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IF-AHP METHOD: A DECISION-MAKING TOOL FOR PERSONNEL SELECTION

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ABSTRACT

This project focuses on the Intuitionistic Fuzzy Analytic Hierarchy Process (IF-AHP) method in solving personnel selection problems for any available position in a company instead of the traditional method of choosing new personnel. This is the novelty of the project. The objective of this project is to implement the IF-AHP method as a powerful tool in solving new personnel selection for a position in a company. The IF-AHP method is simple in computations and cost-effective since the analysis can be done using MS Excel. The IF-AHP method is executed to solve selection problems because it can handle hesitancy, ambiguity, and intuition judgments made by decision-makers (DMs) and increase the accuracy of the assessment. This mathematical model can be assigned to any area of Multi-Criteria Decision Making (MCDM) problems as portfolio selection and for best student selection that considers multiple conflicting criteria.

Keyword: *Intuitionistic Fuzzy Analytic Hierarchy Process (IF-AHP), Multi-Criteria Decision Making (MCDM), personnel selection*

1. INTRODUCTION

Selecting the best personnel for a job scope is a challenging process. Personnel selection is a process of assessing and evaluating candidates and narrowing down from the pool of candidates where employment offers will be made (Chan, 2004). This process requires the decision-makers (DMs) to make a selection that will benefit the company. Traditionally, the DMs will interview to assess the qualification of the candidates for a particular position. This traditional method may not be efficient since human judgment may be vague and ambiguous. In this project, the Intuitionistic Fuzzy Analytic Hierarchy Process (IF-AHP) method is implemented to solve personnel selection problems. This is the novelty of the project where a mathematical model is used in the evaluation process instead of using the traditional selection method. The IF-AHP method is not only capable in improving the objectivity of human judgment, but it also helps in completing the process by reflecting hesitant information from DMs as they elicit judgments on assessment items (Xu et al., 2020). In conclusion, this project focuses on the application of IF-AHP as a decision-making tool for personnel selection problems.

2. FINDINGS

The process of recruiting a new employee can be more manageable by employing the IF-AHP method. The advantage of this method is it can accommodate the ambiguity of expert opinions and increase the accuracy of the assessment. This method is also cost-effective since Microsoft Excel's built-in features can be used to perform the analysis, negating the need for the user to purchase any other software to solve personnel selection problems. The computation is simple and has minimal risk since every evaluation criterion is taken into account. The IF-AHP method helps to ease the decision-making process and assists the decision-makers to rank the alternatives in order of best to worst.

3. METHODOLOGY

The steps in implementing the IF-AHP method (Abdullah & Najib, 2016) are illustrated in Table 1.

Step 1: Performing data scaling based on the scale of the Intuitionistic fuzzy (IF) judgment in Table 1. Forming a pairwise comparison matrix based on the accumulated data.

AHP Linguistic Variables	AHP Preference Number	TIFNs	Reciprocal TIFNs
Equally important (E)	1	(0.02, 0.18, 0.80)	(0.18, 0.02, 0.80)
Moderately more important (WMI)	3	(0.13, 0.27, 0.60)	(0.27, 0.13, 0.60)
Strongly more important (SMI)	5	(0.33, 0.27, 0.40)	(0.27, 0.33, 0.40)
Very strong more important (VSMI)	7	(0.62, 0.18, 0.20)	(0.18, 0.62, 0.20)
Extreme/absolute more important (AMI)	9	(1.0, 0, 0)	(0, 1.0, 0)

Table 1 Linguistic Variables for Pairwise Comparison

Step 2: Identifying the weightage of the decision-makers. The importance of the decision-makers is considered as linguistic variables and these linguistic variables are adapted from Boran et al. (2009). Table 2 shows the defined Triangular Intuitionistic Fuzzy Numbers (TIFNs) for the linguistic variables.

Linguistic Variables	TIFNs
Very important	(0.90, 0.05, 0.05)
Important	(0.75, 0.20, 0.05)
Medium	(0.50, 0.40, 0.10)
Unimportant	(0.25, 0.60, 0.15)
Very unimportant	(0.10, 0.80, 0.10)

Table 2 Linguistic Variables and The Importance of Decision Makers

The weightage of the *k*th decision-maker is obtained by using Eq. 1 below:

$$\lambda_k = \frac{\left(\mu_k + \pi_k\left(\frac{\mu_k}{\mu_k + v_k}\right)\right)}{\sum_{k=1}^{t}\left(\mu_k + \pi_k\left(\frac{\mu_k}{\mu_k + v_k}\right)\right)}$$	(1)

