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Application of analytic hierarchy process to the employee performance evaluation

Dayong Xu

Department of Business Administration, University of Science and Technology
Liaoning, Anshan, Liaoning, (CHINA)
E-mail : xh616@sohu.com

ABSTRACT

The objective evaluation of the application of analytic hierarchy process decision-making, is a very effective organic combination of qualitative analysis and quantitative analysis methods. For employee performance evaluation decision-making is also a multi-target, multi-level, complex structure, many factors system evaluation and decision-making and thus the use of the analytic hierarchy process for such projects is appropriate. For employee performance evaluation indicators established and reasonable quantitative problems, including employees work ability, work attitude, work performance, including a more comprehensive index evaluation system using analytic hierarchy process to build a comprehensive evaluation model, and gives comprehensive evaluation value is calculated. Combined with case analysis of employee performance evaluation, the results show that the analytic hierarchy process to improve the reasonableness and accuracy of the reviews.

KEYWORDS

Analytic hierarchy process; Employee performance; Index system; Evaluation model; Decision-making.



INTRODUCTION

Analytic Hierarchy Process (AHP) is a University of Pittsburgh professor of operations research home Sadi (TLSaaty) in the early 1970s a combination of quantitative and qualitative in dealing with complex decision problems program more sort of system analysis method. Orderly hierarchy of the complex issues of various factors are interrelated by dividing it so principled, based on certain objective reality judgment, given to each of the relative importance of each factor in the level of quantitative mathematical method to determine each the weights of the levels of various factors, to provide a scientific basis for the correct evaluation of the research project.

ESTABLISHING EMPLOYEE PERFORMANCE APPRAISAL INDEX SYSTEM

The employee performance evaluation system design principles

① The system principle of comprehensiveness: evaluation index system should be able to compare the system to reflect all aspects of the employees to be able to seize the main factors to ensure a comprehensive assessment of the comprehensiveness and credibility.

② The guiding principle evaluation system built to allow companies to better understand the employees, which provided for it in the future for its development platform with upside.

③ Easy the test evaluation index system of the implementation of the principle of excellent indicators one is easy to implement. Therefore, the evaluation system should be clear, explicit semantics; data collection is convenient and easy to calculate. Any cumbersome, complex evaluation system will eventually be eliminated.

④ The authenticity principle evaluation index system should be designed to be true, the test data, projects are real and effective.

⑤ The fairness, the standard formulation of the principle of openness performance appraisal work for jobs, not different people have different standards. Should recognize that each member of the organization are equal and fair chance to compete. Appraisal process should also be fair.

⑥ Hierarchical principle to measure the program's effectiveness and identify indicators weights more convenient.

⑦ Qualitative and quantitative principles to proceed from a quantitative level to explore suitable for modern industrial production, high-tech industrial development, performance appraisal quantitative approach^[1].

Employee performance evaluation system ideas

Analytic Hierarchy Process to decompose complex problems into component factors, grouped by relations of domination in turn these factors form a hierarchical structure. By pairwise comparison to determine the relative importance of various factors in the hierarchy. And a comprehensive policy makers judge, to determine the total ranking of the relative importance of the decision-making program. It uses the ideology of the first decomposed comprehensive system, finishing, and comprehensive subjective judgment of the people, the qualitative analysis and quantitative analysis of the combination of quantitative decision-making. It can not be quantified indicators discharged in accordance with the size of the order, they are distinguished from each other.

Must pay attention to the reliability and validity analysis

The reliability of the so-called employee performance appraisal indicators, the true extent of this assessment indicators, this indicator is the enterprise operation

Existence away a working link? Can use the data or information expression? Can be proved to be observed, it is used in the data collection method is scientific and reliable.

The validity of the so-called employee performance appraisal indicators, is the effectiveness of this assessment indicators: this indicator can examine how the attitude of the staff, this indicator reflects the level of ability of staff work, staff calculated this indicator the results, according to the indicators to evaluate their work, we recognized that it is fair, according to this indicator to guide employees labor really have a positive role in the enterprise to achieve economic goals.

