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A Personnel Selection Model Based on TOPSIS

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Abstract

In order to establish mutual-support team, resolve the problem of new team members choosing, this paper puts forward the selection model into two parts: preliminary evaluation and the second time evaluation, based on the team-efficacy.The charater of the model is the that: ①make the efficiency of the team as the starting point, set the evaluation index system; Applying the Fuzzy TOPSIS law, with the positive and negative ideal point to close to the ideal personnel to determine the degree of primary staff. ②set up a mathematical model which make team members have the greatest benefit from the selective personnel based on synergy, complementing each other's ideas, considered the team members and selected members of the interaction between members of the selection of decision-making, the choice of judges and different from previous studies. Finally, the case illustrates the effectiveness and feasibility.

Key words: Team-efficacy; Personnel Seletion; Fuzzy TOPSIS law; Mathematical model

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INTRODUCTION

Selecting personnel based on team characteristic is very important for work team efficiency and organization development.

Literature review

About personnel selection, there are a lot of researchers in abroad[1-3], they Put forward many evaluation methods. For example,It puts forward a talent evaluation method based on soft indicators and hard indicators[4-6].Some research put forward data mining methods based on decision trees.also some paper put forward AHP method for dean selection[7].

This paper put forward fuzzy topsis method for personnel selection.

1. METHOLOGY

1.1 Personnel Evaluation Indicator Construction

Based on the relevant researches, the evaluation system is determined.

1.2 Evaluation Method

The prosecure is the following:

Step 1: Give weight

Evaluation experts $D = (d_1, d_2, \dots , d_k)$,evaluation indicator collection $C = (c_1, c_2, \dots , c_n)$. taking $K = 3$ $n = 5$ as example. It is shown in table 1.

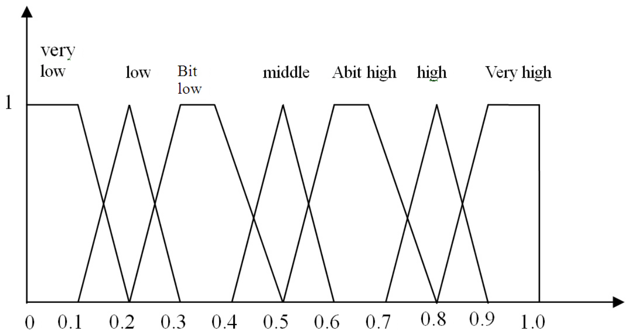


Figure 1
Indicator Fuzzy Number

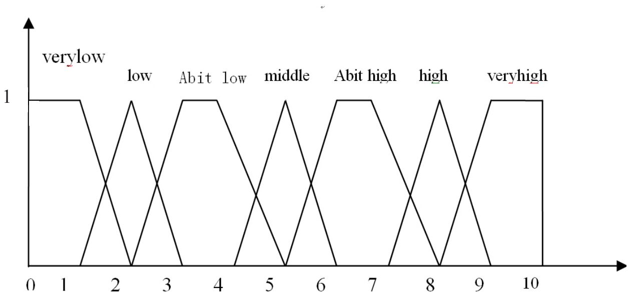


Figure 2
Personnel Indicator Fuzzy Number

Table 1
Indicator Language Variable Evaluation Value

Indicator	Expert		
	D_1	D_2	D_3
C_1	H	H	H
C_2	VH	VH	VH
C_3	VH	VH	H
C_4	H	H	H
C_5	H	H	H

$\tilde{w}_{jk} = (w_{jk1}, w_{jk2}, w_{jk3}, w_{jk4}), j = 1, 2, \ldots, n$ indicator weights are:

$$w_{j1} = \min_k(w_{jk1}), w_{j2} = \frac{1}{k}\sum_{k=1}^{k} w_{jk2}, w_{j3} = \frac{1}{k}\sum_{k=1}^{k} w_{jk3}, w_{j4} = \max_k(w_{jk4}) \quad (9)$$

Step 2: Evaluation score obtaining

It is shown in table 2.

