Application of Mutations Progression Method in Enterprise Human Resources Evaluation

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Abstract — As a study of the mutations phenomenon of system theory, the theory of mutations is widely used in many subjects. One common application, derived by mutations model progression method is to solve the multi-criteria decision problem. The main characteristics of mutations progression method is that it firstly for the evaluation target system of multi-level contradiction decomposition, and the use of mutations theory and fuzzy methods generates the fuzzy membership function mutation, by concentration formula for comprehensive quantitative operations, finally as a parameter, namely the general membership functions, which are evaluated. In this paper, Mutations progression method on the use of Enterprise Human Resources Evaluation has been studied and found the result is more reasonable, objective and feasible for the settlement of the issue of Enterprise Human Resources Evaluation, which provides a new way of thinking.

Index Terms — mutations progression method, human Resources, comprehensive evaluation

I. INTRODUCTION

Human resource is one of the most valuable resources in the world as well as a strategic resource in the 21st century, when performance appraisal plays an increasingly important in human resource management [1]. At present, many scholars to the enterprise human resources performance evaluation are studied. The application of various algorithms constructs the effective model, and made many discoveries. Zhijun Han and Xiaojun Cai [2] evaluates the quantitative validity of performance appraisal in human resources management by the method of analysis of variance, and some canonical results are made that may occur in performance appraisal system. Yanling Xiao, Xiaojing Liu and Jianbo Liu [3] use entropy method to adjust performance indicator weight given by the process, so it lives up to dynamic weight index and gives an example to show how to use entropy method. Jian Li [4] uses the method of ANP to appraise the human resource from the aspects of mentality, competence and knowledge and gets the results that the appraisal will provide a justice to the development of the organizations and the individuals. Xisong Liu, Chunrong Du and Yaowu Wang, et al [5] who base on the human resource management of large-scale projects establish an evaluation system according to the achievement, capacity and manner of evaluated object and prove that the evaluation system and evaluation model are successfully applied in a practical project.

These above-mentioned literatures study the performance evaluation of human resources, and apply different algorithms to evaluate the performance of human resources and establish the model. These documents for performance evaluation of enterprise human resources have made important contribution to the research, and practice guidance is obvious. Each method has its own characteristics, and some methods have problem in determining the right weight problem correctly, and some methods’ calculation are more complicated, but there is not a mutations progression method applied to the enterprise human resources evaluation. This method is not used to the weight of indicators, but it takes into account the relative importance of evaluation, thereby reducing the subjectivity without losing scientific, reasonable, simple and accurate calculation of its extensive scope, worth exploring.

II. THE BASIC THOUGHTS AND PROCEDURES OF THE MUTATIONS PROGRESSION METHOD

A. Use mutations in the evaluation index system of organizations

Firstly, according to the evaluation purpose, decompose the total evaluation index into multi-level, arranged in a handstand tree target by multi-layer structure, from the total evaluation of the lower targets to the indicators, and gradually into the lower sub-indicators. The original data only need to know the bottom sub-indicators. An index of decomposition was to get more specific index, so, when the quantified decomposed into sub-indicators that can be measured, decomposition can stop. Mutation because a state variable coefficients of control variables is not more than four, so all levels corresponding to the general indicators (a subset of indicators for a single indicator) not more than 4 decompositions.

B. Determine the evaluation index system of mutations in the system type mutations

A total of seven types of mutations in the system, the most common are 3 kinds, which is sharp point mutation system; swallow tail mutation system; butterfly mutation system. Their mathematical models are [6]:

\[ f(x) = x^4 + ax^2 + bx \]  \( (1) \)

(2) Swallow tail mutation system:
\[ f(x) = \frac{1}{5} x^5 + \frac{1}{3} ax^3 + \frac{1}{2} bx^2 + cx \]  

(2) Butterfly mutation system:

\[ f(x) = \frac{1}{6} x^6 + \frac{1}{4} ax^4 + \frac{1}{3} bx^3 + \frac{1}{2} cx^2 + dx \]  

(3) Butterfly mutation system:

Above \( f(x) \) says a system of a state variable \( x \), the potential function of state variable \( x \) coefficient of \( a, b, c, d \) said the state variable control variables. The system state variables and the control variables are two aspects of the contradiction.

If an indicator is only broken down into two sub-indicators, the system can be regarded as a sharp point mutation system. If an indicator decomposed into three sub-indicators, the system can be regarded as swallow tail mutation system. If an indicator can be broken down into four sub-indicators, the system can be regarded as butterfly mutation system.

