International Journal of Applied Engineering and Technology ISSN: 2277-212X
An Open Access, Online International Journal Available at http://www.cibtech.org/jet.htm
2022, Vol.12, pp.283-286/Jayabaharathi
Research Article

DECISION MAKING USING FUZZY PROMETHEE FOR REVERSE SUPPLY CHAIN MANAGEMENT OUTSOURCING

***M. Jayabaharathi**
[1]*Department of Management of Studies*
**Author for Correspondence*: *m.jayabharathi12@gmail.com*

ABSTRACT
The rising awareness about environmental issues and the need to outrank the competitors necessitates reverse supply chain management. By implementing reverse supply chain process, the industries are able to recapture the products value and can minimize the production cost. The implementation of reverse supply chain management requires huge investment and upgraded technology. Hence most of the manufacturing sectors are outsourcing reverse supply chain management. When it comes to outsourcing, selection of appropriate supplier becomes a problem for industries. In this study, fuzzy Preference Ranking Organization Method for Enrichment Evaluation (fuzzy PROMETHEE) methodology is applied to select the best reverse supply chain management from five alternatives by four decision makers considering ten factors.

Keywords: *Environmental Issues, Fuzzy PROMETHEE, Outsourcing, Reverse Supply Chain Process*

INTRODUCTION

In recent years, outsourcing has become a common phenomenon observed in many manufacturing firms. In general, outsourcing is defined as the process of purchasing service or materials that are already provided by some external agencies. Companies prefer outsourcing for many reasons like effective procurement service, technology feasibility, cost optimization, flexibility and reducing number of employees. Outsourcing is commonly witnessed in industries like healthcare, accounting, IT sectors, manufacturing sectors and R&Ds. A study states that Apple, Nike, IBM, Cisco and Wal-Mart are the most outsourcing companies in the world. A study carried by Chen et al. [1] on outsourcing in IT sectors indicates that most of the IT sectors are outsourcing for cost reduction and to focus more on internal resources. Most of the manufacturing industries are adopting reverse supply chain management as a step to curb production cost while emphasizing on environmental concern. Further, to combat the menace of End of Life (EOL) product and for effective waste management, reverse logistics (RL) is mandatory. As stated by Sarkis et al. [2], RL is defined as the process of co-coordinating activities such as process planning, effective cost management, inventory control from post-consumption to pre-consumption for proper disposal or recapturing value. Factors such as poor commitment from top management, lack of technology advancement and capital constraints are identified as potential

MATERIALS AND METHODS

Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) methodology in fuzzy context is used for selecting the best reverse logistics network. The evaluation methodology is a combination PROMETHEE developed by [14] and fuzzy logics by [15]. The following are the steps involved in fuzzy PROMETHEE. Step 1: Establish criteria, decision makers and alternatives. Let there be i criteria, j alternatives and n decision makers. Step 2: Define linguistics values and respective triangular fuzzy number. In this study, a five-scale linguistics variable with corresponding triangular fuzzy number is used to rate the criteria and prioritize the alternatives. Table 1 displays the five-scale linguistics variable and their corresponding fuzzy number. Step 3: Aggregate the ratings provided by Decision makers. Using equation (1), the average priority weight of criteria is calculated.

RESULTS AND DISCUSSION

From the average priority weight of factors (Table 2), it could be understood that while selecting third party reverse logistics provider, environmental compliance of the service provider must be given top priority. Other factors such as Effective disposal system (F_2), cost (F_4) and Handling capacity (F_8) must be noticed while selecting service provider. Based on the results as shown in fig. 1, the alternative A_5 provides best reverse supply chain management. It should be noticed that the alternative A_5 outranks all other alternatives in vital factors concerning environmentally assisted reverse logistic provider.

