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Comparative Analysis of FAHP and FTOPSIS Method for Evaluation of Different Domains

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Abstract: *Fuzzy logic approach for academic performance evaluations is in general fairly new. However, it has reached a wide range of application areas like performance evaluations and deciding the ranks for alternatives/criteria. In educational systems in addition to evaluation of teachers academic performance, and similarly software development scenario selecting software programmers. Fuzzy techniques have been adapted for evaluation based on numerical scores obtained in an assessment and for assessing Teachers performance and selecting software programmers. This research we have used MCDM techniques for FAHP (Fuzzy Analytic Hierarchy Process (FAHP)) and FTOPSIS (fuzzy Technique for Order Performance by Similarity to Ideal Solution) methods. Which are best methods for evaluations for selecting ranks. A small sample of 5 teachers and 5 software programmers and 5 criteria related to teachers and software programmers are considered which is collected from different educational or software organizations and weighted values are evaluated. Ranks obtained through FAHP and FTOPSIS are compared and found to be satisfactory.*

Keywords: *MCDM techniques, Fuzzy TOPSIS method, Fuzzy AHP, Alternatives, Criteria, selected Teachers and Software programmers.*

1. INTRODUCTION

Multi criteria decision making is a method to deal with the process of making decision among number of alternatives with conflicting criteria on them. fuzzy AHP is an extension of original AHP method suggested by saaty to deal with qualitative and quantitative data. TOPSIS known as one of the most classical MCDM methods, was first developed by Hwang and Yoon the concept of TOPSIS to develop a methodology for solving multi-criteria decision-making problems with interval data. Education system specially engineering education contributes a major role to develop the nation. In an academic institution Teachers and Students are two main pillars and without these two an academic organization can never be survived. Teachers are the most important assets of an educational organization and good teachers provide the good quality education among the students. It means that teachers' performance evaluation has become one of the most important activities not only for the long run of an organization but for the development of the society.

Most of the software fails during the development and even after development and not delivered in stipulated time period, which may creates problem for software development organization in context of their reputation and reliability in IT industry. Selection of various resources required to develop software in optimal manner is very essential to avoid all these problems. Optimal resource allocation for a specific type of software project is a challenging task to minimize the software development cost and hence to deliver software product to the client well in advance. Many resources like technical resources: hardware, software and most essentially human resources are necessary to assign in optimal manner. These resource allocation may be based on expertise or heuristic manner, which sometimes fails due to uncertainty involved, hence multi criteria decision making(MCDM) based method: Fuzzy AHP can be used for human resource allocation for a particular type of software project.

Very few literatures are available on this topic Santanu ku. Mishra)[1] and et.al has applied fuzzy AHP and byasian technique for programmer selection. However other researchers have applied fuzzy

AHP method and other MCDM methods for selection purpose. Sumeet Kaur Mishra and et.al [2] has also used MCDM approach for selection of effort estimation model based on four criteria: reliability, MMRE, percentage prediction and uncertainty for various models suggest by various scientist as alternatives. Results has been compared with AHP and it was found that algorithmic model has highest weight value as compare to other models like expert judgment based model and non algorithmic model. Pin-Chang Chen tried [3] to identify appropriate personality traitsand key professional skills through the information statistics. P. Kousalya and et.al. presented the use of multi criteria decision-making methods for ranking alternatives that curb student absenteeism in engineering college [4]. S. Mahmoodzadeh and et.al proposed a new methodology to provide a simple approach to assess alternative projects and help decision makers to select the best one with the help of fuzzy AHP and TOPSIS technique [5].

In this paper, we used to mcdm techniques and applied for two different domains .expert are given to their weights for teachers and software programmers and getting rankes for teachers and programmers.

