processes. Performance Measurement describes the feedback or information on actions of green supply chain towards accomplishing customer expectations and strategic objectives. By peer-review, it is determined that a few research works are conducted in the extent of mixed operations based GSCM module with OFPI approach for mapping GSCM of individual industry, is accepted as research gap. Therefore, the author searched the pre-research gaps that there is a need for developing such as:

- Integrated operations based GSCM module appended with OFPI approach to estimate the GSCM-OFPI of individual organization in the terms of %, crisp value and state about the lagging of performance from 100% or ideal value to mileage up the future GSCM performance.

The above drawbacks are recorded and prioritized as Research Gaps. The relevant literature review is conducted to confirm and shape the pre-RGs. the author utilized the Internet-Based Research Search Engines (IBRSEs) as a search mechanisms, exclusively focus upon the key performance GSCM practices. The number of publications are searched by utilizing the Google based Internet Based Search engine such as The Science Direct - http://www.sciencedirect.com/, Springer Link - https://link.springer.com/, Emerald Insights - http://www.emeraldinsight.com/ links are followed to conduct literature survey. A few of them elaborated below:

Articulated that insufficient numbers of research works are published in relational to measure the SCM performance of firm under green strategies [(1)]. The authors built a Stackelberg leader follower game strategies, where the vendors acted as stackelberg leader and buyers acted as follow. The supplier's pricing decision is maximized by exploring the game-theoretic approach based strategies. It is suggested lastly that buyer's strategies should cooperate with supplier while investing the money for purchasing stuffs [(2)]. Authors said that integrated best-worst strategies with VIKOR technique under interval type-2 fuzzy environment for green supplier need to be addressed. The appropriate green supplier is evaluated by employing the proposed integrated approach [(3)]. Authors defined a rough set based MCDM approach under three decision makers of industry corresponding to five evaluation GSCM PM Metrics against candidate green suppliers. The authors have synchronized the previous work for evaluating and selecting the most suitable supplier for gearboxes Indian iron and steel industry [(4)]. Authors audited the mediating outcome for Service Quality and latent association among the relational capital and organizational performance in a case study of mobile telecommunication setting [(5)]. Authors depicted and analyzed the two sixty three survey of respondents of grocery's store such as managers under COVID-19 pandemic to identify the food SC strategies. The research indicated that SC strategies traceability and sharing data related to customers, positively controls the visibility of Indian market, while visibility influences the acceptance of sustainable indices for customers [(6)]. Developed interval-valued fuzzy number set and merged this with modified MCDM technique TOPSIS for benchmarking supplier firms under agile supply chain actions [(7)]. Used a revised ranking approach accompanied with fuzzy performance important index to identify the barriers/ill-strong measures in Agile Supply Chain Management [(8)]. The authors investigated the cost and risk sharing contract affects over the green supply by calculating the optimal decision of each decision modes [(9)]. The authors examined the mediating effect of SC visibility over the BDAC–GSCI links and its moderate effects over flexibility and control-oriented culture [(10)]. The author calculated the consumers' perceived value analyzing the trustworthiness levels of the green and quality-safety information proposed by the supplier and the producer [(11)]. The author used the product pricing and green promotion efforts based