Do the reliability. of employee performance evaluation indicators. Validity analysis, common problems are mainly two aspects: First, the lack of seriousness of the argument prior design plans less scientific analysis; discussion of things just symbolic in the management team to noisy meal, no objection is raised even if after the feedback is often ignored by, hard to do in-depth scrutiny; Lack of demonstrable professional, and participate in the discussion of the people, most of them not knowledgeable of designers, the focus of the discussion is often the "fairness", rather than the implementation of this principle of the "scientific" significant management shortcomings."^[2]

AHP MODEL AND STEP

Analytic Hierarchy Process to solve the problem, can be roughly divided into four steps: the relationship between the various elements ① analysis system, the establishment of a system of hierarchical structure; ② to the same level of the elements on the upper level of a criteria the importance of pairwise comparisons to establish pairwise comparison judgment

matrix; ③ by the judgment matrix calculated by comparing elements heavier the relative weights of the criteria; the ④ calculated layers of elements on the the system goals synthesis rights and sort.

Stablising the hierarchical structure

By analyzing the relationship of each index, the establishment of the hierarchical structure shown in Figure 1.

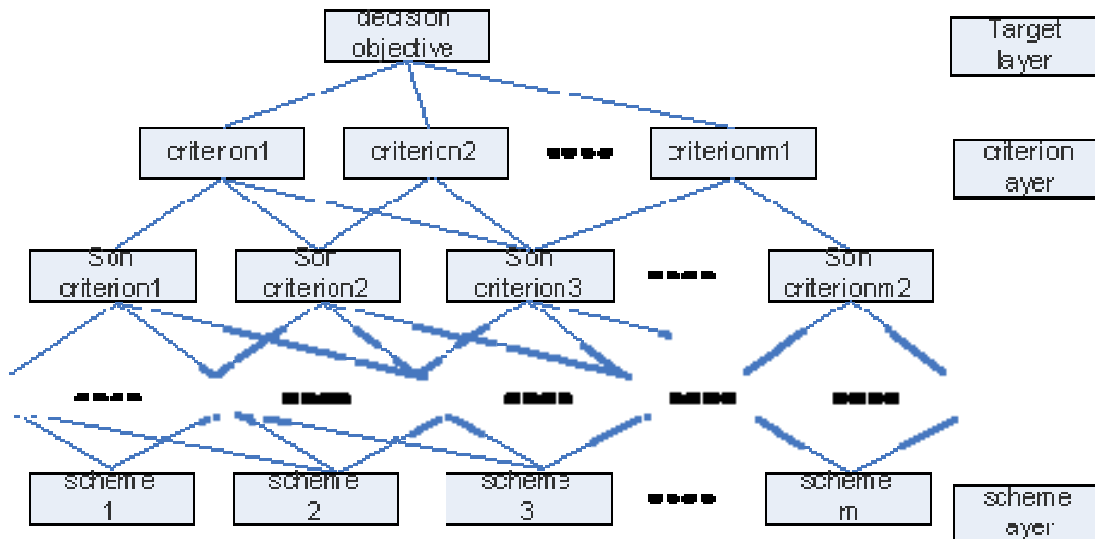


Figure 1 : Hierarchical structure diagram

Construct the pairwise comparison judgment matrix

Evaluation index system is established, the affiliation between the upper and lower-level indicators were identified, and any system analysis are based on certain information AHP information is based primarily on the relative importance of each level of each factor given judgment, these indicators to identify and score to the capital with a subjective judgment, in order to reduce the impact of subjective factors, Saaty 1 to 9 scale method, between each two of the various factors to be quantified judgment matrix. These judgments numerical representation, written in matrix form is to determine the matrix. The judgment matrix representation for a factor of the previous level, the level, the relative importance of factors related thereto. In this paper, the employee performance appraisal index system, identified through expert consulting, questionnaire, and multi-party discussions, on the same level indicators, pairwise comparisons to determine the elements of the matrix A, a_{ij} is the relative importance of the elements a_i a_j its value by expert judgment scales to determine based on the information and data as well as their own experience and values. The judgment scale indicates the quantity of the elements a_i on the relative importance of the feature a_j scale judgment scale used in TABLE 1, so that for the same level n indicators obtained twenty-two comparison determination matrix $A = \{a_{ij}\}$.

The value of the judgment matrix should satisfy the following conditions:

$$a_{ij} > 0, a_{ji} = \frac{1}{a_{ij}}, a_{ii} = 1 \quad a_{ij} = \frac{a_{ik}}{a_{jk}}$$

TABLE 1 : Judgment the matrix scale and their meanings

Judgment scales	Definition
1	A and B are equally important
3	A slightly than B
5	A is important than B
7	A rmuch more important than B
9	A is absolutely important than B
2,4,6,8	Judge between the two adjacent scales
Reciprocal	The important ratio of A and B is λ ,The important ratio of B and A is $1/\lambda$

Note: 2,4,6,8,1 / 2,1 / 4,1 / 6,1 / 8 indicates the importance of registration intervene 1,3,5,7,9,1 / 3,1 / 5,1 / 7,1 / 9, these Figures are determined according to experts qualitative analysis of intuition and judgment.

