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Discuss in Senior Executives Performance Assessment Methods Based on Fuzzy Decision

1Liu Baoping, 2Rong Lishan and 3Hu Shuai
1College of Economics and Management, University of South China, P.O. Box 421001, Hengyang City, Hunan Province, People’s Republic of China
2City Construction College, University of South China, P.O. Box 421001, Hengyang City, Hunan Province, People’s Republic of China

Abstract: In this study, we come up with the senior executives performance assessment method based on fuzzy decision, which combines the concept of fuzzy decision and the analysis in the defect of the traditional assessment methods. Performance assessment is the basic and key process of human resource management and senior executives are the core of the organization. Therefore, it is of great significance of evaluating the performance of them effectively. The core innovation of this research is that this kind of assessment method makes full use of the concept of the fuzzy decision. The previous work in this field is discussed theoretically mostly on the viewpoints, principles or superficial data evaluation. Compared with previous work, we propose a senior executives performance appraisal methods based on fuzzy decision. Finally, we analyzed the performance by implementing specific numerical experiments to verify the proposed models.

Key words: Fuzzy decision, senior executives, performance assessment

INTRODUCTION

Performance appraisal is the basis and key of human resource management. Fierce market competition puts forward new demands for human resources management. The implementation of performance appraisal and performance improvement is the important guarantee for the enterprise to achieve strategic objectives and obtain continuous self-improvement (Fan, 2010). Senior executives are the core of the organization, which play a decisive role in the organization's development. The full play of the role of senior executives has a direct impact on the development of enterprises (Liu and Peng, 2011). Therefore, the effective performance appraisal for senior executives becomes particularly important. At present, some domestic performance evaluation and performance management for senior executives are discussed theoretically mostly on the viewpoints, principles or superficial data evaluation, in which the importance of the issues is raised, but it unable to carry out in-depth study on the executives performance index set, weight determination, assessment modeling and conclusion reliability (Liu and Bai, 2006). The proposed set of assessment methods on how to apply performance management usually lack the maneuverability, therefore its effectiveness is naturally greatly reduced (Zhang, 2007).

To overcome this drawback, we propose a senior executives performance appraisal methods based on fuzzy decision. First of all, this method assesses the overall quality of senior executives through fuzzy synthetic evaluation method. Then fuzzy centralized decision method is applied to sort the comprehensive assessment test scores. The effective application of fuzzy centralized decision method can give qualitative analysis and quantitative analysis effectively on senior executives so that senior executives know their performance levels and performance capabilities, which helps to understand their own inadequacies comprehensively and improve their level of performance.

FUZZY DECISION

Fuzzy comprehensive evaluation decision: Fuzzy comprehensive evaluation regards the evaluation targets as a fuzzy set composed of a variety of factors (called the factor set U) and then set these factors into different evaluation grades to assemble into the fuzzy set for evaluation (called the evaluation set V). After this, the attribution grade level (called the fuzzy matrix) of each single factor is calculated and then get the quantitative solution value (called fuzzy matrix synthesis) by calculating according to the weight distribution of various factors in the evaluation target. The model and the steps:

Corresponding Author: Liu Baoping, College of Economics and Management, University of South China, P.O. Box 421001, Hengyang City, Hunan Province, People’s Republic of China
The evaluation targets are defined as the factor set U = \{u_1, u_2, \ldots, u_n\}, the evaluation set V = \{v_1, v_2, \ldots, v_m\}.

Fuzzy relation matrix is obtained by calculating each evaluated things' attribution grade level to fuzzy subset through membership function, R = (r_{ij})_{m \times n} represents the attribution grade level of the evaluated fuzzy set which is judged on the j-th level by the i-th factor.