C. Bifurcation equation of mutation system derives concentration formula

Mutation system for the potential function for \( f(x) \), according to mutations theory, and its all set point into balance surface, the equation of \( f(x) \) for the first derivative of the above-mentioned, that is, the singular point \( f'(x) = 0 \). It's collection of odd through the second derivative of \( f(x) \), namely \( f''(x) = 0 \) expansion x, get bifurcation set equation of mutations system. Bifurcation set equation shows that if the control variables satisfy this equation, the system will mutate \([7]\).

Through the decomposition of the form of bifurcation set equations to the concentration formula, the concentration formula will return a system different from the quality control of state variables into the same qualitative state, that is, into a state variable that states the quality.

The bifurcation set equation of sharp point mutation system’s decomposition form is \([8]\):

\[ a = -6x^2, b = 8x^3 \]  

(4) Deducing concentration formula \( x_a = a^{1/2} \), \( x_b = b^{1/6} \). In the formula, \( x_a \) said that the \( x \) value corresponding to \( a \), \( x_b \) said that the \( x \) value corresponding to \( b \).

The bifurcation set equation of swallow tail mutation system’s decomposition form is:

\[ a = -6x^2, c = -3x^4, b = 8x^3 \]  

(5) Deducing concentration formula \( x_a = a^{1/2} \), \( x_b = b^{1/6} \), \( x_c = c^{1/2} \). In the formula, \( x_a \) said that the \( x \) value corresponding to \( a \), \( x_b \) said that the \( x \) value corresponding to \( b \), \( x_c \) said that the \( x \) value corresponding to \( c \).

The bifurcation set equation of butterfly mutation system’s decomposition form is:

\[ a = -10x^2, c = -15x^4, b = 20x^3, d = 4x^5 \]  

(6) Deducing concentration formula \( x_a = a^{1/2} \), \( x_b = b^{1/6} \), \( x_c = c^{1/2} \), \( x_d = d^{1/6} \). In the formula, \( x_a \) said that the \( x \) value corresponding to \( a \), \( x_b \) said that the \( x \) value corresponding to \( b \), \( x_c \) said that the \( x \) value corresponding to \( c \), \( x_d \) said that the \( x \) value corresponding to \( d \).

D. The use of concentration formula for comprehensive evaluation

According to multi-objective fuzzy decision theory, on the same program objectives in a variety of circumstances, such as \( A_1, A_2, \ldots, A_m \) for the fuzzy goals. The ideal strategy is \( C = A_1 \cap A_2 \cap \cdots \cap A_m \), and its membership function is \([9]\):

\[ \mu_c = \mu_{A_1}(x) \land \mu_{A_2}(x) \land \cdots \land \mu_{A_m}(x) \]  

(7) Here, \( \mu_{A_i}(x) \) is the membership functions of \( A_i \), defined as membership function of this program and membership function which of the minimum target.

For different programs, such as for \( G_1, G_2, \ldots, G_n \), Charged \( G_i \) membership function \( \mu_{G_i}(x) > \mu_{G_j}(x) \), that is said program \( G_i \) is superior to the program \( G_j \).

Thus the use of concentration formula under the control of the same object variables (indicators) to calculate the corresponding value should be "large and medium-sized small check" principle. However, for complementary indicators, usually in lieu of using the average in the final comparison object to use of "small in the big check" principle, that is sorting of evaluation objects according to the size of the total score evaluation indexes.

III. THE USE OF THE MUTATIONS PROGRESSION METHOD FOR EVALUATION THE ENTERPRISE HUMAN RESOURCES

A. Establishing Enterprise Human Resources Evaluation System

The investigation of enterprise employees in input index selection should reflect the work condition and consumption of resources. In the working status of staff into the way of questionnaire, the system is mainly based on the quality of employees, considering the work
attitude [10]. In the last company human resources evaluation index system according to the requirement of mutations progression method into a multi-level evaluating target structure, and according to the indexes in order of importance, an important index in front row, secondary index in behind (see table 1).

B. Determine Evaluation Target System of All Levels of Mutations in the Type of System

According to the basic principle of mutations progression method, indicators at all levels of mutations in the type of system are given by:

(1) The third grade index system. Efficiency is a swallow tail type for non-complementary; work quality is a sharp point mutations system for complementary; safety accident is a sharp point mutations system for complementary; professional is a sharp point mutations system for complementary; knowledge is a swallow tail type for complementary; express is a sharp point mutations system for complementary; organization is a swallow tail type for non-complementary; team is a sharp point mutations system for complementary; professional is a sharp point mutations system for complementary.

(2) The second grade index system. Performance indexes for non-complementary, swallow tail type; capability indexes for complementary, butterfly mutations system; attitude indexes for non-complementary, swallow tail type.

(3) The top of the enterprise human resources performance evaluation index system for the complementary, swallow tail type.

