# Construction in Electric Power Enterprises based on Entropy Weight-Analytic Hierarchy

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**Keywords:** Party Building Performance, Analytic Hierarchy Process, Entropy Weight Method, Comprehensive Evaluation.

**Abstract:** Establishing a scientific evaluation method for the performance evaluation of Party building is an important link to urge the implementation of various tasks of Party-building work. In view of the shortcomings of the existing subjective empowerment methods, a performance evaluation method of Party Building Based on entropy weight-analytic hierarchy process (AHP) was constructed by using the principles of entropy weight method and analytic hierarchy process (AHP). Firstly, according to the content and characteristics of the performance appraisal of the party building work in power enterprises, constructed the evaluation index system of the performance appraisal of the party building work; secondly, on the basis of the analytic hierarchy process, the subjective weight values of each index are calculated, then the index weight is revised by the entropy weight method, the final evaluation result is obtained by the comprehensive evaluation method. Finally, taking a subordinate unit of Anhui Electric Power Company as an example, proving the feasibility of the Entropy Weight-Analytic Hierarchy Process in the performance evaluation of Party building in power enterprises.

## 1. Introduction

To achieve a great dream, we must build a great project" was pointed out in 19th National Congress of the Communist Party .To achieve this dream, we must build a great project. This great project is a new great project of party building that our party is pushing forward. In order to promote the standardization of the party branch and the role of party members and the deep integration of party building work and central work requires a scientific and effective evaluation of the party's construction work in press [1]. This is also an important way to improve the party construction level and achieve a comprehensive and strict governance of the party.

The press [2-5] considered the characteristics of party building work in power supply enterprises, government agencies, universities, and hospitals, and constructed a set of evaluation system indicators. Literature[6] used the analytic hierarchy process to construct the performance evaluation system of party building work. The literature [7-8] used fuzzy analytic hierarchy process to evaluate the emergency communication plan of power system and the energy efficiency of power plant. The literature [9-10] adopts the entropy weight method to objectively empower the development of logistics financial risk and P2P online lending platform. In addition, as in [11-12], the hierarchical-entropy weight method was used to correct the index weights of overhead line operation risks and beam bridge reliability.

In summary, this paper proposes an energy enterprise party building performance appraisal method based on entropy weight-analytic hierarchy process. Its innovations are as follows: First, consider the party organization standardization construction, construction quality, branch learning education and innovation activities. The mode of the situation, the propaganda and ideological culture and the activities of civilized creation, the evaluation of the professional level of the department, and the characteristics of the work of the power industry, and the establishment of a complete performance evaluation system for party building work. Secondly, considering the

advantages and disadvantages of the subjective and objective weighting methods, the analytic hierarchy process calculates the weights of various indicators affecting the performance of party building, and then the weights are corrected by the entropy method. Finally, the index values and index weights are comprehensively calculated. The result of party building performance appraisal evaluation is obtained, and according to this result, this paper provides the theoretical basis and reference basis for performance evaluation of party building work.

## 2. Establishing a Performance Appraisal Indicator System for Party Building Work

In order to evaluate the quality of party construction to the objective, standardized, scientific and rational calculation performance, party construction need combining with service characteristics of the electric power enterprise, considering the factors affecting the characteristics of the party construction, establish a complete, comprehensive and scientific comprehensive evaluation system. Based on the data survey of a unit directly under Anhui electric power company and the consultation of experts in related fields, this paper selects important representative indicators and establishes a two-level indicator system according to the analytic hierarchy process. It including four first-level indicators such as party organization standardization construction and construction quality, branch learning and education and innovative activity mode, propaganda, ideology, culture and civilization creation activities, and department professional level evaluation, and the corresponding 21 second-level indicators. The specific indicator system was showed in table 1.

## 3. Entropy Weight Hierarchy Analysis Evaluation Model

### 3.1 Data Normalization

Since different units, orders of magnitude and dimensions of evaluation indicators will affect the evaluation, and the data should be pre-processed, such as. normalized. Currently, maximum-minimum normalization method is often used for data normalization, that is, as in (1) and in (2), are used for positive indicators.

$$Y_{ij} = \frac{x_{ij} - \min\limits_{j} x_{ij}}{\max\limits_{j} x_{ij} - \min\limits_{j} x_{ij}} \tag{1}$$

$$Y_{ij} = \frac{\max\limits_{j} x_{ij} - x_{ij}}{\max\limits_{j} x_{ij} - \min\limits_{j} x_{ij}} \tag{2}$$

### 3.2 Determination of Index Weight

a) Weight determination of ahp: Analytic hierarchy process (AHP), is the comprehensive evaluation technology is extensively used in a method of weighted function structure is a kind of subjective judgment method, the advantage is that can better play to the policymakers' subjective initiative, can combine subjective judgment and quantitative analysis method. The basic principle is as follows:

In the first step, assume that there are indexes, calculate the importance of pares comparison between indexes, and form the proportion judgment matrix, as in (3) and in (4)

$$a_{ij} = \frac{w_i}{w_j} \left(i = 1, 2, \cdots, m\right) \tag{3}$$

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mm} \end{pmatrix} \tag{4}$$

Among them, says the importance of the first is the importance of the indicators of multiples, indicates the importance of index score, and indicates the importance of index scores. You may refer to the determination of proportion of nine-scale system, as shown in Table 1.