Table I: Linguistics variable with respective fuzzy numbers

Linguistic Variable for Criteria weighting	**Fuzzy Number**	**PerformanceRating**
Very High (VH)	(0.75, 1. 00,1.00)	Best (B)
High (H)	(0.50, 0.75,1.00)	Good (G)
Medium (M)	(0.25, 0.50,0.75)	Fair (F)
Low (L)	(0.00, 0.25,0.50)	Poor (P)
Very Low (VL)	(0.00, 0.00,0.25)	Worst (W)

Table II: Weight of each factor

	D_1	D_2	D_3	D_4	**Fuzzy Weight**
F_1	VH	H	VH	VH	(0.6875, 0.9375,1.00)
F_2	VH	VH	VH	VH	(0.75, 1.00, 1.00)
F_3	VH	H	H	H	(0.5625, 0.8125,1.00)
F_4	VH	VH	VH	VH	(0.75, 1.00, 1.00)
F_5	VH	H	H	M	(0.50, 0.75, 0.9375)
F_6	VH	VH	VH	VH	(0.75, 1.00, 1.00)
F_7	M	H	H	M	(0.50, 0.625, 0.875)
F_8	H	M	L	VH	(0.375, 0.625,0.8125)
F_9	H	H	H	H	(0.50, 0.75, 1.00)
F_{10}	VH	VH	VH	VH	(0.75, 1.00, 1.00)

Table- III. Normalized fuzzy decision matrix

	A1	A2	A3	A4	A5
F1	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)
F2	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)
F3	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.25, 0.50, 0.75)	(0.50, 0.75, 1.00)
F4	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)
F5	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)
F6	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)
F7	(0.50, 0.75, 1.00)	(0.50, 0.75, 1.00)	(0.25, 0.50, 0.75)	(0.25, 0.50, 0.75)	(0.25, 0.50, 0.75)
F8	(0.25, 0.50, 0.75)	(0.25, 0.50, 0.75)	(0.25, 0.50, 0.75)	(0.50, 0.75, 1.00)	(0.75, 1.00, 1.00)
F9	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)
F10	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)	(0.75, 1.00, 1.00)

REFERENCES

1. Y. H. Chen, T. C. Wang and C. Y. Wu, "Strategicic decisions using the fuzzy PROMETHEE for IS outsourcing," ExpertSystems with Applications, Vol. 38(10), 2011, 13216-13222.
2. J. Sarkis, M. M. Helms and A. A. Hervani, "Reverse logistics and social sustainability," Corporate Social Responsibility andEnvironmental Management, Vol. 17(6), 2010, 337-354.
3. P. González-Torre, M. Alvarez, J. Sarkis and B. Adenso-Díaz, Barriers to the implementation of environmentally oriented reverse logistics: evidence from the automotive industry sector. British Journal of Management, Vol. 21(4), 2010, 889-904.
4. J. M. Alonso, J. Clifton and D. Díaz-Fuentes, "The impact of government outsourcing on public spending: Evidence fromEuropean Union countries," Journal of Policy Modeling, Vol. 39(2), 2017, 333-348.
5. N. Beaumont and A. Sohal, "Outsourcing in Australia," International Journal of Operations & Production Management, Vol. 24(7), 2004, 688-700.
6. A. Spithoven and P. Teirlinck, "Internal capabilities, network resources and appropriation mechanisms as determinants ofR&D outsourcing," Research policy, Vol. 44(3), 2015, 711-725.
7. N. Subramanian, A. Gunasekaran, M. Abdulrahman and C. Liu, "Factors for implementing end-of-life product reverse logistics in the Chinese manufacturing sector," International Journal of Sustainable Development & World Ecology, Vol. 21(3), 2014, 235-245.
8. M. Tavana, M. Zareinejad, D. Di Caprio, and M. A. Kaviani, "An integrated intuitionistic fuzzy AHP and SWOT method foroutsourcing reverse logistics," Applied Soft Computing, Vol. 40, 2016, 544-557.
9. P. Sasikumar and G. Kannan, "Issues in reverse supply chain, part III: classification and simple analysis," InternationalJournal of Sustainable Engineering, Vol. 2(1), 2009, 2-27.
10. T. Briggs and P. L.Kunsch and B. Mareschal "Nuclear waste management: an application of the multicriteria PROMETHEE methods," European Journal of Operational Research, Vol. 44(1), 1990, 1-10.
11. R. Dulmin and V. Mininno, "Supplier selection using a multi-criteriadecision aid method,"

Journal of purchasing and supplymanagement, Vol. 9(4), 2003, 177-187.
12. J. P. Brans, P. Vincke and B. Mareschal, "How to select and how to rank projects: The PROMETHEE method," Europeanjournal of operational research, Vol. 24(2), 1986, 228-238.
13. L. A. Zadeh, "Fuzzy sets," Information and control, Vol. 8(3), 1965, 338-353.