TABLE I

<table>
<thead>
<tr>
<th>A level Indicator</th>
<th>B level Indicator</th>
<th>C Level Indicator</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>1.0000</td>
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<td>plan ability C17</td>
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<td>0.8566</td>
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<td>team B8</td>
<td>obedient spirit C18</td>
<td>0.8877</td>
<td>0.8932</td>
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<td>1.0000</td>
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<td>1.0000</td>
<td>0.9667</td>
<td>0.9231</td>
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</tr>
</tbody>
</table>

C. Use Concentration Formula to Evaluate and Sorting

In order to solve the dimensionless model parameters reunification, each index data needs to do dimensionless processing so that dimension of the data after the elimination of restrictions on the value range of 0 ~ 1.

The better indicator of the type (positive indicators):

$$y_{ij} = \frac{x_{ij}}{\max(x_{ij})}$$ (8)

The smaller the better type of indicators (reverse targets):
\[ y_{ij} = 1 - \frac{x_{ij}}{\max(x_{ij})} \]  

(9)

Of which, \( i = 1, 2 \cdots, m \) ( \( m \) is the index number); \( j = 1, 2 \cdots, n \) ( \( n \) is the index number).

Use concentration formula to calculate mutation series of the control variables indicators of each unit that need evaluation, and then take the mutant series of the subsystem of each unit that is evaluated, and as control variables of the evaluation system indicator on the level.

For example, the quality of the evaluation system, an indicator of control variables out of the mutation type of series as indicators of performance evaluation system of indicators of the quality of the control variables. Series is in accordance with the requirements of mutation progression method and mutation system of non-complementary to "large and medium-sized small check" to check the principle, that is, from a mutation in the smallest class, and mutation system of complementary check the mutant series average. Therefore:

For performance indexes:

\[
\begin{align*}
X_A &= \min(x_a, x_b, x_c) \\
X_B &= \frac{(x_a + x_b)}{2} \\
X_C &= \frac{(x_a + x_b)}{2} \\
X_D &= \min(x_a, x_b, x_c)
\end{align*}
\]

For capability indexes:

\[
\begin{align*}
X_A &= \frac{(x_a + x_b)}{2} \\
X_B &= \frac{(x_a + x_b + x_c)}{2} \\
X_C &= \frac{(x_a + x_b + x_c)}{3} \\
X_D &= \min(x_a, x_b, x_c)
\end{align*}
\]

For attitude indexes:

\[
\begin{align*}
X_A &= \frac{(x_a + x_b)}{2} \\
X_B &= \frac{(x_a + x_b)}{2} \\
X_C &= \frac{(x_a + x_b)}{2}
\end{align*}
\]

In the first use concentration formula to calculate mutation series of the control variables indicators of each unit that need evaluation, then take mutations series as control variables of top indicators, through mutations series we can get the overall evaluation score of the staffs in the last. This score can evaluate on human resource performance evaluation and can also sort the total score.

D. Enterprise Human Resources Evaluation of Empirical Analysis

For convenience, the author describes a recruitment examination, for example. Assuming a senior management personnel recruitment Of A and B, C, D, E five candidate performance ability, attitude, three kinds of assessment, the application of the method for calculating the standardized series of mutation data in table 1. Each man will only needs to put their evaluation index of standardized data into the model of mutations, and can obtain their performance scores (table 2). Table 2 shows B through a comprehensive evaluation of the performance of the quality of the highest scores, although the indicators of capacity while the lowest scores, but is no less than with other managers and B in the indicators of performance indicators and evaluation of the attitude of the highest scores. D managers evaluate the performance of the overall quality scores of the second, only slightly higher than B in ability indicators. A manager scores the lowest, although the indicators of the ability and attitude indicators are high, but performance indicators to 0. So B is the best candidate.

### Table II

<table>
<thead>
<tr>
<th>candidate</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>0.8157</td>
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<td>( X_B )</td>
<td>0.9921</td>
<td>0.9915</td>
<td>0.9933</td>
<td>0.9938</td>
<td>0.9942</td>
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<td>( X_C )</td>
<td>0.9890</td>
<td>0.9965</td>
<td>0.9987</td>
<td>0.9948</td>
<td>0.9925</td>
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<td>( X_D )</td>
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<td>0.9346</td>
<td>0.9327</td>
<td>0.9339</td>
<td>0.9281</td>
</tr>
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</table>

| ranking | 5 | 1 | 3 | 2 | 4 |

IV. Conclusion

On the use of mutations progression method in this article, enterprise human resources performance has been evaluated and found that the results are reliable. From the calculation process, we can find this method does not need to assign weights of evaluation indexes, and it only consider the relative importance of index, avoid the incertitude and subjective directly use the concept of "large" weight, thus it is simple. This method is applied to the treatment of the performance evaluation of enterprise human resources and should be further refined to promote.

### References