2. METHODOLOGY

The Multi criterion Decision-Making (MCDM) are gaining importance as potential tools for analyzing complex real problems due to their inherent ability to judge different alternatives (Choice, strategy, policy, scenario can also be used synonymously) on various criteria for possible selection of the best/suitable alternative (s). These alternatives may be further explored in-depth for their final implementation. The analytic hierarchy process (AHP), as proposed by Saaty is a later development and it has recently become popular. Recently modification to the AHP is considered to be more consistent than the original approach. Some other widely used methods are the fuzzy AHP and the fuzzy TOPSIS methods. Analytic Hierarchy Process (AHP) is proposed by Satty is an approach for decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives. The output of the AHP is prioritized ranking indicating the overall preference for each of the decision alternatives eventually help the decision maker to select the best approach. Fuzzy logic can be used to deal this type of problem. The FAHP method is an advanced analytical method which is developed from the AHP and this method is often criticized for its inability to adequately handle the inherent uncertainty and imprecision associated with the mapping of the decision-makers perception to exact numbers. The Positive Ideal Solution maximizes the benefit criteria and minimizes the cost criteria, whereas the Negative Ideal Solution maximizes the cost criteria and minimizes the benefit criteria then Fuzzy TOPSIS approaches enable experts and users to efficiently select more suitable alternatives for evaluations for performance of two different domains.

2.1. Fuzzy Analytic Hierarchy Process (FAHP)

The steps for implementing the AHP process are illustrated as follows:

- ✓ Define the Objectives.
- ✓ Identify the Criteria/Attributes.
- ✓ Choose the Alternatives.
- ✓ Establish the Hierarchy.
- ✓ Design Questionnaire and survey
- ✓ Construct the Pairwise Comparison matrices using Satty's 9-point scale.

Table1. *Saaty's 9-Point Scale Of Pair-Wise Comparison*

Table 2: Saaty's nine point scale	
Compare factor of i and j	Numerical rating
Extremely preferred	9
Very strongly preferred	7
Strongly preferred	5
Moderately preferred	3
Intermediate judgment between two adjacent judgment	2, 4,6,8

- ✓ Synthesize Judgments.
- ✓ Calculate Consistency (C.I) Index.

Table2. *Table of Random Index (Saaty, 1980)*

MATRIX ORDER	1,2	3	4	5	6	7
R.I.	0	0.52	0.89	1.12	1.26	1.36
MATRIX ORDER	8	9	10	11	12	13
R.I.	1.41	1.46	1.49	1.52	1.54	1.56

- ✓ Comparison between Criteria and Alternatives
- ✓ Calculate Final Rankings

An AHP hierarchy has at least three levels:

Level-1: The main objective or goal of the problem at the top.

Level-2: Multiple criteria that define alternatives in the middle.

Level-3: Competing alternatives at the bottom.

2.2. Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS)

The concept of TOPSIS to develop a methodology for solving multi-criteria decision-making problems with interval data. The steps of TOPSIS model are as follows:

- ✓ Calculate the normalized decision matrix.
- ✓ Calculate the weighted normalized decision matrix.
- ✓ Determine the Positive Ideal Solution and Negative Ideal Solution.
- ✓ Calculate the separation measures for each alternative from the positive and negative ideal solution.
- ✓ Calculate the relative closeness to the ideal solution for each alternative.
- ✓ Rank the preference order.

3. EXPERIMENTS & RESULTS

In this methodology experts have to give their own remarks for each teacher / programmer against each criterion and weightings for evolution of teacher's performance and by using these data evaluation technique can be applied for programmer's performance by developing a software project replicated in the Tables below.

Criterion for teacher is Knowledge, presentation, communication explanation, voice, expression and criteria for Application experience, Platform experience, Programmer capability, Language and tool experience and Personal continuity. We have Compare criteria to criteria pertaining to teacher and programmer is shows in the Table3.