The fuzzy vector of evaluation factors, A = [a_1, a_2, \ldots, a_n]:

\[ \sum_{i=1}^{n} a_i = 1 \]

Then, Comprehensive evaluation is carried out as:

\[ B = A \odot R = [b_1, b_2, \ldots, b_n] \]

\[ b_i = \prod_{j=1}^{n} a_j r_{ij} \]

R : Transformation matrix of fuzzy relation
A : Input fuzzy vector, Weights matrix
B : Output modulus vector
a_1, a_2, \ldots, a_n : Fuzzy weights, Required to meet:

\[ \sum_{i=1}^{n} a_i = 1, a_i \in [0,1] \]

\[ \odot \] : Synthesis operator, It can be (V, \land), (+, ), (\lor, \lor) etc

Centralized fuzzy decision: In order to sort the factors of the set U = \{u_1, u_2, \ldots, u_n\}, the expert group composed of m experts (|M| = m) sort the elements of the set U, respectively and M kind of advice is obtained V = \{v_1, v_2, \ldots, v_m\}. However, these views are often fuzzy and "centralized fuzzy decision" aims at concentrating these views into a more reasonable opinion.

The expert group composed of m experts will give m kinds of advices by sorting the elements of the set U, U = \{u_1, u_2, \ldots, u_n\}. V = \{v_1, v_2, \ldots, v_m\}, v_i is the i-th sequence of opinions, namely a certain sort of the elements of set U.

\[ \forall u \in U, B_i(u) \text{ represents the number of elements ranked after } u \text{ in the } i \text{-th opinions sequence. If } u \text{ ranked first in the } i \text{-th opinions sequence } (V_i), B_i(u) = n-1; \text{ If } u \text{ ranked second in the } i \text{-th opinions sequence, } B_i(u) = n-2; \text{ If } u \text{ ranked } k \text{-th in the } i \text{-th opinions sequence } (V_i), B_i(u) = n-k. \]

As the following:

\[ B(u) = \sum_{i=1}^{n} B_i(u) \]  \hspace{1cm} (1)

It is the Borda count of u. Obviously, B(u) is the sum of u's scores in the all opinions sequence v_1, v_2, \ldots, v_m. Thus, all the elements of U can be sorted by the size of the Borda count and the new sequence is a more reasonable opinion in the centralized opinions.

When the centralized ideas and people's intuition do not coincide, it is sorted by the size of the weighted Borda count:

\[ B(u) = \sum_{i=1}^{n} a_i B_i(u) \sum_{i=1}^{n} a_i - 1 \]  \hspace{1cm} (2)

EXAMPLE

The overall ability of seven senior executive's year-end scores (Table 1) in the same company is evaluated by using fuzzy comprehensive evaluation decision method and centralized fuzzy decision method. u_i (i = 1, 2, \ldots, 7) of Table 1 represents the i-th senior executive and represents the j-th specific assessment criteria and the weighting of the indicators (Table 2).

Senior executives comprehensive quality assessment based on fuzzy comprehensive evaluation method: First of all, the overall quality of senior executives is determined by the fuzzy comprehensive evaluation method and the degree of personal overall quality is ranked.

Based on the above steps of fuzzy comprehensive evaluation method we determine the factor set of objects at first. The factor set includes decision-making capacity, emergency handling, employee recognition level, net profit, investment income and other specific assessment indicators. U = \{u_1, u_2, \ldots, u_7\}, judge set V = \{v_1, v_2, \ldots, v_7\} (best, good, average, pass and fail). Second, determine the membership function:

\[ \mu_{A_{best}}(X) = \begin{cases} 1, & x \geq 90 \\ \frac{x-60}{30}, & x < 90 \end{cases} \]

\[ \mu_{A_{good}}(X) = \begin{cases} 1, & 70 \leq x < 90 \\ \frac{x-70}{20}, & 60 \leq x < 70 \\ 0, & x < 60 \end{cases} \]

\[ \mu_{A_{pass}}(X) = \begin{cases} 1, & 50 \leq x < 60 \\ \frac{x-50}{10}, & 40 \leq x < 50 \\ 0, & x < 40 \end{cases} \]
Table 1: Senior executives performance assessment