To calculate the index weight value

Index weight means an indicator of the relative importance of the overall evaluation. Weight not only embodied with boot intent and value of the concept, and its owned by a sexual mutual constraining the results of the performance evaluation has an important impact, so the performance evaluation process which, you must want to attach importance to the right to re-determine the scientific and reasonable nature. Between the relative importance of the evaluation indicators is different with respect to the evaluation objectives. This relative importance in the evaluation index between the size, available weight coefficients to characterize. When the evaluation object and evaluation to determine the comprehensive evaluation of the results rely on the weight coefficient. That weight coefficient determined reasonable or not related to the comprehensive evaluation of the credibility of the results^[3]. Therefore, the determination of the weight coefficient should be particularly cautious in this, we can use the level analysis to determine the steps are as follows:

(1)Computing each row element of the matrix A, Volume: W_i

$$W_i = \left(\prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}} \quad (i = 1, 2, \dots, n)$$

(2)Calculated rows n times Rad value: $\bar{W}_i = \sqrt[n]{W_i}$ $i=1,2,3,\dots,n$.Wherein, n is a matrix of order.

(3)The vector normalization process $(\bar{W}_1, \bar{W}_2, \dots, \bar{W}_n)^T$, is calculated as follows $W_i = \bar{W}_i / \sum_{i=1}^n \bar{W}_i$

Then $W = (W_1, W_2, \dots, W_n)^T$ is Is the demand vector.

Calculated to determine the maximum eigenvalue λ_{max} of the matrix A

$$\lambda_{max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i} \quad \text{Where,} \quad AW = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \mathbf{M} & \mathbf{M} & \mathbf{M} & \mathbf{M} \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \begin{bmatrix} W_1 \\ W_2 \\ \mathbf{M} \\ W_N \end{bmatrix}$$

$$(AW)_i = a_{i1}W_1 + a_{i2}W_2 + \dots + a_{in}W_n$$

Consistency

judge.

(1) Calculate the consistency index $C.I.$. Only when the matrix completely consistent judgment matrix A before = λ_{max} n, inconsistent, you can use the λ_{max} -n, the magnitude of the difference to examine the degree of consistency, generally use the consistency index $C.I.$, the $C.I.$ smaller, indicating the greater consistency.

$$C.I. = \frac{\lambda_{max} - n}{n - 1}$$

(2) Investigation of the same order matrix average consistency index. Related to the order of the judgment matrix, the greater the general order, the greater the possibility of consistency random deviation generally like the data in TABLE 2

TABLE 2 : Average random consistency index

Dimension	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54	1.56	1.58	1.59

(3) Calculate the consistency ratio C.R. May also take into account the consistency deviation causes random test whether the judgment matrix has satisfactory consistency have to be compared with the average random consistency index obtained test number, that is,

$$C.R. = \frac{C.I.}{R.I.}$$

$C.R.=0$ A complete consistency.when $C.R.<0.10$ A satisfactory consistency when $C.R.>=0.10$. A has a non-satisfactory consistency, should be adjusted or discarded without. By destination allocation and adjust the weight of each index, can be demonstrated by a grasp on the evaluation index system tendentious and flexibility^[4].

THE ANALYTIC HIERARCHY PROCESS IN EMPLOYEE PERFORMANCE EVALUATION

Delivery structure for class times

Application of AHP, the first is to clarify the scope of the problem, included factors, the association between the factors and affiliation, as well as the final requirements of the answer, and then construct a structural model of the analytic hierarchy. According to the analysis of employee performance, evaluation of alternative projects mainly include the following aspects:

The first existing form is the ability to hold state. That employees have the ability to create what aspect performance? This ability to How Species level? And so on. Employees' ability to hold state "performance index we call it the" capacity assessment indicators.

Second existing form of the ability to play state "employees in the process of creating performance, play to their ability,Demonstrated the enthusiasm, initiative: he has this ability, but he is willing to Maili Qi? Ability to play state ", that is,The strength of the responsibility of the employee in the course of their work performance. Initiative, ethical standards, and so on. The employees' ability indicators of performance appraisal swing state "we call it" attitude assessment indicators.