Table 2
Evaluation Score

Indciator	Personnel	Experts		
		D1	D2	D3
C1	A1	MG	MG	MG
	A2	G	G	G
	A3	VG	VG	G
	A4	G	G	G
	A5	MG	MG	MG
C2	A1	MG	MG	VG
	A2	VG	VG	VG
	A3	VG	G	G
	A4	G	G	MG
	A5	MG	G	G
C3	A1	G	G	G
	A2	VG	VG	VG
	A3	VG	VG	G
	A4	MG	MG	G
	A5	MG	MG	MG
C4	A1	G	G	G
	A2	G	VG	VG
	A3	VG	VG	VG
	A4	G	G	G
	A5	MG	MG	G

To be continued

Continued

Changing Language variable evaluation value into Fuzzy evaluation value $\tilde{x}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk}, d_{ijk})$ $i = 1, 2, \ldots n, j = 1, 2, \ldots m$ the evaluation result is as following.

$$\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}, d_{ij}), a_{ij} = \min_k\left(a_{ijk}\right), b_{ij} = \frac{1}{k}\sum_{k=1}^{k} b_{ijk}, c_{ij} = \frac{1}{k}\sum_{k=1}^{k} c_{ijk},$$
$$d_{ij} = \max(d_{ijk}) \quad (10)$$

Step 3: The evaluation weight vector is:

$$\tilde{D} = \begin{pmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \cdots & \tilde{x}_{mn} \end{pmatrix} \quad \tilde{w} = \left(\tilde{w}_1, \tilde{w}_2 \ldots\ldots \tilde{w}_n\right) \quad (11)$$

$\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}, d_{ij})$ $\tilde{w}_j = (w_{j1}, w_{j2}, w_{j3}, w_{j4})$ $i = 1, 2, \ldots m, j = 1, 2, \ldots n$

Step 4: Standardization operation

$$\text{Efficiency index } \tilde{r}_{ij} = \left(\frac{a_{ij}}{d_j^*}, \frac{b_{ij}}{d_j^*}, \frac{c_{ij}}{d_j^*}, \frac{d_{ij}}{d_j^*}\right) \quad (12)$$

$$\text{Cost indicator: } \tilde{r}_{ij} = \left(\frac{\overline{a_j}}{d_{ij}}, \frac{\overline{a_j}}{c_{ij}}, \frac{\overline{a_j}}{b_{ij}}, \frac{\overline{a_j}}{a_{ij}}\right) \quad (13)$$

$$d_j^* = \max_i d_{ij} \qquad \overline{a_j} = \min_i a_{ij}$$

Step 5: Construction weight fuzzy evaluation matrix

$$\tilde{V} = \left[\tilde{v}_{ij}\right]_{m\times n}, i = 1, 2 \ldots\ldots m. \ j = 1, 2 \ldots\ldots n. \tilde{v}_{ij} = \tilde{r}_{ij} \cdot \tilde{w}_j \quad (14)$$

Step 6: Ideal status determined:

Gains positive and minus ideal solutions: (FPIS, A^*) and (FNIS, A^-).

$$A^* = (\tilde{v}_1^*, \tilde{v}_2^* \ldots\ldots \tilde{v}_n^*), A^- = (\tilde{v}_1^-, \tilde{v}_2^- \ldots\ldots \tilde{v}_n^-) \quad (14)$$
$$\tilde{v}_j^* = \max_i\left(v_{ij4}\right) \qquad \tilde{v}_j^- = \min_i\left(v_{ij1}\right)$$
$$i = 1, 2, \ldots m, j = 1, 2, \ldots n$$

Step 7: Calculation the distance

$$d(\tilde{m},\tilde{n})=\sqrt{\frac{1}{4}\left[(m_1-n_1)^2+(m_2-n_2)^2+(m_3-n_3)^2+(m_4-n_4)^2\right]} \quad (15)$$
$$\tilde{m}=(m_1,m_2,m_3,m_4),\tilde{n}=(n_1,n_2,n_3,n_4)$$

Step 8: Calculation Close to degree coefficient

$$cc_i=\frac{d_i^-}{d_i^*+d_i^-} \quad i=1,2......m$$
$$d_i^*=\sum_{j=1}^{n}d(\tilde{v}_{ij},\tilde{v}_j^*) \quad i=1,2......m$$
$$d_i^-=\sum_{j=1}^{n}d(\tilde{v}_{ij},\tilde{v}_j^-) \quad i=1,2......m \quad (16)$$
$$cc_i=1, A_i=A^*, cc_i=0, A_i=A^-$$

If cc_i gets closes to 1, A_i is closer to A^*, The reverse is also true. 4 the personnel determined

The relative neartude from O_i to P^* is:

$$T_i=\frac{(P^*-O^i)^T P^*}{\|P^*\|^2} \quad (17)$$

$$o_i=(y'_{1j},y'_{2j}......y'_{nj})\ j=1,2......n\ T_i=1-\frac{\sum_{i=1}^{n}y'_{ij}P_i^*}{\sum_{i=1}^{n}(P_i^*)^2} \quad (18)$$

Oboviously, $T_i\in[0, 1]$,when O_i = P*, T_i = 0, when , O_i = P*, T_i = 1.