policies and analyzed the influences of green promotion efforts, financial interest rate and free-riding behavior under optimal operations [12]. The authors examined the influence of internal GSCM practices, green human resource management and supply chain environmental cooperation on firm performance and SCM [13]. The author developed the coordination mechanism between food producer and supplier under cost concerns related to green food production and marketing in the context of SCM [14]. The authors proposed a novel series-parallel inventory and redundancy allocation system in the context of green supply chain included a single manufacturer and multiple retailers operations in several positions [15]. The authors identified the interrelations among the green GSCM pressures, practices and performance measures. The authors compared the reasons of GSCM implementation, levels of implementation and improvement in performance for large ceramic enterprises [16]. The authors built a novel fuzzy based gain-loss computational approach and applied the same towards fuzzy solving the resilient supplier problem of modern SCM [17]. The authors suggested the factors of block chain based technology to be adapted by industries to boost up the GSCM [18]. The authors provided the meaning of fuzzy set and explain various usages of fuzziness mathematical tools in decision making problems [19]. The authors used the data of 76 commercial banks of four countries, since period 2009-2018. The Generalized Method of Moments (GMM) is executed to analyze the customer's results of commercial banks. It is found that SC qualitative assessment is required by bank to obtain the crowd of customers [20]. The authors proposed an integrated theoretical for digital project-driven supply chains (PDSC) to address multiple objectives in Architecture, Engineering, Construction and, Operations and Maintenance (AECOM) value SC. [21]. The authors measured and validated the information of entrepreneurial measures and the main constructs by using the socio-cognitive career theory. It is declared that entrepreneurial career require the understand ability of SC practices [22]. The authors empirically investigated the mediating effect of Service Quality (SQ) and potential relationship between Relational Capital (RC) and Organizational Performance (OP) in a case study of Egyptian mobile telecommunication setting for developing robust SCM [23]. The authors analyzed the 236 survey of respondents of UK retail grocery stores' under COVID-19 pandemic to identify the food SC barriers [24]. The authors investigated the performance of three-echelon SC under uncertainty concern by testing the results of influence against contract sequence [25]. The authors conducted a multi-tier analysis over the medical equipment SCM network under an empirical case study of a firm [26]. The authors investigated the gauging managerial response against disruption and abnormal demand under last mile distribution [27]. The authors investigated the trend of fresh produce SC and provided suggestion the barriers to be improved for Indian context industries [28]. The authors suggested the digital barriers linked to improve the circular economy of production system and applied the fuzzy modelling over barriers to audit the level of circular economy across production system. The authors suggested a few significant digital barriers, which need to be mileage up for enhancing the future sustainability [29] . The authors quantified the behaviour intention of individuals to control SCM performance of a case study Indian organization by executing the cloud storage services based extended UTAUT2 technique [30].

After conducting literature review on applications of MCDM module towards tackling the performance measurement problems of a firm under GSCM strategies, the authors confirmed the prior research gaps.

1.2 Research objectives

The confirmed RGs are transformed into research agendas. Research objectives argued that there is need to develop such as:

- Universal GTFs based GSCM significant operational module, which can map the GSCM of an individual firm in the terms of fuzzy, crisp value and percentage %.
- To shape a GSCM-OFPI approach to find out the lagging of estimated GSCM performance from expected or ideal GSCM performance.
- To suggest the GSCM architectures, WHICH need to be augmented to meet expected or ideal GSCM performance.

1.3 Module development

As research gaps are confirmed, the author explored the organized literature review of 36 significant Research Documents (RDs) to construct the module. Out of 36 RDs, 22 are used to frame the methodology/approach and 10 RDs are explored to construct GTFs based GSCM module, residue are not considered to shape research work. The grounds for not including the 4 RDs are such as one RD is not clearly debating with GSC performance mapping of firm. One RD is linked to alternative evaluation problem of multiple organizations under objective information and residue two is focused on trend analysis of GSCM. The RDs divergence summary is depicted by Figure 1. The description of module's architectures and aligned operations is exhibited here: Green stuff checking, ($C_{1,1}$), Green logistic, ($C_{1,2}$), Green delivery, ($C_{1,3}$), Green buying, ($C_{1,4}$) and Green machines utilization, ($C_{1,5}$) under first level of hierarchy (Raw material linked Operations). While, Competitive advantage in adopting green strategies, ($C_{2,1,}$), Green manufacturing, ($C_{2,2}$), Establishing firm's green brand, ($C_{2,3}$), Effort environmentally friendly products, ($C_{2,4}$) and Effort toward environmentally friendly packages, ($C_{2,5}$) under second level of hierarchy (Production Operations). The

structure of model is shown below by Figure 2.

