# Chapter 10
# Assessment Study of Power Enterprise Soft Power Based on Fuzzy-ANP

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**Abstract** With requirements of lean, meticulous management, power enterprise soft power has become more and more urgent. In this paper, I analyze the operating environment and internal development that are needed in power enterprise, and the principles established indicators and combined with relevant literature and expert opinion. On the basis of soft power in the power enterprise and the basic content elements, I build a power supply enterprise soft power evaluation index system. Soft power research is cutting-edge research-based emotional issues. There are a lot of qualitative indicators, so the paper designs evaluation index value questionnaire. On the index value of the evaluation, I use AHP to calculate the index weight and build soft power evaluation model.

**Keywords** AHP · Evaluation model · Power supply enterprise · Soft power

## 10.1 Introduction

Today in the background of economic globalization, to carry out enterprise management activities needs pay attention to the world, learn the international modern enterprise management mode and management concept. The reason why global international enterprises can take up each industry leadership is not only its capital, scale and "hard power", but also is closely linked with its "soft power", such as powerful technology, brand, the prestige and so on.

In order to realize the construction goal of "one strong three excellent" modern international company of state grid, we need to start from two aspects—"hard

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power" and "soft power". Between them, the hard power is the material base of the development of power supply enterprises, and the soft strength is the guarantee of continuously improving the hard power in the correct direction and plays a role in a comprehensive efficient way. Since the state grid company was founded, China power grid has made great progresses in "hard power", such as substation capacity, equipment technical level, power supply capacity. In order to make it function in smooth and efficient way, the power supply enterprise need to have more efficient management ability. At present, there is an urgent need for power supply enterprise to evaluate soft power, analyze the important factors of influencing the soft power, and work out the promotion measures.

## 10.2 Analysis of Soft Power

Soft power is first proposed in 1990 by an American scholar, Joseph nanotubes, since then the "soft power" research and application became the trend. Soft power was gradually recognized by the people as a theory. In many our country development fields, such as foreign and national competition strategy, the soft strength theory used more widely. In recent years, the soft strength theory and connotation further enrich. Its application scope is from the macro field extends to the micro field, and gradually becomes a theory generally accepted in the concept.

For the power supply enterprise, the soft power is the embodiment of the comprehensive ability. Our country is still in a power supply enterprise of rapid development. This period has main features: the technology changing quickly, the scale development strong needs, the investment difficult decision, weak link numerous, service-oriented enterprises heavy construction task, etc. At the same time, the current power supply enterprise at all levels faces urgent task, such as how to support ultra-high voltage grid, how to harness smart grid, how to realize "one strong three excellent".

These traits and task require the power supply enterprise must have the correct understanding and execution ability, which also is good soft strength. Based on the latest soft power theory and the characteristics of the power supply enterprise, we definite the soft power of the power supply enterprise composition. Soft power includes 8 strengths: the strength of learning, thinking, innovation, planning, implementation, control, affinity and appeal.

## 10.3 Fuzzy-ANP Methodology

### *10.3.1 Introduction of ANP Method*

Professor T.L. Satty, university of Pittsburgh, put forward the independent pass class time structure in the basis of the development of analytical hierarchy process (ANP) in 1996, which is complex system of decision model that can solve existing

dependence and internal feedback effect. As the network analytic hierarchy process considering of the mutual influence and disposal between the elements, it can describe the relationship of the real world between the objective things more accurately, so it becomes a more effective decision-making method.

ANP system elements are divided into two parts. The first is the control of factors, including problems target and decision-making rule. The second part is the network layer, which is composed by all the elements in the control group; the interior is network structure influencing each other (Lianfen and Shubai 1990; Shubhai 1988).

We use Delphi method to judge the relative importance of each index in the ANP system. Judging standard generally, we use, is the 1–9 scale method.

The control layer elements of ANP are $B_1$, $B_2$,…, $B_m$.

The network layer element set are $C_1$, $C_2$,…, $C_N$. $e_{jk}$ (k = 1, 2,…, $n_j$) is one of the elements in $C_j$. By comparing the elements' influence, in $C_j$, on the $e_{jk}$ (k = 1, 2,…, $n_j$), we can structure judgment matrix, based on the control rule. Then the characteristic root method get sort vector, $\left[w_{i1}^{(jk)}, w_{i2}^{(jk)}, \ldots, w_{in_i}^{(jk)}\right]^T$. If the above characteristic vector through the consistency check, will the written form matrix, and it can get the weight of local vector matrix: Similarly, in turn, will other elements of the relationship between elements set inside and outside is, by the network layer of various elements of the mutual influence ranking vector form shall not be entitled to heavy super matrix $W_s$.

Each element of the matrix is a matrix, column and for 1; But W is not the normalized matrix. In order to calculate the convenient, it needs to be a super matrix column.

Namely, the elements of the matrix $W_s$ should be weighted. Then we get weighted super matrix.

In the control layer rule, through the comparison of the group elements' influence, in the network layer, on $C_j$ (j = 1,…, N), we can get a normalized sort vector:

$H_j = \left[h_{1j}, \ldots, h_{Nj}\right]^T$, then can get weighted matrix H.

Multiplying the matrix H and W, we can get weighted super matrix W.

Stable processing is the limit of the super matrix calculated each relative ranking vector:

$$W^{\infty} = \lim_{k \to \infty} (1/N) \sum_{k=1}^{N} \overline{W}^k \tag{10.1}$$

The original matrix corresponding line of each index of the value of a stable weight premise condition is the limit convergence and only. Through calculating the type, we get value of the weight of each index. ANP calculation process is complicated, so this paper using Super Decisions software example calculation, get the weight of the index (Sun and Tian 2001; Liu et al. 2003).

