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Identification of Green Supply Chain Practices of a Company: An Empirical Research

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Abstract—*In present paper, a green supply chain management index has been constructed from the extension of literature review. The author has applied the Triangular Fuzzy Number (TFN) set coupled with center of gravity method in order to rank the weak and ill define criterion. Eventually, the suggestions are provided to managers to amend the performance of preferred candidate alternative industry. An empirical study has carried out to exhibit the feasibility, effectiveness and validity of the proposed method.*

Keywords*: Green supply chain management, green supply chain, fuzzy logic.*

INTRODUCTION

In recent years, environmental (green) management has evolved to be included in the boundary of supply chain i.e. both upstream and downstream activities. The Green Supply Chain Management (GSCM) is used as a strategy for enhancing productivity and environmental performance and bringing the overall socio-economic development [1,2]. It is the application of appropriate techniques, technologies, and management systems to produce the environmentally compatible goods and services. GSCM philosophy focuses on how firms utilize the supplier's processes and technologies, as well as the supplier's ability to integrate environmental concerns and enhance the firm's competitive advantage. GSCM is defined as an emerged important organizational philosophy to achieve corporate profit and market share objectives by reducing environmental risks and impacts while improving ecological efficiency of these organizations and their partners [6]. Fig. 1 has shown the green supply chain.

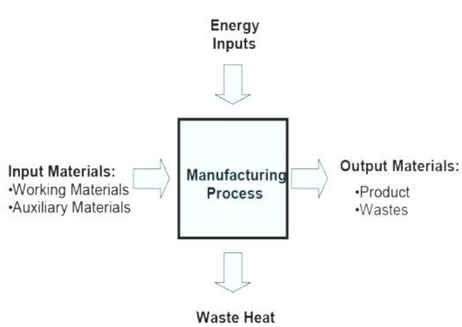

Fig. 1 Green supply chain

FUZZY LOGIC

The fuzzy set theory was first introduced by [3] for dealing with problems in which a source of vagueness is present. It has been considered as a modeling language to approximate situations in which fuzzy phenomena and fuzzy criteria exist. MCDM is concerned with structuring and solving decision and planning problems involving multiple criteria. The purpose is to support decision makers facing such problems. Typically, there does not exist a unique optimal solution for such problems and it is necessary to use decision maker's preferences to differentiate between solutions. Solving can be interpreted in different ways. It could correspond to choosing the "best" alternative from a set of available.

Methodology:

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

$$\tilde{a} \oplus \tilde{b} = (a_1, a_2, a_3) \oplus (b_1, b_2, b_3) = (a_1 + b_1, a_2 + b_2, a_3 + b_3) \quad (1)$$

$$\tilde{a} - \tilde{b} = (a_1, a_2, a_3) - (b_1, b_2, b_3) = (a_1 - b_3, a_2 - b_2, a_3 - b_1) \quad (2)$$

$$\tilde{a} \otimes \tilde{b} = (a_1, a_2, a_3) \otimes (b_1, b_2, b_3) =$$

$$\tilde{a} \otimes \tilde{b} = (a_1 \times b_1,\ a_2 \times b_2,\ a_3 \times b_3) \quad (3)$$

$$\tilde{a} / \tilde{b} = (a_1, a_2, a_3) \big/ (b_1, b_2, b_3) \quad (4)$$

$$= (a_1 / b_3, a_2 / b_2, a_3 / b_1)$$

Formulation of the Decision-Making Problem

Let $E = \{e_1, e_2, ..., e_q\}$ be the set of decision-makers in the group decision making process. $A = \{A_1, A_2, ..., A_m\}$ be the set of alternatives, and $C = \{C_1, C_2, ..., C_n\}$ be the set of criteria-attributes.

Suppose that $\tilde{\tilde{a}}_{ijk} = (a_{ijk1}, a_{ijk2}, a_{ijk3}, a_{ijk4}; w_{ijk})$ is the attribute value given by decision maker e_k, where $\tilde{\tilde{a}}_{ijk}$ is a trapezoidal fuzzy number for the alternative A_i with respect to the attribute C_j.

Let $\tilde{\tilde{w}}_{kj} = (w_{kj1}, w_{kj2}, w_{kj3}, w_{kj4}; \eta_{kj})$ be the attribute weight given by the decision maker e_k, where $\tilde{\tilde{w}}_{kj}$ is also a trapezoidal fuzzy number. Then the aggregated fuzzy rating of alternatives with respect to each criterion can be defined as

Where,

$$a_{ij} = \frac{1}{K} \sum_{k=1}^{K} a_{ijk} \tag{5}$$

$$b_{ij} = \frac{1}{K} \sum_{k=1}^{K} b_{ijk}$$

$$c_{ij} = \frac{1}{K} \sum_{k=1}^{K} c_{ijk}$$

Then the aggregated fuzzy weight of each criterion can be defined as:

$$\tilde{\tilde{w}}_j = (w_{j1}, w_{j2}, w_{j3}) \tag{6}$$

Where,

$$w_{j1} = \frac{1}{K} \sum_{k=1}^{K} w_{kj1}$$

$$w_{j2} = \frac{1}{K} \sum_{k=1}^{K} w_{kj2}$$

$$w_{j3} = \frac{1}{K} \sum_{k=1}^{K} w_{kj3}$$

Construction of Weighted Decision-Making Matrix

Let $\tilde{\tilde{V}} = [\tilde{\tilde{v}}_{ij}]_{m \times n}$ be the weighted matrix, then:

$$\tilde{\tilde{v}}_{ij} = \tilde{\tilde{x}}_{ij} \otimes \tilde{\tilde{w}}_j \tag{7}$$

The center of gravity method to convert the triangular fuzzy set $(A, B; C)$ in to the measured or script value form [4]:

$$\frac{A + 4B + C}{6} \tag{8}$$

Procedural steps of identifying ill performance criteria:

Step 1: Form a committee of five decision-makers, and then identify the evaluation criteria of green production; revealed in Table (1).