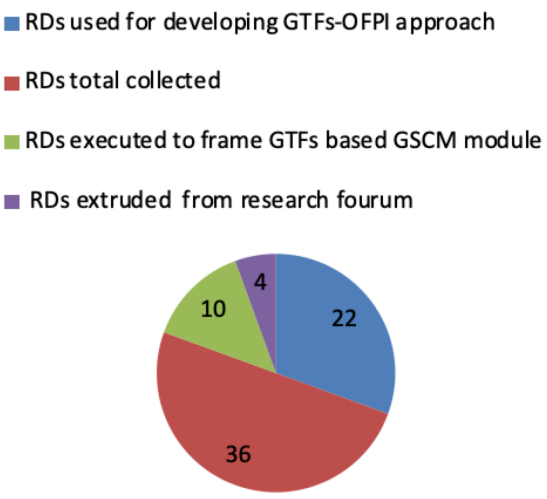

Fig 1. RDs divergence summary

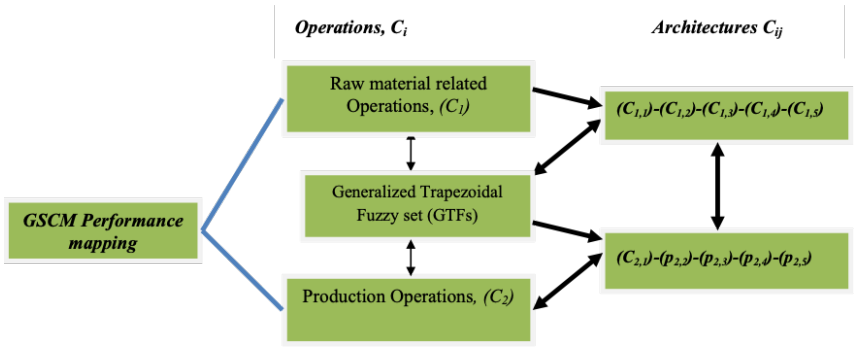

Fig 2. GSCM module development

2 Methodology

The author employed the GSCM-OFPI approach overa developed module to estimate the performance in individual organization in different terms. The method is applicable for all the structured modules. The below section 2.1 depicted the research framework-2.2 revelated Fuzzy Performance Model (FPM) [31].

2.1 The Structure of research

The structure of research explicates the structure to be used for solving the problems of other disciplines. Figure 3 depicts the structure of research work.

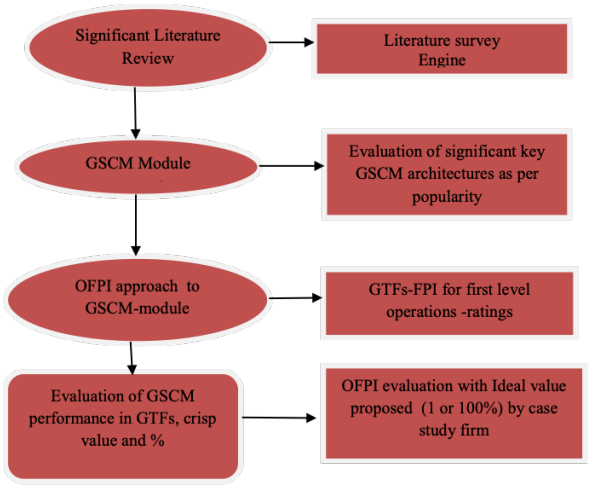

Fig 3. The structure of conducted research work

2.2 Overall Fuzzy Performance Index (OFPI) approach

OFPI approach is executed to summarize the fuzzy performance of an individual industry. It can tackle the fuzzy data. The core aim is to usage of (OFPI) mathematical model for estimate the overall performance of a industry in various forms of fuzzy set by tackling the subjectivity associated with architectures of module. Currently, it is in comprehensive use for benchmarking purpose of supplier agents in the forum of GSCM. The description of OFPI mathematical model is said below:

A fuzzy set in $\tilde{A}$ in a universe of discourse X is characterized by a membership function $\mu_{\tilde{A}}(x)$ which associates with each element x in X a real number in the interval [0, 1]. The function value $\mu_{\tilde{A}}(x)$ is termed the grade of membership of x in $\tilde{A}$. A trapezoidal fuzzy number can be defined as and the membership function, is defined as $\tilde{A} = (a_1, a_2, a_3, a_4; w_{\tilde{A}})$and the membership function $\mu_{\tilde{A}}(x) : R \to [0, 1]$, is defined as follows:

$$\mu_{\tilde{A}}(x) = \begin{cases} \dfrac{x - a_1}{a_2 - a_1} \times w_{\tilde{A}}, & x \in (a_1, a_2) \\ w_{\tilde{A}}, & x \in (a_2, a_3) \\ \dfrac{x - a_4}{a_3 - a_4} \times w_{\tilde{A}}, & x \in (a_3, a_4) \\ 0, & x \in (-\infty, a_1) \cup (a_4, \infty) \end{cases} \tag{1}$$

Here, $a_1 \le a_2 \le a_3 \le a_4$ and $w_{\tilde{A}} \in (0, 1)$

Suppose that $\tilde{a} = (a_1, a_2, a_3, a_4; w_{\tilde{A}})$are $\tilde{b} = (b_1, b_2, b_3, b_4; w_{\tilde{B}})$ two trapezoidal fuzzy numbers, then the operational rules of the trapezoidal fuzzy numbers $\tilde{a}$ and $\tilde{b}$are shown as follows:

Addition Operation:

$$\begin{aligned} \tilde{a} \oplus \tilde{b} = (a_1, a_2, a_3, a_4; w_{\tilde{A}}) \oplus (b_1, b_2, b_3, b_4; w_{\tilde{B}}) = \\ (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4; \min(w_{\tilde{A}}, w_{\tilde{B}})) \end{aligned} \tag{2}$$

Substation Operation:

$$\begin{aligned} \tilde{a} - \tilde{b} = (a_1, a_2, a_3, a_4; w_{\tilde{A}}) - (b_1, b_2, b_3, b_4; w_{\tilde{B}}) = \\ (a_1 - b_4, a_2 - b_3, a_3 - b_2, a_4 - b_1; \min(w_{\tilde{A}}, w_{\tilde{B}})) \end{aligned} \tag{3}$$

Multiplication Operation:

$$\begin{aligned} \tilde{a} \otimes \tilde{b} = (a_1, a_2, a_3, a_4; w_{\tilde{A}}) \otimes (b_1, b_2, b_3, b_4; w_{\tilde{B}}) = \\ \tilde{a} \otimes \tilde{b} = (a_1 \times b_1, a_2 \times b_2, a_3 \times b_3, a_4 \times b_4; \min(w_{\tilde{A}}, w_{\tilde{B}})) \end{aligned} \tag{4}$$

Division Operation:

$$\begin{aligned}\tilde{a}/\tilde{b} &= (a_1,a_2,a_3,a_4;w_{\tilde{A}})/(b_1,b_2,b_3,b_4;w_{\tilde{B}}) \\ &= (a_1/b_4,a_2/b_3,a_3/b_2,a_4/b_1;\min(w_{\tilde{A}},w_{\tilde{B}}))\end{aligned} \tag{5}$$

$C_i = i^{\text{th}}$ = 1st level evaluation index; i = 1, 2, ..., m.

$C_{ij} = j^{\text{th}}$ 2nd level evaluation index which is under j^{th} 1st level evaluation index C_j ; j = 1,2, ..., n.

The computed fuzzy rating of individual 1st level evaluation criteria can be calculated as (Equation. 6) [32,33].

$$U_i = \frac{\sum_{j=1}^{n}(w_{ij}\otimes U_{ij})}{\sum_{j=1}^{n} w_{ij}} \tag{6}$$

Here u_{ij} represents aggregated fuzzy performance measure (rating) and w_{ij}represent aggregated fuzzy importance grade corresponding to interrelated architectures c_{ij} at 2nd level. Also, u_{ij} represents the computed fuzzy performance measure (rating) corresponding to the index c_i at 1st level. Thus, overall fuzzy performance index *U(FPI)* can be obtained as follows [34,35].

$$U(FPI) = \frac{\sum_{i=1}^{m}(w_i\otimes U_i)}{\sum_{i=1}^{m} w_i} \tag{7}$$

Here u_i= rating of i^{th} 1st level evaluation index C_i; w_i= Importance grade of i^{th} 1st level evaluation index c_i.

3 Result and discussion

The result and discussion included the GSCM Performance Measurement-Case study-3.1 and results-3.2.

3.1 GSCM Performance Measurement-Case study

A hypothetical case research, where GSCM performance measurement under mixed green operations linked architecture means module is carried out. The proposed decision support system (consisted of module with OFPI approach) is explored to measure the GSCM of firm. In module, GSCM module included such as Green raw material checking, ($C_{1,1}$), Green transportation, ($C_{1,2}$), Green delivery, ($C_{1,3}$), Green purchasing, ($C_{1,4}$), Green equipment, ($C_{1,5}$), Competitive advantage in adopting green strategies, ($C_{2,1,}$), Green production, ($C_{2,2}$), Establishing firm's green image, ($C_{2,3}$), Effort environmentally friendly goods, ($C_{2,4}$), Effort toward environmentally friendly packages, ($C_{2,5}$) at 2nd level and green procurement and production at 1st level. A committee of four expert's panel KL, K2, K3 and K4 is formed to express their ratings preferences in linguistic terms against 2nd level architectures.

The practical steps for measuring the SC Performance of a firm such as gear and shaft under mixed green strategies i.e. presented below.

Step 1: Constructed of a team of decision making panel for evaluating the GSCM performance ratings and weights against architectures of aforesaid module. The module is shown Table 1.

Step 2: Evaluated and selected the appropriate linguistic scale for ratings and importance weights against evaluation operations and allied architectures, shown in Table 2.

Step3: Converted the linguistic terms into Generalized Trapezoidal Fuzzy Numbers (GTFNs), is shown in Table 2.