The third exists morphology "capability into state. That employees in the process of creating the performance, dem onstrated ability to actual effect: you have the ability to also Maili Qi, and that your efforts will ultimately not really translate into corporate performance? "Can force transformed state "performance index we call it" performance assessment indicators.

Assessment of employee performance management to pay attention to is the "ability", "attitude", "performance" in three aspects. That is it, "capacity", "attitude" and "performance" among what kind of dialectical relationship it?

Before the work, we will first examine the employee's ability to hold state "- the ability to level.Into the work, we see that the employees' ability to play the state "- attitude. After work, we investigated the employees "capability into state" - what the results.

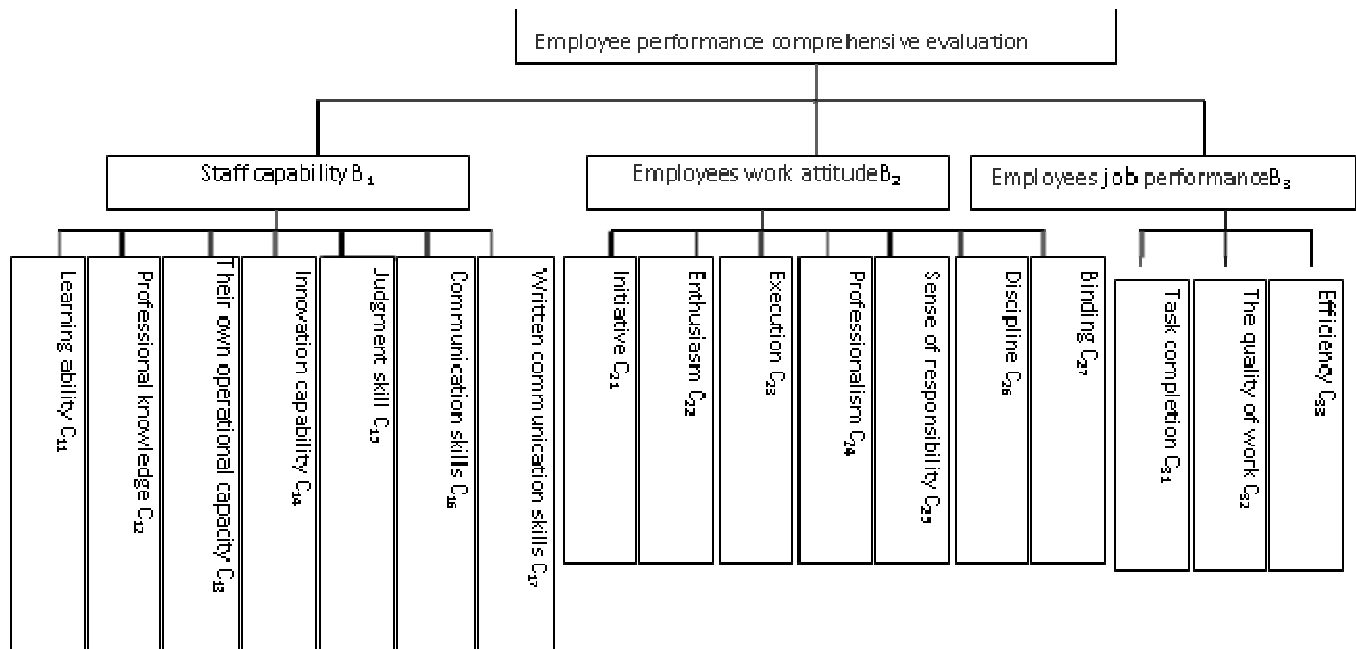


Figure 2 : Employee performance evaluation index hierarchy

Constructed twenty-two comparative judgment matrix to calculate the index weight value, calculate the largest eigenvalue of the judgment matrix λ_{max} , as well as the consistency of judgment

Evaluation index system of the above, the Panel believes that the evaluation of employee performance, employee job performance than employees working attitude, staff capability important the staff capability than employees working attitude is important, you have TABLE

TABLE 3 : Judgment matrix A-B

Comprehensive assessment of employee performance	Staff capability	Employee Work Attitudes	Employee job performance
Staff capability	1	2	1/2
Employee Work Attitudes	1/2	1	1/3
Employee job performance	2	3	1
Weights	0.2970	0.1634	0.5396

