

Selection of Effective Platform for Reviews by Fuzzy TOPSIS Method

M. Rajeswari* and D. Venkatesan

School of Computing, SASTRA University, Thirumalaisamudram, Thanjavur – 613401, Tamil Nadu, India;
rajeswarimohan05@gmail.com, venkatgowri@cse.sastra.edu

Abstract

Objectives: User review is recognized as an effective way to promote a product or service. These reviews may be presents in different platforms such as blog, review site, social networking site, and messaging instance site. **Methods:** Selection of the best platform among different alternatives is called as Multi Criteria Decision Analysis/Method (MCDM) method. Objective is to select an effective platform for review. Fuzzy Analytic Hierarchy Process (AHP) is used for ranking and determines effective platform for reviews. It uses multiple criteria for making decision. In this research, the Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method is used which improves the quality of decision making for ranking alternative. **Findings:** When comparing with Fuzzy AHP method Fuzzy TOPSIS has an adequacy to include and exclude the criteria and alternative, which may change over a period of time. There is no restriction in number of criteria when we use the Fuzzy TOPSIS method. For future enhancements of this project can be done by using either fuzzy Analytic Network Process (ANP) or Aggregated Indices Randomization Method (AIRM) or can use hybrid method combination of any MCDM technique to rank the platform for product review. **Applications:** Fuzzy TOPSIS is useful for movie and product review and also we can apply this technique in uncertain situation.

Keywords: electronic Word Of Mouth (eWOM), Fuzzy Analytic Hierarchy Process (AHP), Fuzzy Scale, Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Multi Criteria Decision Analysis/Method (MCDM), VIKOR

1. Introduction

Now a day review has great impact on customer purchase decision. Reviews are available in different platforms such as review site, blog, social networking site and messaging instance. Online review is a most influencing tool; the reason is people trust opinion of other people than advertisements. Whenever people plan to make a purchase on online, they used to see review of the product before they go for a purchase. electronic Word Of Mouth (eWOM) highly influence people in both positive and negative way. Reviews are made by the customer who has purchased the product or service. Some of the reviews are also given by the professionals who are having great skills and experience.

1.1 MCDM Technique

Multi Criteria Decision Analysis/Method (MCDA)

method uses multiple criteria to make a decision in decision environments. There are many MCDM¹ techniques available to make a decision such as VIKOR, Analytic Hierarchy Process (AHP), ANP, and Technique for Order of Preference by Similarity Ideal Solution. We can't apply these MCDM techniques in uncertain situation. Every MCDM technique has its own advantage and disadvantage. Here we have used Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to evaluate eWOM present in different platform. Criteria used to evaluate these platforms are timeliness, accuracy, source trustworthiness, usefulness. Based on these criteria blog, social networking site, review site are evaluated to know which is best suited for review. We can't apply exact value in all situations in which we can apply "Fuzzy" based on previous experiment or history to determine output. Triangular Fuzzy number used as a scale which ranges from 0 to 6.