Step4: Team assigned the linguistic ratings and weights for 2nd and 1st level, is depicted in Tables 3, 4 and 5. Next, same assigned linguistic variables (in the forms of GTFs) are aggregated for 2nd level architectures (aggregated GTFs-ratings cum weights) and 1st level operations (aggregated GTFs weights) by using Equation.1-5, is shown in Tables 6 and 7, respectively.

Step 5: Applied FPI (Equation. 6) on aggregated GTFs-ratings and weights of 2nd level architectures to calculate FPI of 1st level GSCM operations.

Step 6: OFPI (Equation. 7) is applied over evaluated FPI of 1st level GSCM operations with aggregated GTFs-weights of 1st level operations to calculate OFPI of case study firm, is shown in Table 7.

3.2 Results

The OFPI becomes (0.408179, 0.539028, 1.085557; 1.256745), It is evaluated 0.80 in terms of crisp value. The managers proposed the FPI (1.0, 1.0, 1.0, 1.0; 1.0) as ideal GTFs. It is found that 1 in CV. The results stated that firm has to improve 0.20 to maintain future GSCM performance. The results are shown in Figure 4.

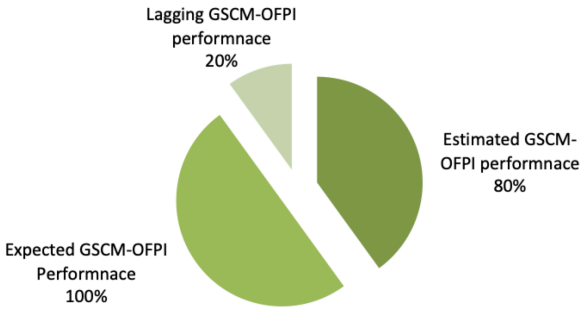

Fig 4. GSCM-OFPI Performance by pie chart

Table 1. Integrated operationsbased GSCM module

Goal (C)	Mixed Operations	Interrelated architectures, (C_{ij})	Citations
OFPI Performance measurement of GSCM of individual industry	Raw-materials linked Operations	Green stuff checking, ($C_{1,1}$)	(3)
		Green logistic,($C_{1,2}$)	(4)
		Green delivery ,($C_{1,3}$)	(6)
		Green buying,($C_{1,4}$)	(7)
		Green machines utilization, ($C_{1,5}$)	(14)
	Production Operations	Competitive advantage in adopting green strategies, ($C_{2,1,}$)	(23)
		Green manufacturing ,($C_{2,2}$)	(26)
		Establishing firm's green brand, ($C_{2,3}$)	(28)
		Effort environmentally friendly products,($C_{2,4}$)	(29)
		Effort toward environmentally friendly packages, ($C_{2,5}$)	(30)

Table 2. Set of linguistic variables and their corresponding fuzzy representations

Linguistic terms for importance grade	Linguistic terms for performance rating	Fuzzy representation
DL: Definitely low	DL: Definitely low	(0.0, 0.0, 0.0, 0.0; 1.0)
VL: Very low	VL: Very low	(0.0, 0.0, 0.02, 0.07; 1.0)
L: Low	L: Low	(0.04, 0.10, 0.18, 0.23; 1.0)
ML: More or less low	ML: More or less low	(0.17, 0.22, 0.36, 0.42; 1.0)
M: Middle	M: Middle	(0.32, 0.41, 0.58, 0.65; 1.0)
MH: More or less high	MH: More or less high	(0.58, 0.63, 0.80, 0.86; 1.0)
H: High	H: High	(0.72, 0.78, 0.92, 0.97; 1.0)
VH: Very high	VH: Very high	(0.93, 0.98, 1.0, 1.0; 1.0)
DH: Definitely high	DH: Definitely high	(1.0, 1.0, 1.0, 1.0; 1.0)

Table 3. Appropriateness ratings in terms of linguistic variable for 2nd level GSCM architectures

Architectures, (C_{ij})	K_1	K_2	K_3	K_4
($C_{1,1}$)	VL	VL	VL	DH
($C_{1,2}$)	VL	MH	MH	H
($C_{1,3}$)	ML	H	H	H
($C_{1,4}$)	MH	MH	MH	DH
($C_{1,5}$)	DH	VL	L	H
($C_{2,1}$)	H	H	DH	DH
($C_{2,2}$)	MH	VL	VL	DH
($C_{2,3}$)	MH	MH	MH	H
($C_{2,4}$)	VL	MH	MH	DH
($C_{2,5}$)	ML	H	MH	H