Note: $\lambda_{max} = 3.0092$; CI=0.0046; RI=0.58; CR=0.0079

TABLE 4 : Judgment matrix B₁-C

Staff capability	Learning ability	Professional knowledge	Their own operational capacity	Innovation capability	Judgment skill	Communication skills	Written communication skills
Learning ability	1	1	3	1/2	1/4	1/3	2
Professional knowledge	1	1	1/2	1/3	1/2	1/3	2
Their own operational capacity	1/3	2	1	1/2	1	1/2	3
Innovation capability	2	3	2	1	2	3	4
Judgment skill	4	2	1	1/2	1	1	2
Communication skills	3	3	2	1/3	1	1	2
Written communication skills	1/2	1/2	1/3	1/4	1/2	1/2	1
weight	0.1041	0.0840	0.1150	0.2851	0.1709	0.1810	0.0599

Note: $\lambda_{max} = 7.6926$; CI=0.1154; RI=1.32; CR=0.0874

TABLE 5 : Judgment matrix B₂-C

Employee Work Attitudes	initiative	Enthusiasm	Execution	Professionalism	Sense of responsibility	Discipline	Binding
Initiative	1	1	1	1	1	1	1
Enthusiasm	1	1	1/4	1/3	1/2	1/2	1
Execution	1	4	1	3	2	2	2
Professionalism	1	3	1/3	1	1/3	1/2	1
Sense of responsibility	1	2	1/2	3	1	1/4	3
Discipline	1	2	1/2	2	4	1	4
Binding	1	1	1/2	1	1/3	1/4	1
Weights	0.1304	0.0750	0.2503	0.1010	0.1464	0.2140	0.0828

Note: $\lambda_{max} = 7.6926$; CI=0.1154; RI=1.32; CR=0.0874

TABLE 6 : Judgment matrix B₃-C

Employee job performance	Task completion	The quality of work	Efficiency
Task completion	1	1/3	1/2
The quality of work	3	1	2
Efficiency	2	1/2	1
weight	0.1634	0.5396	0.2970

Note: $\lambda_{max} = 3.0092$; CI=0.0046; RI=0.58; CR=0.0079

The judgment matrix-level single-Sort:

$$(a_1, a_2, a_3) = (0.2970, 0.1634, 0.5396)$$

$$b_1 = (0.1041, 0.0840, 0.1150, 0.2851, 0.1709, 0.1810, 0.0599)$$

$$b_2 = (0.1304, 0.0750, 0.2503, 0.1010, 0.1464, 0.2140, 0.0828)$$

$$b_3 = (0.1634, 0.5396, 0.2970)$$

Similarly, we get a total order of hierarchy:

$$W_1 = (0.0309, 0.0249, 0.0342, 0.0847, 0.0508, 0.0538, 0.0178)$$

$$W_2 = (0.0213, 0.0123, 0.0409, 0.0165, 0.0239, 0.0350, 0.0135)$$

$$W_3 = (0.0882, 0.2912, 0.1603)$$

Finally, given the employee performance evaluation model

$$R = W \times Y$$

Wherein $R = (r_1, r_2, \dots, r_n)$ is n employees' performance evaluation results vector

$W = (w_1, w_2, \dots, w_m)$ is m evaluation weight vectors

$Y = (y_{ij})_{m \times n}$ is m employees Indicators non-dimensional data matrix

According to the size of the r_j sort the staff the larger staff, its overall performance is better Comprehensive evaluation method of the performance of employees given here may be used in the comparison between the employees, i.e. of different employees performance to sort, can also be used for vertical comparison, i.e. several years the performance of a staff sort.

CONCLUSION

As the main body of creating the economic efficiency of enterprises, the growing influence of corporate employees for competitive advantage. The companies want their employees to be able to contribute to the development of the enterprises of their biggest talent, but also want to be able to make a clear distinction between its performance pros and cons. AHP is a quantitative analysis of qualitative issues is simple, flexible and practical multi-criteria decision-making methods. Actual staff performance appraisal work has strong practicability and maneuverability, the promotional value. From the analysis, it can be seen, the analytic hierarchy process provides an effective tool for employee performance evaluation and decision-making, and the results of its analysis is a valuable reference for policy makers. Of course, the impact of employee performance evaluation decisions there are many other uncertainties, this article only selected some representative factors were analyzed, in practical work, still to be combined with the specific circumstances of the project staff performance evaluation selection, the method should be combined with other evaluation decisions truly reflect the real situation of the employee's performance, so as to provide the basis to make the right decisions

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