* Author for correspondence

1.2 Fuzzy TOPSIS

Users are not able to identify which platform provides quality information for making decision about review. The criteria that are required for evaluating different web 2.0 platform may change over time. But these criteria cannot be changed periodically using fuzzy AHP thus leading to inconsistent in criteria selection. Computational complexity is high as there are more computational steps. Fuzzy TOPSIS overcome these problems while making a decision. Fuzzy TOPSIS uses Positive and Negative Ideal Solution (NIS) used to find how far and close to the solution. Fuzzy TOPSIS use the scale ranges from (0, 0, 1) to (5, 5, 6) which is shown in Table 1. AHP used to calculate weight. Weighted normalized matrix constructed by multiplying weight into decision matrix. Closeness coefficient used to rank the platform. Platform which has a highest closeness co-efficient is best for product or service review. Steps for Fuzzy TOPSIS are shown in Figure 1. In² used Fuzzy TOPSIS to select maintenance policy. In industries maintenance policy play a major role to improve the productivity. Wrong selection leads to more failure and decreases the productivity. Selection of Optimum maintenance is tedious task due to uncertainty. In³ has used Fuzzy TOPSIS to rank air carriers of Turkish domestic airline industry. They have enhanced the TOPSIS multi criteria technique and proven that the Fuzzy TOPSIS is more accurate to rank the air carriers than TOPSIS method. Evaluation is based on quality and advertising. In⁴ compares the TOPSIS and Fuzzy TOPSIS method in evaluation of TWSQ. MCDM techniques were used to evaluate the platform, which improve the service quality and customer satisfaction level in travel website. They concluded that Fuzzy TOPSIS technique is more accurate to rank than TOPSIS technique. In⁵ used Fuzzy AHP to solve the supplier selection problem. Fuzzy AHP technique used to select important criteria to evaluate supplier in manufacturing industry. These criteria influence the supplier selection process. Fuzzy AHP helps companies to choose best supplier. In⁶ proved that the Fuzzy TOPSIS is most suited for supplier selection than Fuzzy AHP. Fuzzy AHP is inadequacy to criteria. Those disadvantages are overcome by using Fuzzy TOPSIS technique, which intern reduces the computational complexity. In⁷ used Fuzzy AHP is a MCDM method. Fuzzy AHP is a method determines the relative importance of criteria to evaluate different notebook product. This method helps the buyer to choose best product in notebook. In⁸ used Analytic Hierarchy Process to evaluate high-tech industries.

Technology development highly influence by the science based industrial park. Due to space constrain in Taiwan park this is more important to select the firm with higher efficiency. AHP select important criteria to rank the firm. In⁹ used Fuzzy AHP to select database in Turkish national identity card management. DBMS selection needs optimal number of criteria. Fuzzy AHP optimize the selection criteria to select database in software development process. In¹⁰ used Fuzzy AHP to select qualified faculty. The criteria use to rank the faculties which influence the quality teaching. Educational institute are get benefit from using Fuzzy AHP to choose faculties. In¹¹ shows how eWOM influences the box office sales. Instead of rating judgments are made on number of post published in the review sites. Studies found that the WOM influence the box office sales in later time than eWOM. In¹² used decision making method to solve the multi agent complex decision making problem. In¹³ selection of math teacher is done by using both Fuzzy AHP and Fuzzy TOPSIS method. They concluded each organization use any of these method based on their requirements.

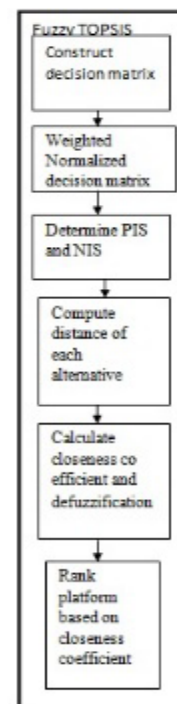


Figure 1. Fuzzy TOPSIS steps.

2. System Model

2.1 Fuzzy TOPSIS

Step 1: In the first step after determining fuzzy linguistic

Table 1, collect the survey from user of different eWOM platform. K – Users rank each criterion ($C_1, C_2, C_3, \dots, C_n$). Scale used here is to rate the criteria which is ranges from (0,0,1) to (5,5,6). Criterion weight denoted by using fuzzy triangular number $w_j = (w_{j1}, w_{j2}, w_{j3})$ which is shown in Table 2. Alternatives (m) are referred as ($A_1, A_2, A_3, \dots, A_n$).

$$a_j = 1/g \sum_{l=1}^g h_{lg} \quad b_j = 1/g \sum_{l=1}^g h_{lg} \quad c_j = 1/g \sum_{l=1}^g h_{lg} \quad (1)$$

Table 1. Fuzzy scale

Linguistic scale	Fuzzy scale
Very low	(0,0,1)
Low	(0,1,2)
Low medium	(1,2,3)
Medium	(2,3,4)
Medium high	(3,4,5)
High	(4,5,6)
Very high	(5,5,6)

