Research on the Overhaul Capital Allocation Model Based on the Scale and State Properties of the Old Assets

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Abstract

As a typical asset-intensive enterprise, real asset management has a vital impact on enterprise operation and development. With the continuous development of China's power grid, the power grid scale and equipment number are increasing, and the value and quantity of power grid assets is huge. At present, the importance of reasonable development scale and structural decisions of power grid assets is ignored, and the actual situation of different regions is not fully considered in the allocation of overhaul funds. This paper takes old assets as the research object, deeply analyzes the actual impact of the scale and status of old assets on overhaul capital, and constructs the entropy capital allocation adjustment model combined with the entropy method, which can further improve the scientific nature and rationality of overhaul capital allocation. Finally, the empirical research in a certain region verifies the applicability of the model. The results show that the model can provide theoretical support and method reference for the overhaul investment scientific analysis and reasonable decision-making under the requirements of precise investment control.

Key words: *old assets; overhaul funds; allocation*

1. Introduction

Major investment is an important guarantee for the safe operation of power grid, and it is also an important part of the grid enterprise management control. Because of the current economic situation, policy situation and other factors, electricity growth slowed down, and the development of power grid enterprises received certain influence. Coupled with the continuous promotion of power transmission and distribution price reform, enterprise business development has been certainly affected, and enterprise precision investment also has faced higher requiremnets. The traditional extensive investment management mode needs to be further optimized. At present, there is a mismatch between the overhaul capital investment and the asset scale and the asset operation state. Therefore, based on the scale and status attributes of the old assets, this paper puts forward a scientific and reasonable optimization model of overhaul capital allocation, clarifies the principle of investment decision-making, and formulates reasonable investment allocation strategies, which can further improve the efficiency of capital input and output and ensure the rational use of funds.

Literature [1] based on the whole life cycle management process of distribution network planning, construction, operation, etc., established a medium and low voltage distribution network infrastructure project investment decision-making allocation model suitable for municipal power grid enterprises, and finally verified the model's performance through an example analysis. applicability. Document [2] establishes the quantitative model of investment auxiliary decision based on regional development and expected business performance, focusing on solving the decomposition and distribution of total investment in various regions, and provides scientific decision-making tools for optimizing enterprise resource allocation and improving business performance. Document [3-4] constructs a model based on investment capacity, realizes the division of investment scale and structure within the scope of investment capacity, and provides reference for the scientific and reasonable investment structure allocation of power grid enterprises. Document [5] establishes a 10 kilovolt distribution grid investment distribution evaluation index system in terms of safety, reliability, economy, flexibility, coordination, and

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environmental impact 6. The comprehensive evaluation of fuzzy mathematics is adopted.

To sum up, there are many research schemes for investment distribution, and few studies on the distribution of overhaul investment, this paper deeply analyzes the basic principles and main characteristics of the current overhaul investment, which can effectively take into account the different elements of the enterprise asset scale, operation status, benefit output, and put forward a scientific and reasonable overhaul capital distribution model, and ensure the safe and stable operation of enterprises, and realize the scientific and reasonable distribution of funds.

2. Construction of allocation index system of capital investment

2.1. Identification of the influencing factors of overhaul capital investment

With the improvement of operating life, the frequency of different equipment overhaul is rising. This article systematically analyzes the main factors affecting overhaul capital investment, combined with the basic principles and characteristics of overhaul capital investment, refer to the corresponding research results, fully integrate the main influencing factors of overhaul investment management, and identify from different aspects of market factors, business factors, asset factors, asset factors, and natural conditions factors. It includes old asset scale, average operating life of equipment, equipment defect rate, equipment failure rate, line heavy load ratio, heavy load ratio, distribution load ratio, electricity sales, average annual number of natural disasters (times), etc.

2.2. Establishment of the investment allocation index system

In order to accurately combine the distribution scale of our power grid company overhaul investment, the paper studied the index system of the overhaul investment scale allocation. Combined with the current studies, it is not that the more accurate the indicators are selected, the more accurate the model will be, but the relationship between the factors to find the indicators enough to meet the final purpose. Therefore, we should combine the actual meaning of various indicators and select representative comprehensive indicators to reflect the differences and characteristics of different indicators. The construction of the index system should give full consideration to the principle of applicability, and take into account the basic requirements such as the comprehensive representativeness of the index, the data accessibility and the comparison of the indicators. The indicators of overhaul investment distribution of power grid companies will greatly affect the formulation of the capital investment plan, mainly considering the economic and social conditions of each region and the actual situation of the power grid (including the stock scale of power grid, power growth and power grid operation). The construction of the index system is as follows.