Table 1. Constructing Nine-Scale System of Proportional Judgment Matrix

| $a_{ij}$**Value** | **Implication** |
|---|---|
| 1 | indicators *i* is import as *j* |
| 3 | indicators *i* is slightly more important than indicators n *j* |
| 5 | indicators *i* is significantly more important indicators *j* |
| 7 | Indicators *i* is more important than *j* |
| 9 | Indicators *i* is extremely important than *j* |
| 2,4,6,8 | The comparison of indicators *i* and *j* is between the above levels |
| Reciprocal of the above Numbers | Comparison of indices *i* and *j* |

In the second step, according to the proportional judgment matrix A, the row arithmetic mean method (RAM) was used to calculate the arithmetic mean of the rows row by row, as in (5)

$$\overline{\mathrm{R}}_i = \frac{1}{m}\sum_{j=1}^{m} a_{ij} \quad (i = 1, 2, \cdots, m) \tag{5}$$

Third step, on line all the arithmetic mean normalization, which get the weight of each index, as in (6)

$$\rho_i = \overline{R}_i \Big/ \sum_{j=1}^{m} \overline{R}_j \ (i = 1, 2, \cdots, m) \tag{6}$$

b) Entropy weight method to determine the weight: Entropy is a method of objectively to empower the method can avoid subjective influence subjective values. The method of index weight. Entropy is a concept derived from thermodynamics. The more research objects contain less information, the greater the uncertainty and entropy will be. Conversely, when the amount of information, the more the uncertainty is smaller, the smaller the entropy value of the corresponding. Therefore to apply entropy weight in the process of using the discrete degree of index to judge, when the index, the greater the degree of discrete the greater the influence of the index of comprehensive evaluation, namely, the bigger the weight. Assuming an m party organization, evaluation indexes, entropy weight method to determine the weight of basic steps are as follows:

The first step, the weight of index for transformation, the actual value transform for evaluation index. Transform formula is as in (7).

$$a_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{7}$$

Among them, the $x_{ij}$represents the first i party organization the first j index value, $a_{ij}$said the party organization of the index value i share.

The second step is to calculate the entropy index. The calculation formula is as in (8):

$$k_j = -\left(\frac{1}{\ln n}\right)\sum_{i=1}^{n} a_{ij} \ln a_{ij} \tag{8}$$

Among them, $k_j$represents the entropy of the j index, as in (9)

$$q_j = \frac{1 - k_j}{\sum_{j=1}^{m}\left(1 - k_j\right)} \tag{9}$$

Where $q_j$represents the weight of the $j$ index.

c) Determination of composite weight: On the subjective weight using the analytic hierarchy process (ahp) to obtain and use of entropy method to obtain the objective weight of synthetically, obtained by type (10) party performance appraisal indexes composite weights.

$$\lambda=\alpha\rho+(1-\alpha)q \tag{10}$$

Where, αrepresents the proportion of subjective weight and the composite weight of each index changes with the change of α.

d) Comprehensive evaluation results of calculation: The final comprehensive evaluation result W can be obtained by integrating the evaluation value of normalized indexes obtained by (1) and (2) with the index weight obtained by in (11).

$$W_i = \sum_{j=1}^{m} Y_{ij}\lambda_j \tag{11}$$

## 4. Case Study

### 4.1 Data Statistics and Processing:

Taking a unit directly under Anhui electric power company as an example, the annual party construction work of 10 party branches is assessed and evaluated from 4 first-level indicators and 21 second-level indicators. The assessment data of each party branch is shown in Table 3.

According to the type (1) and (2) ,the training center of each party branch party performance appraisal index data normalization processing, can be obtained after the normalization of evaluation data.

### 4.2 Determine Index Weight

a) Analytic hierarchy process (ahp) to determine the subjective weight of each index: First, the established performance appraisal index system of party construction as shown in table 1, invite experts to four primary indicators and the corresponding secondary indicators to determine judgment matrix.

Second, by equation (5), (6) can be respectively to calculate the index weight and the secondary index weight, can be calculated according to the analytic hierarchy process (AHP) eventually determine the index weight ρ, including the level of index weights and their corresponding secondary index weight, as shown in Fig. 1

$$\begin{aligned}\rho = (&0.0878, 0.0271, 0.0229, 0.0454, 0.0910,\\ &0.0331, 0.0348, 0.0156, 0.0199, 0.0327, 0.0090,\\ &0.0102, 0.0195, 0.0264, 0.0328, 0.0173, 0.1130,\\ &0.0482, 0.1224, 0.1328, 0.0523)^T\end{aligned}$$

Fig 1. The index weightρ

b) Entropy weight method is used to determine the objective weight of each index.

The entropy value of each index can be calculated (as shown in Fig. 2) according to equation (8), and the weight of each index can be calculated according to equation (9).