Table 2. Decision matrix

	S_1	S_2	S_3
C_1	(2,3,4)	(1,1,2)	(1,2,2)
C_2	(3,3,1)	(0,1,2)	(4,5,5)
C_3	(4,5,6)	(4,5,6)	(2,3,1)
C_4	(5,5,6)	(2,2,3)	(3,2,2)

Where l, g=1,2,...,n

n- Number of rating

Each criteria weight is normalized as follow:

$$w_j = (w_{j1}, w_{j2}, w_{j3})$$

$$w_{j1} = \frac{1/l_t}{\sum_{t=1}^n 1/l_t}, w_{j2} = \frac{1/m_t}{\sum_{t=1}^n m_t}, w_{j3} = \frac{1/n_t}{\sum_{t=1}^n 1/n_t} \quad (2)$$

$$\tilde{W} = [\tilde{W}_1, \tilde{W}_2, \tilde{W}_3]$$

Step 2: Construction of decision matrix

$$R = \begin{bmatrix} n_{11} & n_{12} & \dots & n_{1n} \\ n_{21} & n_{22} & \dots & n_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ n_{m1} & n_{m2} & \dots & n_{mn} \end{bmatrix} \quad (3)$$

Ratings for the alternative subject to each criterion forms decision matrix that is denoted by $r = (n_j)g \times h$.

Step 3: Normalized decision matrix is constructed as follow:

Weighted normalized matrix determined by AHP method.

$$R = \begin{bmatrix} n_{11} & n_{12} & \dots & n_{1n} \\ n_{21} & n_{22} & \dots & n_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ n_{m1} & n_{m2} & \dots & n_{mn} \end{bmatrix} \quad P = \begin{bmatrix} p_{11} & p_{12} & \dots & p_{1n} \\ p_{21} & p_{22} & \dots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \dots & p_{mn} \end{bmatrix} \quad (4)$$

p_j = Normalized Fuzzy number

W_j =calculated by using AHP.

Where t=1,2,3,...,n & m=1,2,3,...,n.

Step 4: Calculation of fuzzy PIS & NIS

A^+ - PIS

A^- - NIS

$$A^+ = \{ p_1^+, p_2^+, \dots, p_n^+ \}$$

Where $p_j^+ = \max(p_{j1}), \max(p_{j2}), \max(p_{j3})$

$$A^- = \{ p_1^-, p_2^-, \dots, p_n^- \}$$

Where $p_j^- = \min(p_{j1}), \min(p_{j2}), \min(p_{j3})$

Step 5: calculate separation measure for each alternative platform².

$$b_i^* = \sqrt{\sum_{j=1}^n (p_i - p_j^*)^2} \quad t=1, 2, \dots, n \quad (5)$$

$$b_i^- = \sqrt{\sum_{j=1}^n (p_i - p_j^-)^2} \quad t=1, 2, \dots, n \quad (6)$$

Step 6: Calculate the relative closeness of each alternative to the ideal solution

$$C_i = \frac{b_i^-}{b_i^* + b_i^-} \quad (7)$$

Closeness coefficient - C_i

3. Results and Discussion

Following criteria are used to evaluated following platforms.

C_1 - Timeliness

C_2 - Accuracy

C_3 - Usefulness

C_4 -Source trustworthiness

S_1 -Blog

S_2 -Review site

S_3 -Social networking site

Table 2 shows the constriction of decision matrix using alternative which are blog, review site, Social networking site and criteria which are timeliness, accuracy, usefulness and source trustworthiness. Weight of criteria along with decision matrix is shown in Table 3. Weight is calculated by using Fuzzy AHP method. Normalized weighted Decision matrix of Fuzzy TOPSIS is shown in Table 4. Normalized weighted decision matrix is constructed by multiplying weight into decision matrix. Separation measure and closenee coefficient values are shown in Table 5. Dataset of different platform for different criteria collected through the email. In email contain the Excel sheet which had the criteria to evaluate the platform and link to be evaluated. Rating of different eWOM platforms