<table>
<thead>
<tr>
<th>Executives</th>
<th>v1</th>
<th>v2</th>
<th>v3</th>
<th>v4</th>
<th>v5</th>
<th>v6</th>
<th>v7</th>
<th>v8</th>
<th>v9</th>
<th>v10</th>
<th>v11</th>
<th>v12</th>
<th>v13</th>
<th>v14</th>
<th>v15</th>
<th>v16</th>
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</thead>
<tbody>
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<td>89</td>
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</tr>
</tbody>
</table>

Table 2: Detailed assessment indicators

<table>
<thead>
<tr>
<th>Assessment content</th>
<th>Detailed assessment indicators</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v1</td>
<td>Leadership</td>
<td>Decision-making capacity, emergency handling, motivating force, etc.</td>
</tr>
<tr>
<td>v2</td>
<td>Plan execution ability</td>
<td>The accuracy of planning, organization, etc.</td>
</tr>
<tr>
<td>v3</td>
<td>Communication and coordination skills</td>
<td>Communication, teamwork, etc.</td>
</tr>
<tr>
<td>v4</td>
<td>Learning ability</td>
<td>Professional knowledge, ability to accept new knowledge</td>
</tr>
<tr>
<td>v5</td>
<td>Innovation</td>
<td>New ideas, new initiatives, etc.</td>
</tr>
<tr>
<td>Attitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v6</td>
<td>Employee satisfaction</td>
<td>Employee recognition, recognition degree</td>
</tr>
<tr>
<td>v7</td>
<td>Responsibility</td>
<td>Whether responsible, carry out business decisions, etc.</td>
</tr>
<tr>
<td>v8</td>
<td>Positive</td>
<td>Proactive, working with passion, etc.</td>
</tr>
<tr>
<td>v9</td>
<td>Discipline</td>
<td>Self-discipline, caution, etc.</td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v10</td>
<td>Profit target completion rate</td>
<td>Completion of finance goals</td>
</tr>
<tr>
<td>v11</td>
<td>ROE</td>
<td>Net profit, investment income, etc.</td>
</tr>
<tr>
<td>v12</td>
<td>Sales growth rate</td>
<td>Sales volume, sales ratio</td>
</tr>
<tr>
<td>v13</td>
<td>Others satisfaction</td>
<td>Governments, communities, shareholders, customers, etc.</td>
</tr>
<tr>
<td>v14</td>
<td>Core staff growth</td>
<td>Technology backbone, management backbone</td>
</tr>
<tr>
<td>v15</td>
<td>Completion rate of new business</td>
<td>New products, new markets</td>
</tr>
<tr>
<td>v16</td>
<td>Safety and environmental protection</td>
<td>energy conservation, safety, etc.</td>
</tr>
</tbody>
</table>

\[
\mu_{A_{\text{res}}} (X) = \begin{cases} 
1, & x = 60 \\
50 - 60 \leq x < 60 \\
0, & x \leq 50, x > 60 \\
\end{cases}
\]

\[
\mu_{A_{\text{res}}} (X) = \begin{cases} 
1, & x = 40 \\
70 - 40 \leq x < 70 \\
0, & x \leq 40, x > 70 \\
\end{cases}
\]

Determine the membership degree of the evaluated indicators to fuzzy subset through the membership function, then, we get fuzzy relation matrix as:

\[
R = \begin{bmatrix}
1 & 1 & 0 & 0 & 0 \\
0.933 & 1 & 0.2 & 0 & 0 \\
0.9 & 1 & 1 & 1 & 0 \\
0.93 & 1 & 0.2 & 0 & 0 \\
0.767 & 1 & 1 & 1 & 0 \\
0.9 & 1 & 1 & 1 & 0 \\
0.833 & 1 & 0.5 & 0 & 0 \\
0.833 & 1 & 0.4 & 0 & 0
\end{bmatrix}
\]

\[
R = \begin{bmatrix}
0.833 & 1 & 0.5 & 0 & 0 \\
0.867 & 1 & 0.4 & 0 & 0 \\
0.967 & 1 & 0.1 & 0 & 0 \\
0.932 & 1 & 0.2 & 0 & 0 \\
0.767 & 1 & 0.7 & 0 & 0 \\
1 & 0.8 & 0 & 0 & 0 \\
0.833 & 1 & 0.5 & 0 & 0 \\
0.867 & 1 & 0.4 & 0 & 0
\end{bmatrix}
\]