2. CONSTRUCTION PERSONNEL SELECTION MODEL

Using 360 evaluation method to constructing the evaluation model:

$$\prod=[h_1\alpha_1 \quad h_2\alpha_2 \quad \cdots \quad h_p\alpha_p] * \begin{bmatrix} f_{11} & f_{21} & \cdots & f_{m1} \\ f_{12} & f_{22} & \cdots & f_{m2} \\ \vdots & \vdots & \ddots & \vdots \\ f_{1p} & f_{2p} & \cdots & f_{mp} \end{bmatrix} = \{\sum_{k=1}^{p} h_j\alpha_k f_{ki} \mid i=1,2,\cdots,m; j=1,2,\cdots,p\}$$

$f_{mp}=\frac{1}{5}*\sum_{l=1}^{5}x_{mpl}\ \chi_{mpl}, \chi_l$ is the evaluation score. h_j is indicator weight according AHP, α_p is indicator, f:the score, m:the number of indicator, p:the number of evaluation personnels.

3. CALCULATION

Choosing three personnel from the five

(1) three experts (D_1, D_2, D_3) give evaluation scores for (A_1, A_2, A_3 , A_4, A_5).the result is shown in table 2.

(2) three experts (D_1, D_2, D_3) give (c_1, c_2, c_3 , c_4, c_5) evaluation scores ,shown in table 3.2.

(3) according to figure3.2,3.3,and model (3.1) and (3.2), the fuzzy evaluation matrix and fuzzy personnel weight indicators are obtained.it is shown in table3.4.

(4) according (3.3), (3.4) and Normalization.the reaults is shown in talbe 3:

Talbe 3
Standardization Matrix

	C_1	C_2	C_3	C_4	C_5
A_1	(0.35,0.48, 0.56,0.72)	(0.4,0.63, 0.8,1)	(0.49,0.7, 0.74,0.9)	(0.49,0.64, 0.64,0.81)	(0.49,0.64, 0.64,0.81)
A_2	(0.49,0.64, 0.64,0.81)	(0.64,0.81, 1,1)	(0.56,0.78, 0.93,1)	(0.49,0.7, 0.74,0.9)	(0.56,0.72, 0.8,0.9)
A_3	(0.49,0.7, 0.74,0.9)	(0.56,0.75, 0.87,1)	(0.49,0.76, 0.86,1)	(0.56,0.72, 0.8,0.9)	(0.49,0.66, 0.7,0.9)
A_4	(0.49,0.64, 0.64,0.81)	(0.4,0.66, 0.77,0.9)	(0.35,0.58, 0.68,0.9)	(0.49,0.64, 0.64,0.81)	(0.49,0.66, 0.7,0.9)
A_5	(0.35,0.48, 0.56,0.72)	(0.4,0.66, 0.77,0.9)	(0.35,0.52, 0.65,0.8)	(0.35,0.54, 0.58,0.81)	(0.35,0.48, 0.56,0.72)

(5) gains positive and minus ideal solutions (FPIS, A^*) and (FNIS, A^-).

A^* = [(0.9,0.9,0.9,0.9),(1,1,1,1),(1,1,1,1),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)]

A^- = [(0.35,0.35,0.35,0.35),(0.4,0.4,0.4,0.4),(0.35,0.35,0.35,0.35),(0.35,0.35,0.35,0.35)]

(6) gaining the distance:

Table 4
Distance with Positive Ideal Solution

	C_1	C_2	C_3	C_4	C_5
$d(A_1,A^*)$	0.4	0.37	0.33	0.28	0.28
$d(A_2,A^*)$	0.28	0.2	0.25	0.24	0.2
$d(A_3,A^*)$	0.24	0.26	0.29	0.2	0.26
$d(A_4,A^*)$	0.28	0.37	0.42	0.28	0.26
$d(A_5,A^*)$	0.4	0.37	0.45	0.37	0.4

Table 5
Distance with Negative Ideal Solution

	C_1	C_2	C_3	C_4	C_5
$d(A_1,A-)$	0.22	0.38	0.39	0.32	0.32
$d(A_2,A-)$	0.32	0.49	0.5	0.39	0.41
$d(A_3,A-)$	0.39	0.43	0.47	0.41	0.37
$d(A_4,A-)$	0.32	0.34	0.34	0.32	0.37
$d(A_5,A-)$	0.22	0.34	0.28	0.27	0.22

(7) according to model (3.8) the close to degree coefficient:

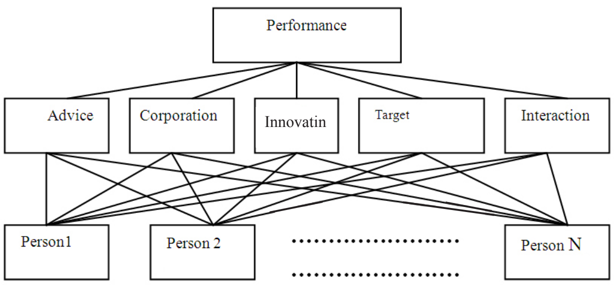
Table 6
Close to Degree Coefficient

	di*	di-	di*+di-	cc_i
A_1	1.66	1.63	3.29	0.5
A_2	1.17	2.11	3.288	0.64
A_3	1.25	2.07	3.32	0.62
A_4	1.61	1.69	3.3	0.51
A_5	1.99	1.33	3.32	0.4

If cc_i = 1, $A_i = A^*$, cc_i = 0, $A_i = A^-$ the closer to 1,the better.

According to table 6,the order is 0.64>0.62>0.51>0.5>0.4, A_2, A_3, A_4 are determined.

The evaluation indicator systems are:



(8) Indicator Importance Analysis

Using AHP with 1—9,the results is shown in table 1,using MATLAB to calculation λ_{max},the results is 0.22:0.22:0.18:0.27:0.11.

Table 7
Indicator Weight

	Advice	Corporate	Innovation	Target	Interaction	Weight
Advice	1	1	1.25	0.83	2	0.22
Corporate	1	1	1.25	0.83	2	0.22
Innovation	0.8	0.8	1	0.67	1.6	0.18
Target	1.2	1.2	1.5	1	2.4	0.27
Interaction	0.5	0.5	0.625	0.42	1	0.11

$$\begin{bmatrix} f_{11} & f_{21} & \cdots & f_{m1} \\ f_{12} & f_{22} & \cdots & f_{m2} \\ \vdots & \vdots & \ddots & \vdots \\ f_{15} & f_{25} & \cdots & f_{m5} \end{bmatrix} = \begin{bmatrix} 14.0 & 28.0 & 17.2 & 16.7 & 21.6 \\ 29.0 & 8.30 & 34.5 & 27.8 & 27.0 \\ 14.0 & 28.0 & 10.3 & 11.1 & 21.6 \\ 23.0 & 14.0 & 27.3 & 22.2 & 16.3 \\ 20.0 & 21.7 & 10.4 & 22.2 & 13.5 \end{bmatrix}$$

$$\Pi = \begin{bmatrix} 0.044 & 0.11 & 0.072 & 0.135 & 0.077 \\ 0.066 & 0.066 & 0.036 & 0 & 0.033 \\ 0.011 & 0.044 & 0.072 & 0.135 & 0 \end{bmatrix} \begin{bmatrix} 14.0 & 28.0 & 17.2 & 16.7 & 21.6 \\ 29.0 & 8.30 & 34.5 & 27.8 & 27.0 \\ 14.0 & 28.0 & 10.3 & 11.1 & 21.6 \\ 23.0 & 14.0 & 27.3 & 22.2 & 16.3 \\ 20.0 & 21.7 & 10.4 & 22.2 & 13.5 \end{bmatrix} =$$

$$\begin{bmatrix} 0.044 & 0.11 & 0.072 & 0.135 & 0.077 \\ 0.066 & 0.066 & 0.036 & 0 & 0.033 \\ 0.011 & 0.044 & 0.072 & 0.135 & 0 \end{bmatrix} \begin{bmatrix} 14.0 & 28.0 & 17.2 & 16.7 & 21.6 \\ 29.0 & 8.30 & 34.5 & 27.8 & 27.0 \\ 14.0 & 28.0 & 10.3 & 11.1 & 21.6 \\ 23.0 & 14.0 & 27.3 & 22.2 & 16.3 \\ 20.0 & 21.7 & 10.4 & 22.2 & 13.5 \end{bmatrix} =$$

$$\begin{bmatrix} 9.459 & 7.7219 & 9.772 & 9.2984 & 8.6481 \\ 4.002 & 4.1199 & 4.1229 & 4.0692 & 4.4307 \\ 6.929 & 7.3512 & 7.8371 & 6.8564 & 7.3197 \end{bmatrix}$$

so the score A_2, A_3, are 44.8931, 20.7447, 36.2934. A_2 is the best.

CONCLUSION

Applying fuzzy TOPSIS, according positive and minus ideal solutions to determine personnel, it is quite enlighten.

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