will be done by users and experts. We have chosen three alternatives such as blog (a1), review site (a2), social networking site (a3). If we add any alternative (say a4), In fuzzy AHP, there is a possibility such that worst case in the first scenario may changes to best case in next scenario with four alternative. But in fuzzy TOPSIS if we add more and more alternatives there will not be any drastic changes in final result. In Fuzzy AHP if add more and more criteria ranking reversal happen which result in the inversion of order importance. But in Fuzzy TOPSIS it didn't happen. It provides no change even when we add more criteria. In Fuzzy AHP if we remove any criteria it is nulling the weight since the weight calculation uses MIN operator, and difference between criteria is more and there is no intersection between them it nullified the weight. In Fuzzy TOPSIS it takes only arithmetic mean between fuzzy numbers which will never lead to null weight. If the number of alternative and criteria increases judgment also get increases. If j be number of alternative and k be the number of criteria Fuzzy TOPSIS needed judgment. Here j is 4 and k is three. In this Fuzzy TOPSIS require 15 judgments. Fuzzy AHP needed judgment. Fuzzy AHP requires 30 judgments which is two times more than fuzzy TOPSIS. If the number of criteria and number of alternatives are very less judgment needed by Fuzzy AHP will be lesser than fuzzy TOPSIS. Hence Fuzzy TOPSIS will be able to provide strong decision then Fuzzy AHP. Table 6 provides the advantages of Fuzzy TOPSIS over Fuzzy AHP.

Table 3. Decision matrix with weight

	Weight			
	S_1	S_2	S_3	
C_1	(2,3,4)	(1,1,2)	(1,2,2)	(1.33,2,2.66)
C_2	(3,3,1)	(0,1,2)	(4,5,5)	(2.33,3,2.66)
C_3	(4,5,6)	(4,5,6)	(2,3,1)	(3.33,4.33,3.33)
C_4	(5,5,6)	(2,2,3)	(3,2,2)	(3.33,3,3.66)

Table 4. Weighted decision matrix

	S_1	S_2	S_3
C_1	(2.66,6,10.6)	(1.33,2,5.32)	(1.33,4,5.32)
C_2	(6.99,9,2.66)	(0,3,5.32)	(9.32,15,13.3)
C_3	(13.32,21.65,19.68)	(13.32,2,5.32)	(6.66,12.99,3.33)
C_4	(16.65,15,21.96)	(6.66,6,10.98)	(9.99,6,7.32)

Table 5. Ranking of platform

	S_1	S_2	S_3	A^+	A^-
C_1	(2.66,6,10.6)	(1.33,2,5.32)	(1.33,4,5.32)	(0,0,1)	(5,5,6)
C_2	(6.99,9,2.66)	(0,3,5.32)	(9.32,15,13.3)	(0,0,1)	(5,5,6)
C_3	(13.32,21.65,19.68)	(13.32,2,5.32)	(6.66,12.99,3.33)	(0,0,1)	(5,5,6)
C_4	(16.65,15,21.96)	(6.66,6,10.98)	(9.99,6,7.32)	(0,0,1)	(5,5,6)
b_i^*	13.8501	9.6158	16.1151		
b_i^-	3.9427	5.4555	7.3184		
C_i	0.1139	0.2078	0.1966		
Rank	3	1	2		

Table 6. Advantage of fuzzy TOPSIS over fuzzy AHP

Parameter	Fuzzy AHP	Fuzzy TOPSIS
Rank reversal	Change the rank	No changes in rank
Importance	Changes in	Didn't change the
weight	importance weight	weight
Nulling the	Nulls the weight	Didn't null the weight
weight	because of MIN	because of arithmetic
	operator	mean calculation
Agility	Provide good agility	Provide good agility
	for few alternative	for more alternative
	and few criteria	and criteria
Restriction	Restriction in	No restriction
	number of criteria	