By calculation, we get:

\[
B = \begin{bmatrix}
(0.129, 0.909, 0.213, 0, 0) \\
(0.825, 0.925, 0.334, 0, 0) \\
(0.852, 0.957, 0.427, 0, 0) \\
(0.912, 0.946, 0.258, 0, 0) \\
(0.791, 0.880, 0.519, 0, 0) \\
(0.821, 0.919, 0.482, 0, 0) \\
(0.875, 0.898, 0.333, 0, 0)
\end{bmatrix}
\]
According to the principle of maximum membership degree in fuzzy logic, the assessment results of seven executives: The first one is "excellent", the other six is "good".

The evaluation result assessed by the fuzzy comprehensive evaluation method is realistic and reflects senior executive's overall quality and ability objectively.

**Senior executives comprehensive capacity assessment based on centralized fuzzy decision method**: You can only divide senior executives into different levels by using fuzzy comprehensive evaluation method but you can't sort the evaluation results of the seven senior executives. Therefore, we apply the centralized fuzzy decision method to sort the evaluation results of the seven senior executives and study into it.

First, determine the seven senior executive's set \( U = \{u_1, u_2, \ldots, u_7\} \); Secondly, the decision-making capacity, emergency handling, employee recognition level, net profit, investment income and other specific test results is sorted from high to low as the experts expressed opinions sequence \( V = \{v_1, v_2, \ldots, v_7\} \); then, determine senior executives’ appropriate rank \( u_i \) and calculate senior executive Borda count according to the test results of each case; Finally, the senior executives are sorted according to the the size of Borda count.

Calculate the seven senior executives Borda count according to Eq. 1: \( B(u_1) = 77, B(u_2) = 68, B(u_3) = 56, B(u_4) = 74, B(u_5) = 52, B(u_6) = 57, B(u_7) = 64 \). According to the order of the centralized Borda count we sort it: \( u_1, u_2, u_3, u_4, u_5, u_6, u_7 \).

Calculate the seven senior executives weighted Borda count according to Eq. 2: \( B(u_1) = 4.69, B(u_2) = 4.19, B(u_3) = 3.6, B(u_4) = 4.73, B(u_5) = 3.26, B(u_6) = 3.57, B(u_7) = 3.99 \). According to the order of the centralized Borda count we sort it: \( u_1, u_2, u_4, u_6, u_5, u_3, u_7 \).

The sorted results of weighted Borda count is more in line with the actual situation because the sorted results of weighted Borda count includes all the specific evaluation index weight and the senior executive’s overall quality and ability is reflected comprehensively and objectively.

**EPILOGUE**

As we all know, performance assessment is the basis and key of human resource management and corporate senior executives are the backbone of enterprises. Senior executives’ enthusiasm, initiative and creativity depends on the fair performance assessment and appropriate incentives. Senior executives performance assessment methods based on fuzzy decision is a more scientific and effective assessment method with strong operability. This paper gives seven senior executives’ year-end assessment indicators knowledge mining by applying fuzzy decision method. We determine the overall quality of senior executives by the fuzzy comprehensive evaluation method and also rank the degree of personal overall quality. We apply the centralized fuzzy decision method to sort the evaluation results of the seven senior executives and study into it. Here we also give a performance analysis through specific numerical experiments and experimental results prove that this method has good performance.

**REFERENCES**