Step 3: Form the aggregated IF judgment matrix based on the decision-makers. Let $R^{(k)} = (R_{ij}^{k})_{m \times n}$ be the IF decision matrix of *k*th decision maker, $\lambda = \{\lambda_1, \lambda_2, \ldots, \lambda_n\}$ be the weights of all the decision-makers and $\sum_{k=1}^{t} \lambda_k = 1 \in [0, 1]$. The aggregated fuzzy judgment matrix is obtained by using the Intuitionistic Fuzzy Weighted Averaging (*IFWA*) operator proposed by Xu (2007) as shown below:

$$r_{ij} = IFWA_{\lambda}\left(r_{ij}^{(1)}, r_{ij}^{(2)}, \ldots, r_{ij}^{(t)}\right) = \lambda_1 r_{ij}^{(1)} \oplus \lambda_2 r_{ij}^{(2)} \oplus \ldots \oplus \lambda_t r_{ij}^{(t)}$$
$$= 1 - \prod_{k=1}^{t}\left(1 - \mu_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{t}\left(v_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{t}\left(1 - \mu_{ij}^{(k)}\right)^{\lambda_k} - \prod_{k=1}^{t}\left(v_{ij}^{(k)}\right)^{\lambda_k} \quad (2)$$

where , $r_{ij} = \left(\mu_{ij}, \nu_{ij}, \pi_{ij}\right)$, $\mu_{ij} = 1 - \prod_{k=1}^{t}\left(1 - \mu_{ij}^{(k)}\right)^{\lambda_k}$, $v_{ij} = \prod_{k=1}^{t}\left(v_{ij}^{(k)}\right)^{\lambda_k}$,

$$\pi_{ij} = \prod_{k=1}^{t}\left(1 - \mu_{ij}^{(k)}\right)^{\lambda_k} - \prod_{k=1}^{t}\left(v_{ij}^{(k)}\right)^{\lambda_k}$$

Step 4: Computing the Consistency Ratio (*C.R*) of the aggregated IF judgment matrix by using Eq. 3 below:

$$C.R = \frac{C.I}{RI} < 0.1$$	(3)

where *C.I*, the consistency index is $\frac{\lambda_{max} - n}{n - 1}$, $\lambda_{max} - n$ is the average value of the hesitation value $(\pi(x))$ of the aggregated IF matrix of each criterion and alternative, *n* is the size of the matrix and *RI* is the random index.

Step 5: Computing the IF weight of the aggregated IF judgment matrix. The IF entropy adapted from Vlachos & Sergiadis (2007) is applied to obtain the weight aggregated of the IF matrix. The IF entropy of each aggregated of each row of IF matrix is given by:

$$\bar{\bar{w}}_i = -\frac{1}{nln2}(\mu_i ln\mu_i + v_i lnv_i - (1-\pi_i)ln(1-\pi_i) - \pi_i ln2) \quad (4)$$

If $\mu_i = 0,\ v_i = 0, \pi_i = 1,$ then $\mu_i \ln \mu_i = 0,\ v_i \ln v_i = 0,\ (1-\pi_i)\ln(1-\pi_i) = 0$

If $\mu_i = 1,\ v_i = 0, \pi_i = 0,$ then $\mu_i \ln \mu_i = 0,\ v_i \ln v_i = 0,\ (1-\pi_i)\ln(1-\pi_i) = 0$

Thus, the final entropy weights of each IF matrix is given by:

$$w_i = \frac{1 - \bar{\bar{w}}_i}{n - \sum_{j=1}^{n} \bar{\bar{w}}_i} \quad (5)$$

where $\sum_{j=1}^{n} w_i = 1.$

Step 6: Compute the relative weight and rank the alternatives by using:

$W_i = \sum w_i A_{ij}$	(6)

where W_i is the overall relative rating for alternatives i, w_i is the average normalized weight for criteria j and A_{ij} is the average normalized weight aggregated matrix for criteria j with respect to alternative i.

4. CONCLUSION

To sum up, the IF-AHP method is used to solve personnel selection problems since it can accommodate the ambiguity of expert opinions and increase the accuracy of the assessment. The theory behind the method makes it possible to deal with the hesitation of the DMs when they cannot express their preference for the alternatives easily. In addition, the IF-AHP method helps to ease the decision-making process in selecting the best potential candidate for the company and rank the alternatives from best to worst.

REFERENCES

Abdullah, L., & Najib, L. (2016). Sustainable energy planning decision using the intuitionistic fuzzy analytic hierarchy process: choosing energy technology in Malaysia. *International Journal of Sustainable Energy*, *35*(4), 360–377.

Boran, F. E., Genç, S., Kurt, M., & Akay, D. (2009). A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method. *Expert Systems with Applications*, *36*(8), 11363–11368.

Chan, D. (2004). Personnel Psychology. In *Encyclopedia of Applied Psychology* (Vol. 3, pp. 29–34).

Elsevier Academic Press.

Vlachos, I. K., & Sergiadis, G. D. (2007). Intuitionistic fuzzy information - Applications to pattern recognition. *Pattern Recognition Letters*, *28*(2), 197–206.

Xu, J., Yu, L., & Gupta, R. (2020). Evaluating the performance of the government venture capital guiding fund using the intuitionistic fuzzy analytic hierarchy process. *Sustainability*, *12*(17), 1–24.

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Sekian, terima kasih.

Setuju.

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