Table 4. Importance weights in terms of linguistic variable for 2nd level GSCM architectures

Architectures, (C_{ij})	K_1	K_2	K_3	K_4
($C_{1,1}$)				
($C_{1,2}$)				
($C_{1,3}$)	MH	MH	MH	MH
($C_{1,4}$)	VL	VL	VL	DH
($C_{1,5}$)	MH	MH	MH	MH
($C_{2,1}$)	DH	DH	DH	DH
($C_{2,2}$)	VL	VL	VL	DH
($C_{2,3}$)	MH	MH	MH	DH
($C_{2,4}$)	MH	MH	MH	DH
($C_{2,5}$)	H	H	MH	DH

Table 5. Importance weights in terms of linguistic variable for 1st level GSCM mixed operations

Criteria, (C_i)	Importance weights			
(C_1)	H	H	H	H
(C_2)	H	MH	MH	H

Table 6. Computed appropriateness ratings and importance weights for 2nd level architectures

Criteria, (C_{ij})	Computed appropriateness ratings	Computed importance weights
($C_{1,1}$)	(0.50,0.50,0.51,0.54;1.00)	(0.58,0.63,0.80,0.86;1.00)
($C_{1,2}$)	(0.25,0.25,0.27,0.30;1.00)	(0.25,0.25,0.27,0.30;1.00)
($C_{1,3}$)	(0.26,0.28,0.31,0.34;1.00)	(0.26,0.28,0.31,0.34;1.00)
($C_{1,4}$)	(1.00,1.00,1.00,1.00;1.00)	(1.00,1.00,1.00,1.00;1.00)
($C_{1,5}$)	(0.25,0.25,0.27,0.30;1.00)	(0.25,0.25,0.27,0.30;1.00)
($C_{2,1}$)	(0.50,0.50,0.51,0.54;1.00)	(0.58,0.63,0.80,0.86;1.00)
($C_{2,2}$)	(0.25,0.25,0.27,0.30;1.00)	(0.25,0.25,0.27,0.30;1.00)
($C_{2,3}$)	(0.69,0.72,0.85,0.90;1.00)	(0.69,0.72,0.85,0.90;1.00)
($C_{2,4}$)	(0.69,0.72,0.85,0.90;1.00)	(0.69,0.72,0.85,0.90;1.00)
($C_{2,5}$)	(0.76,0.80,0.91,0.95;1.00)	(0.76,0.80,0.91,0.95;1.00)

Table 7. Computed importance weights for 1st level GSCM operations

Criteria, (C_i)	Computed importance weights
(C_1)	(0.75, 0.78, 0.92, 0.97; 1.0)
(C_2)	(0.72, 0.78, 0.92, 0.97; 1.0)

4 Conclusions

Multi Criterion Decision Making (MCDM) is found out activated towards undertaking industrial management problems in the pitch of SCM operations. In MCDM, PM is found as a significant soft device at global standard for mapping the GSCM efficiency and effectiveness of firms. Effectiveness is extent to which client requirements are met, while efficiency measures how cheaply a firm's capitals are brought into use.

The research work proposed a mixed/integrated operations based MCDM-GSCM module included Raw material related Operations and production at 1st level and Green stuff checking, ($C_{1,1}$) Green logistic, ($C_{1,2}$), Green delivery, ($C_{1,3}$), Green buying, ($C_{1,4}$), Green machines utilization, ($C_{1,5}$), Competitive advantage in adopting green strategies, ($C_{2,1,}$), Green manufacturing, ($C_{2,2}$), Establishing firm's green brand, ($C_{2,3}$), Effort environmentally friendly products, ($C_{2,4}$), Effort toward environmentally friendly packages, ($C_{2,5}$) at 2nd level. The above module realized the linguistic information of four experts in the terms of linguistic variables. To cover the risk included in subjectivity of architectures, the GTFs is applied. The OFPI approach is used to calculate the GSCM-OFPI, which is found (0.508179, 0.639028, 1.085557; 1.356745), It is evaluated 0.80 in

terms of Crisp Value (CV). The managers proposed the OFPI 1 or 100% for benchmarking purpose. It is found that 0.20 need to be mileage up to maintain future overall GSCM performance. As a part of managerial implication, the presented fuzzy based DSS, can be used for measuring GSCM performance of other firm excluding presented case study under same set of operations corresponding to total ten architectures. The research work is assisting the GSCM researchers and readers of environmental economic forum to understand the future defies, practices, operations and architectures of GSCM.

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