Table3. *Comparing Criteria to Criteria for Teachers and Programmer*

	c1	c2	c3	c4	c5	gm	nm	e1	e2	LAMDA	CI	CR
c1	1	3	1	4	0.5	1.430969	0.252807	1.38275	5.469586	5.544331	0.136083	0.121502
c2	0.33	1	0.25	1	0.2	0.440045	0.077742	0.411508	5.293251			
c3	1	4	1	1	0.33	1.057097	0.186756	0.999526	5.352053			
c4	0.25	1	1	1	1	0.757858	0.13389	0.810395	6.052705			
c5	2	5	3	1	1	1.97435	0.348805	1.937287	5.55406			
						5.660319						

Table4. *Pair wise comparison between teacher to teacher for criteria knowledge*

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	GM	NM	E1	E2	LAMDA	CI	CR
T1	1	0.5	1	1	5	0.33	1	1	0.5	1	0.915256	0.092537	0.908348	9.816002	12.46247	0.273608	0.18363
T2	2	1	2	0.5	1	1	3	2	1	7	1.5575	0.157472	1.891928	12.01438			
T3	1	0.5	1	1	0.2	1	2	1	1	1	0.85134	0.086075	0.943807	10.96491			
T4	1	2	1	1	3	2	0.25	1	1	3	1.245731	0.12595	1.490393	11.83318			

T5	0.2	1	0.2	0.33	1	1	1	4	0.5	1	0.695281	0.070297	1.065916	15.16307			
T6	3	1	1	0.5	1	1	1	0.2	1	0.5	0.827197	0.083634	0.98784	11.81144			
T7	1	0.33	0.5	4	1	1	1	0.5	0.25	1	0.779194	0.078781	1.092133	13.86292			
T8	1	0.5	1	1	0.25	5	2	1	1	3	1.141309	0.115393	1.449638	12.56265			
T9	2	1	0.5	1	2	1	4	1	1	0.2	1.048122	0.105971	1.289028	12.16396			
T10	1	0.142	1	0.33	1	2	1	0.33	5	1	0.82972	0.083889	1.210708	14.4322			
											9.890649						

the pair wise comparison matrix according to Saaty's scale mentioned in Table-1 of exports for the criteria Knowledge (C1) is as follow:-In the above table shows the one of the criteria knowledge will comparing the Teacher1 to Teacher 10.calculate consistency Index(C.I) and consistency Ratio(C.R)Here C.I=0.2and C.R=0.1.The above process can be repeated for other alternatives (C2 to C5) and CR is found to be less than 0.10 and normalized weights for all the alternatives for each of the criteria Similarly comparison is done to programmer for each alternative . Following FTOPSIS step will be applied then we get the ranks for teachers and software programmers as follows. Which is shows in the table5 and table 6

Table5. *Teachers Ranks*

Teachers	weighted values	Ranks
T2	0.710880021	1
T6	0.660471902	2
T4	0.621821698	3
T8	0.603871124	4
T1	0.555112387	5
T9	0.474612612	6
T5	0.36131722	7
T10	0.334289965	8
T3	0.274986518	9
T7	0.12458288	10

Table6. *Programmers Ranks*

Programmer ID	Weight	Rank
P_2	0.547003565	1
P_{10}	0.481438405	2
P_9	0.449598421	3
P_8	0.428740236	4
P_4	0.422203388	5
P_5	0.409586061	6
P_6	0.405543827	7
P_1	0.381932158	8
P_7	0.390980623	9
P_3	0.343045869	10

4. CONCLUSION

This paper concludes that the we have used MCDM techniques for FAHP (Fuzzy Analytic Hierarchy Process (FAHP)) and FTOPSIS (fuzzy Technique for Order Performance by Similarity to Ideal Solution) methods. Which are best methods for evaluations for selecting ranks. expert is giving the different weights for different domains(teachers/programmer) and applying FAHP and FTOPSIS methods we get the highest weighted value for teacher2 and parogrammer2.so we conclude that same rank are get for different domains for same technique. The above tables is shows that ranking for teachers/programmers in the table teachers 2 is getting highest weighted value to comparing others teachers same as programmer 2 is getting highest weighted value to comparing other programmers.

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