### *10.3.2 The Fuzzy Comprehensive Evaluation Method*

The fuzzy comprehensive evaluation method is a comprehensive evaluation method that based on fuzzy mathematics. The method changes qualitative evaluation into quantitative evaluation based on fuzzy mathematics theory of membership, which uses fuzzy mathematics to make an overall evaluation for things or object restricted by various factors. It has clear results and strong systemic characteristics. It can well solve problems that are vague and hard to measure. It is suitable to solute all kinds of uncertain problems.

The fuzzy evaluation method gives comprehensive evaluation conclusion, based on the establishment of mathematical model at all levels and fuzzy matrix multiplication the firm's law making, according to "the maximum membership degree".

In the fuzzy comprehensive judgment, the major needed data is the weight of each index factor and the level of evaluation index.

The evaluation object sets, factor sets, comments set. We set up these sets in turn: object sets $O = \{o_1, o_2, \ldots, o_l\}$, factor sets $U = \{u_1, u_2, \ldots, u_m\}$ Comments sets $V = \{v_1, v_2, \ldots, v_j, \ldots, v_n\}$, and $\bigcup_{i=1}^{m} u_i = U$, $u_i \cap u_j = \varphi$, $i \neq j$.

We establish m weight distribution of evaluation factors vector W. Set the weight vectors factor set U for W. This paper all factors set weight vectors are used ANP calculated and determined, then we get $W = [w_1, w_2, \ldots, w_m]$, among them, $0 \leq w_i \leq 1$, $\sum_{i=1}^{m} w_i = 1$.

By the single factor for fuzzy evaluation fuzzy comprehensive evaluation matrix R: Separate from factors of the evaluation to determine the object to the evaluation for the membership degree to choose element set, become the single factor evaluation. Fuzzy evaluation matrix R is for single factor evaluation matrix. In R, the I element is the evaluated object's membership for the all levels in the evaluation sets. The column j reflects is evaluated object's factors were taken on a level of evaluation in the j degree. I get the last comprehensive evaluation result (Lianfen 2001; Gao 2006; Liu and Junrong 2006).

## 10.4 Results

According to the index system this paper set up, I evaluate electric power company using questionnaire, and choose relevant experts using 1–9 scoring method to score index and weight of index. Using super decisions software, I calculate the weight of each index that the 10 experts give, and take the average weight of 10 experts as the final index weight (Table 10.1).

Calculation results of soft power components (eight forces) score: the highest scoring 3.922174 is appeal force, and the lowest score 3.688217 is planning force.

**Table 10.1** Weights of soft power evaluation of the power supply enterprise

| Level 1 index | Level 2 index |
|---|---|
| Learning ability 0.081506 | Learning motivation 0.287422 |
| | Learning perseverance 0.14488 |
| | Learning ability 0.143505 |
| | Learning efficiency 0.17385 |
| | Transforming force0.250345 |
| Thinking ability 0.042816 | Thinking basis0.109175 |
| | Thinking speed 0.135796 |
| | Thinking breadth 0.110824 |
| | Thinking highth 0.143472 |
| | Thinking depth 0.201739 |
| | Thinking flexibility 0.298996 |
| Innovation ability 0.049403 | Technology innovation 0.13575 |
| | Management innovation 0.187585 |
| | Knowledge innovation 0.258755 |
| | Marketing innovation 0.4147911 |
| Scheming ability 0.080661 | Anticipation 0.222043 |
| | Persistent 0.228388 |
| | Integrity 0.244724 |
| | Flexibility 0.304847 |
| Executive ability 0.126318 | Executive function 0.194964 |
| | Implementation effect 0.476486 |
| | Efficiency 0.328545 |
| Controlling ability 0.153818 | Standard system 0.149928 |
| | Organization system 0.14215 |
| | Information free 0.415556 |
| | Feedback mechanism 0.292367 |
| Appetency 0.225747 | Family love service 0.207636 |
| | Harmonious service 0.261886 |
| | Satisfied service 0.267045 |
| | Stars service 0.263433 |
| Influence 0.239732 | Social responsibility appeal 0.141849 |
| | The brand image influence 0.207674 |
| | Team morale cohesion 0.405755 |
| | Enterprise culture attraction 0.244722 |

In general, the force are closed at good level, and it shows that the power supply enterprises' work in soft power is still need further intensify efforts to ascend.

The calculation result of power supply company soft power fuzzy comprehensive evaluation is 66.289 % (38.4909 + 27.7981 %) experts giving more than 4 points. That is to say, 66.289 % of staffs think that this company soft power is in a high level. The power supply enterprise soft power comprehensive evaluation result is 3.848744, which is closed to the good level (4 score) (Table 10.2).

**Table 10.2** Weights of eight abilities

| | Learning ability | Thinking ability | Innovation ability | Scheming ability |
|---|---|---|---|---|
| Weight | 0.081506 | 0.042816 | 0.049403 | 0.080661 |
| | Executive ability | Controlling ability | Appetency | Influence |
| Weight | 0.126318 | 0.153818 | 0.225747 | 0.239732 |

## 10.5 Conclusion

From the table, we can see the weight of the appeal and affinity power is larger in soft power. This is the power supply enterprise to the orientation of serving industry practice.

The power supply enterprise is faced with the customer directly, so affinity and appeal power are the main factors of influences to own the customers and promote enterprise business ability. Therefore, when the power supply enterprises take measures to improve the soft power, these two aspects of content should be given proper attention.

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