Research on Diagnosis and Evaluation of Physical Assets of Power Grid Enterprises Based on Combined Weight TOPSIS Theory

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Abstract. Under the new reform requirements, the transmission and distribution price pricing model changes, the sales side is liberalized and competition is introduced, the incremental power distribution business investment is liberalized, and the company’s permitted income is approved on the basis of effective assets. In this paper, the combination weight TOPSIS theory is used to diagnose and evaluate the physical assets of power grid companies, and the accuracy of the model is verified through analysis, and the system's asset status diagnostic analysis and evaluation research is carried out, and the optimization strategy and evaluation calculation are scientifically proposed to provide a research and analysis basis.

1. Introduction

By carrying out research on the management of physical assets of the power grid, on the one hand, it can provide basic information for the mid- and long-term planning of the production and operation of the power grid company, lay a foundation for the continuous deepening of asset management, ensure the safety and integrity of power grid assets, and facilitate the implementation of "governance by law" Implementation, to ensure that the use of physical assets of the power grid is in compliance with laws and regulations, which is conducive to reducing costs and improving asset utilization efficiency and asset contribution.

Literature [3], by combing the relationship between the net asset value rate, power supply reliability (availability coefficient) and other indicators, constructs a matrix correlation evaluation system, and combines the operation data of a power company to carry out the inspection cost of the transmission and distribution assets of the power grid company. Research on the evaluation method of matrix correlation. According to the comprehensive value of the physical assets of the power grid, the literature [4] firstly selected 17 indicators from the four aspects of scale structure, health level, utilization efficiency and management benefits, and constructed the comprehensive value evaluation index system of the physical assets of the power grid. Literature [5] applies the set pair analysis method to establish a comprehensive evaluation model of power grid physical assets, which helps
power companies monitor the health of physical assets and provides a reference for improving the 
management of physical assets.

2. Construction of diagnosis and evaluation system for power grid business development

2.1. Principles for constructing indicator system
In the process of building an evaluation index system for physical assets, the following four principles 
need to be followed. The establishment of the physical asset evaluation index system should stand at 
the height of the company's overall situation, and comprehensively reflect the efficiency of the 
company's overall asset operation by summarizing the results of the subordinate units' asset scale 
structure, asset health level, asset utilization efficiency and asset retirement and retirement.

2.2. Establishment of indicator system

| Serial number | Index category              | Index name                                      | unit               |
|---------------|-----------------------------|------------------------------------------------|--------------------|
| 1             | Asset size indicator        | Original value of assets at the end of the period | Billion            |
| 2             |                             | Original value of newly added fixed assets      | Billion            |
| 3             | Asset utilization indicators | Asset in operation rate                         | %                  |
| 4             | Asset operation indicators  | Equipment defect rate                           | Times/100 sets/year|
| 5             |                             | Proportion of normal state                      | %                  |
| 6             | Asset cost index            | Unit asset operation and maintenance cost        | 100 million yuan/100 million yuan |
| 7             |                             | Unit asset overhaul costs                        | 100 million yuan/100 million yuan |
| 8             | Asset efficiency index      | Unit sales profit                               | Yuan/10,000 kWh    |
| 9             |                             | 95598 service satisfaction rate                 | %                  |

3. Comprehensive evaluation construction
TOPSIS method is a multi-attribute decision-making method, which determines the comprehensive 
evaluation value of the evaluated object by calculating the relative distance between the index vector 
of each evaluation object and the positive ideal solution and the negative ideal solution. The TOPSIS 
method has no strict restrictions on the data distribution, sample size, and index. The original data is 
fully utilized and the information loss is relatively small. This method introduces the good value and 
bad value in the actual sample into the evaluation model through the determination of the positive 
ideal solution and the negative ideal solution, so that the evaluation result fully reflects the group 
characteristics of the evaluated object, so that the evaluation result is more objective. An effective 
multi-index, multi-objective decision analysis method.

4. Empirical analysis
Select 8 different power supply areas in w area as the object of diagnosis and evaluation of physical 
assets, combined with statistical analysis of data, calculate the following results. The comprehensive
weight is calculated by the analytic hierarchy process and entropy method, and the following results are obtained:

| Serial number | Evaluation index                                | Subjective weight | Objective weight | Comprehensive weight |
|---------------|-----------------------------------------------|-------------------|------------------|---------------------|
| 1             | Distribution transformer capacity per household | 0.15              | 0                | 0.12                |
| 2             | Distribution transformer heavy load ratio      | 0.15              | 0.01             | 0.12                |
| 3             | Line heavy load ratio                          | 0.10              | 0                | 0.08                |
| 4             | N-1 pass rate                                  | 0.10              | 0.15             | 0.08                |
| 5             | Average power supply radius of line            | 0.13              | 0.2              | 0.1                 |
| 6             | Power supply reliability rate                  | 0.08              | 0.28             | 0.06                |
| 7             | Comprehensive voltage qualification rate        | 0.20              | 0.16             | 0.16                |
| 8             | Unit sales profit                              | 0.20              | 0.2              | 0.16                |
| 9             | Unit investment increase power supply          | 0.15              | 0                | 0.12                |
| 10            | Average operating life of main transformer     | 0.15              | 0                | 0.12                |
| 11            | Average operating life of the line             | 0.15              | 0.01             | 0.12                |

 Calculate the final evaluation result according to the relative posting progress:

| Project | A      | B      | C      | D      | E      | F      | G      | H      |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| A       | 0.8122 | 0.6903 | 0.4525 | 0.4402 | 0.7199 | 0.5738 | 0.6140 | 0.5058 |

According to the principle of the method, sorting according to the size of the posting progress, the larger the closeness value, the better the solution; the smaller the closeness value, the worse the solution. The areas with relatively large progress are the areas with the best physical assets diagnosis and evaluation. Because area A is the best physical asset diagnosis and evaluation result.

5. Conclusion
This paper proposes a diagnosis and evaluation method for power grid physical assets based on the combined weight TOPSIS theory. Through the construction of physical asset index system and the application of evaluation methods, the physical assets of power grid companies can be comprehensively evaluated to fully grasp the operation and management status of the company’s physical assets. This paper through monitoring and early warning of changes and problems that occur during the operation and management of physical assets of power grid companies, providing auxiliary support for relevant decision-making and deployment, and providing service support for continuous improvement of asset management performance.

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