Table 2. The Performance Appraisal Index System of Party Construction Work

| Level indicators | Secondary indicators | effecting |
|---|---|---|
| Party organization standardization construction and construction quality A1 | Annual work quality and standardization (a1) | Positive indicators |
| | File box material filing situation (a2) | Positive indicators |
| | Party fee card records (a3) | Positive indicators |
| | Red base construction (a4) | Positive indicators |
| | Party building demonstration project situation (a5) | Positive indicators |
| The branch of learning education and innovation way of A2 | Party organization form of education effect (b1) | Positive indicators |
| | Party construction training time (b2) | Positive indicators |
| | Party building business integration (b3) | Positive indicators |
| | Party member service activity participation rate (b4) | Positive indicators |
| | Innovation activities (b5) | Positive indicators |
| Publicity of ideology, culture and civilization creation A3 | Six will talk about the progress of Six will visit (c1) | Positive indicators |
| | Application and approval system of the actual rate (c2) | Positive indicators |
| | Annual number of ideological activities (c3) | Positive indicators |
| | Number of activities organized by the party and the caucus (c4) | Positive indicators |
| | Times of undertaking theme activities (c5) | Positive indicators |
| | Number of commendations for spiritual civilization (c6) | Positive indicators |
| Department of professional level evaluation of A4 | Party construction debriefing assessment (d1) | Positive indicators |
| | Annual party construction special key task participation rate (d2) | Positive indicators |
| | Annual working material qualification rate (d3) | Positive indicators |
| | Pass rate of annual performance appraisal within the department (d4) | Positive indicators |
| | Grid vanguard party branch (d5) | Positive indicators |

Table 3. Assessment Data of Party Branches in a Subordinate Unit of Electric Power Company

| **indicators** | **First party branch** | **second party branch** | **third party branch** | **fourth party branch** | **fifth party branch** | **sixth party branch** | **seventh party branch** | **eighth party branch** | **ninth party branch** | **tenth party branch** |
|---|---|---|---|---|---|---|---|---|---|---|
| a1 | 47 | 48 | 43 | 49 | 49 | 42 | 48 | 47 | 47 | 47 |
| a2 | 29 | 32 | 27 | 37 | 34 | 27 | 36 | 28 | 32 | 35 |
| a3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| a4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a5 | 0 | 0 | 0 | 0 | 1.5 | 0 | 0 | 1.5 | 0 | 0 |
| b1 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| b2 | 0.42 | 0.66 | 0.64 | 0.61 | 0.53 | 0.60 | 0.61 | 0.56 | 0.41 | 0.53 |
| b3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| b4 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| b5 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| c1 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| c2 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| c3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| c4 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 1.5 | 1.5 | 3 |
| c5 | 4.5 | 0 | 1.5 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| c6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| d1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| d2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| d3 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| d4 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| d5 | 2 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |

$$q = (0.0203, 0.0442, 0.0260, 0, 0.1876,$$
$$0, 0, 0.0268, 0.0416, 0, 0.2684, 0, 0, 0.0123,$$
$$0.1131, 0.1144, 0, 0, 0, 0, 0, 0.1454)^T$$

Fig 2. The index weight $q$

c) Composite weight calculation

According to the equation (10) the weight of the analytic hierarchy process (AHP) to get ρ and entropy weight method to calculate the weight of q together, can be concluded that the final composite weight λ.

$$\lambda = (0.0608, 0.0339, 0.0276, 0.0272,$$
$$0.1297, 0.0198, 0.0316, 0.0256, 0.0120,$$
$$0.1270, 0.0054, 0.0061, 0.0166, 0.0611,$$
$$0.0655, 0.0104, 0.0678, 0.0289, 0.0734,$$
$$0.0797, 0.0895)^T$$

Fig 3. The combination weight λ

### 4.3 Case Results Calculation and Analysis

Depending on the equation (11) and its intermediate table to be normalized data and the final composite weights are comprehensive, can get the final training center ten party branch comprehensive evaluation results, the results are as follows Fig.4:

$$W = (0.1920, 0.1873, 0.0895, 0.2797, 0.3132, 0.0742, 0.1890, 0.2093, 0.1532, 0.2439)^T$$

Fig 4. The comprehensive evaluation results

Therefore, the party branch sort performance appraisal for the fifth party branch, the fourth party tenth party branch eighth party branch first party branch party branch 7 second party branch ninth sixth party branch party branch, the third party. The fifth party construction of party branch performance evaluation first, second, fourth party third party branch and party construction performance appraisal ranking sixth party branch is relative. The results are consistent with the actual work assessment results.

## 5. Conclusion

The analytic hierarchy process (ahp) and entropy weight method are applied to the assessment of party construction performance comprehensively, which avoids the human factors in the comprehensive evaluation as far as possible, changes the deficiency brought by the pure subjective evaluation or objective evaluation, and makes the evaluation result closer to the objective reality. According to calculate the weight of each evaluation index and index comprehensive evaluation value, obtained the performance of each party branch construction, provides reference to improve the party construction. According to calculate the weight of each evaluation index and index comprehensive evaluation value, obtained the performance of each party branch construction, provides reference to improve the party construction.

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