4. Conclusion

Fuzzy TOPSIS method is implemented to evaluate and select effective platform for product or service review. Fuzzy TOPSIS method is preferable even when the ratings are vague and not accurate. It also increases accuracy by using fuzzy linguistic approach. Fuzzy TOPSIS reduces the computational complexity and it has adequacy to change criteria and alternative. For future enhancements of this project can be done by using either fuzzy Analytic Network Process (ANP) or Aggregated Indices Randomization Method (AIRM) or can use hybrid method combination of any MCDM technique to rank the platform for product review.

5. References

1. Mehmet Kabak, Serhatbamaoglu, Yigit Kazancoglu. A Fuzzy Hybrid MCDM Approach for Professional Selection, Expert Systems with Applications. 2012 Feb; 39(3):3516–25.
2. Siew-Hong, Ding, Shahrulkamaruddin. Selection of Optimal Maintenance Policy by using Fuzzy Multi Criteria Decision Making Method. Internationals Conference on Industrial Engineering and Operations Management; 2012 Jul. p. 435–43.
3. Gokhan Torlak, Mehmet Sevki, Mehmet Sanal, Selim Zaim. Analysing Business Competition by using Fuzzy TOPSIS Method: An Example of Turkish Domestic Air-line Industry, Expert System with Application. 2011 Apr; 38(4):3396–406.
4. Golam Kabir, Ahsan Akhtar Hasin M. Comparative Analysis of TOPSIS and Fuzzy TOPSIS for Evaluation of Travel Website Service, International Journal for Quality Research. 2012; 6(3):169–85.
5. Mastafa Batuhan Ayhan. A Fuzzy AHP Approach for Supplier Selection Problem: A Case Study in a Gear Motor Company, International Journal of Managing Value and Supply Chains. 2013 Sep; 4(3):11–23.
6. Francisco Rodrigues Lima Junior, Lauroosrio, Luiz Ceaser Riberiocarpinetti. A Comparison between Fuzzy AHP and Fuzzy TOPSIS Method to Supplier Selection, Applied Soft Computing. 2014 Aug; 21:194–209.
7. Phanarutsrichetta, Wannasiri Thurachon. Apply Fuzzy Analytic Process to Evaluate and Select Product of Notebook Computer, International Journal of Modeling and Optimization. 2012 Apr; 2(2):168–73.
8. Chung-Jen Chen, Chin-Chen Hung. Multiple Criteria Evaluation of High-Tech Industries Park Industries for Science-Based Industrial Park in Taiwan, Information and management. 2004 Sep; 41(7):839–51.
9. Ozgurcatak F, Servet Kardbas, Serkan Yildirim. Fuzzy Analytic Hierarchy based DBMS Selection in Turkish National Identity Card Management Project, International Journal of Information Science and Technique. 2012 Jul; 2(4):29–38.
10. Hota HS Sirigiri Pavani, Gangadhar PVSS. Evaluating

- Teacher Ranking using Fuzzy AHP Technique, International Journal of Soft Computing and Engineering. 2013 Jan; 2(6):485–88.
11. Wenjing Duan, Din Gu, Andrew B Whinston. Do Online Review Matters? An Empirical Investigation of Panel Data, Decision Support System. 2008 Nov; 45(4):1007–16.
 12. Amudhavel J, Giri Sruthy, Padmashree D, Pazhani Raja N, Saleem Basha MS, Bhuvaneswari B. A Comprehensive Analysis on Multi Agent Decision Making System, Indian Journal of Science and Technology. 2016 Mar; 9(11):1–5.
 13. Moayeri M, Shahvarani A, Behzadi MH, Hosseinza-deh-Lotfi F. Comparison of Fuzzy AHP and Fuzzy TOPSIS Methods for Math Teachers Selection, Indian Journal of Science and Technology. 2015 Jul; 8(13):1–10.