Step 2: Choose the appropriate linguistic variables for the importance weight of the criteria and the linguistic ratings; revealed in Table (2).

Step 3: Aggregate the weight of criteria to get the aggregated fuzzy weight $\tilde{w}_j$ of criterion C_j, and the decision-makers' ratings to get the aggregated fuzzy rating $\tilde{x}_{ij}$ of green production initiatives A_j under criterion C_j; solved by (Equa. 5, 6) and revealed in Table (3).

Step 4: Construct weighted normalized fuzzy decision matrix.

Step 5: Defuzzification led to ranking the initiatives; solved by (Equa. 8) and revealed in Table (3).

Step 6: Rank the alternatives; higher value high ranking and no need to amend this criteria revealed in Table (3).

CONCLUSION

In today's globalization, enterprises have paid more attention on green supply chain management issues for generating the environmental value. In this research work, the authors explored the Triangular Fuzzy Number (TFN) set coupled with center of gravity method to rank the weak and ill define **c**riterion and deliver the suggestion to amend the performance of preferred candidate alternative industry. The result has been shown in Fig (2). Finally, an empirical study has carried out in order to exhibit the feasibility, effectiveness and validity of the proposed methodology.

REFERENCES

[1] Sarkis, J. (1998). Evaluating environmentally conscious business practices, European *Journal of Operational Research*, Vol. 107, No. 1, pp. 159–174.

[2] Lee, A.H.I., Kang, H.Y., Hsu, C.F. and Hung, H.C. (2009). A green supplier selection model for high-tech industry, *Expert Systems with Applications*, Vol. 36 pp. 7917–7927.

[3] Zadeh, L. A. (1965). Fuzzy Sets, *Information and Control* '', Vol. 8, pp. 338-353.

[4] Leekwijck, V and Kerre (1999) ''Defuzzification: criteria and classification'', *Journal of Fuzzy Sets and Systems*, Vol. 108, pp. 159-178.

[5] Huiyu, C and Weiwei, W. (2010), 'Green supply chain management for a chinese auto manufacturer', *Department of Technology and Built Environment*, university of GAVLE.

[6] Van Hoek, R. I. (1999). From reversed logistics to green supply chains', Supply Chain Management: An International Journal, Vol. 4, No. 3, pp.129 – 135.

Table 1 Green production index [5]

Goal (C)	Initiatives
Green production initiatives evaluation	E-logistics and environment, C1
	Skill policy entrepreneurs, C2
	Integration with green product suppliers, C3
	Scrap/ waste reduction, C4
	Quality improvement, C5
	Delivery improvement, C6

Table 2: Definitions of linguistic variables for the ratings and priority importance of each criterion: Corresponding fuzzy representation

Linguistic variables	Linguistic variables	Triangular interval-valued fuzzy numbers
Very Poor (VP)	Very Low (VL)	(0,0,0.167)
Poor (P)	Low (L)	(0,0.167,0.333)
Moderately Poor (MP)	Medium Low (ML)	(0.167,0.333,0.5)
Fair (F)	Medium (M)	(0.333,0.5,0.668)
Moderately Good (MG)	Medium High (MH)	(0.5,0.668,0.835)
Good (G)	High (H)	(0.668,0.835,1)
Very Good (VG)	Very High (VH)	(0.835,1,1)

Table 3: Priority rating and weights (in linguistic scale) against individual indices assigned by DMs for industry

1st level indices	Priority rating (in linguistic scale) for indices assigned by DMs				
	DM1	DM2	DM3	DM4	DM5
C1	VG	MG	VG	MG	F
C2	VG	MG	F	MP	G
C3	G	MG	G	MP	G
C4	F	MG	F	G	G
C5	MG	G	VG	VG	VG
C6	F	F	VG	MP	G
Ci	Priority rating (in linguistic scale) for indices assigned by DMs				
C1	ML	M	H	MH	VH
C2	H	H	H	H	H
C3	MH	H	M	VH	M
C4	VH	H	VH	M	VH
C5	M	M	H	H	H
C6	H	VH	VH	VH	MH

Table 3: Ranking order of criterion

C1	[0.301,0.512,0.695]	0.507127
C2	[0.334,0.557,0.801]	0.560575
C3	[0.285,0.491,0.723]	0.495575
C4	[0.351,0.579,0.779]	0.574154
C5	[0.392,0.631,0.839]	0.626024
C6	[0.343,0.571,0.742]	0.561261

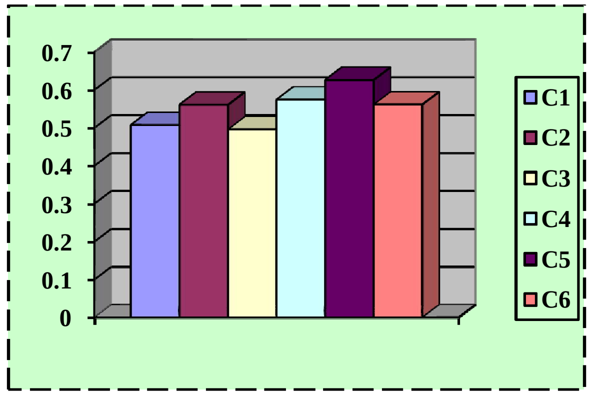

Fig. 4: Ranking order is carried out in accordance with higher value (higher rank)