Table 1. Scale Index System of Operation and Maintenance

Investment of Power Grid Company.

Serial number	Index name	Unit No
1	Scale of the old assets	One hundred 0 million yuan
2	Average equipment operating life	"Year"
3	Equipment defect rate	(Secondary / One Hundred Units / Year)
4	Equipment failure rate	(Secondary / One Hundred Units / Year)
5	Line heavy-load ratio	%
6	Transformer heavy-load ratio	%
7	Electricity quantity is sold	Ten kilowatt hours
8	Annual annual number of natural disasters (times)	Times on

3. Allocation evaluation model construction

3.1. Calculation method of index weight

Generally speaking, if the smaller the information entropy of an index, the greater the worthwhile variation of the index, the more the information provided, the greater the role it can play in the comprehensive evaluation, the greater the weight will be. On the contrary, the greater the information entropy of an index, the smaller the worthwhile variation of the index, the less the information provided, the less the role in the comprehensive evaluation, the less the weight. As an objective comprehensive evaluation method, entropy method mainly aims to determine the weight of the information transmitted to the decision maker. The entropy method is as follows:

(1) n evaluation indicators shall be used to evaluate m pending options.

x_{ik} : Estimate of the evaluation index i of the scheme

k to be selected. x_i^* : Ideal value of the evaluation indicator i. x_i^* The value varies from different characteristics of the evaluation index. For the greater the yield index, the better; for the loss index (reverse index), the smaller the better (which can also be turned into a positive index).

(2) Define the proximity of to: $x_{ik}\ x_i^*\ D_{ik}$

$$D_{ik}=\begin{cases}\dfrac{x_{ik}}{x_i^*} & x_i^*=\max\{x_{ik}\}\\ \dfrac{x_{ik}}{x_i^*} & x_i^*=\min\{x_{ik}\}\end{cases} \quad (1)$$

(3) normalization processing:

$$d_{ik}=D_{ik}\Big/\sqrt{\sum_{i=1}^{n}\sum_{k=1}^{m}D_{ik}^{\ 2}} \quad (2)$$

(4) Overall entropy: the entropy E of m schemes to be selected is evaluated by n evaluation indicators is:

$$E=-\sum_{i=1}^{n}\sum_{k=1}^{m}d_{ik}\ln d_{ik} \quad (3)$$

(5) Overall entropy when the index is independent of the scheme:

If the relative importance of the evaluation index is independent of the scheme to be selected, the entropy is calculated by the following formula:

$$E=-\sum_{i=1}^{n}d_{ik}\ln d_i \quad (4)$$

In formula:

$$d_i=\sum_{k=1}^{n}d_{ik} \quad (5)$$

In this way, the uncertainty of the relative importance of the evaluation index i for the treatment of option decision evaluation can be determined by the following conditional entropy.

(6) Evaluation conditional entropy of the index i.

$$E_i=-\sum_{k=1}^{m}\frac{d_{ik}}{d_i}\ln\frac{d_{ik}}{d_i} \quad (6)$$

It is known from the extremal of entropy that (k=1~m), namely di1 ≈ di2 ≈... the closer the dik,, the greater the conditional entropy and the greater the uncertainty of the evaluation indicators towards the alternative evaluation decision.

(7) Normthe above formula obtains the entropy representing the evaluation decision importance of the evaluation index i.

$$e(d_i)=-\frac{1}{l_n m}\sum_{k=1}^{m}\frac{d_{ik}}{d_i}l_n\frac{d_{ik}}{d_i} \quad (7)$$

3.2. Calculation method of allocation proportion

Based to the above analysis, this paper uses linear weighted sum, namely:

$$F_i=\sum_{j=1}^{m}w_{ij}x_{ij} \quad (8)$$

In the formula: the weight of the index and the standardized data of the index. Therefore, the allocation proportion is calculated as follows:

$$F_i^*=\frac{F_i}{\sum_{\mathrm{i=1}}^{\mathrm{n}}F_i} \quad (9)$$

In formula: the allocation ratio and the comprehensive evaluation results.

4. Empirical analysis

Eight county-level power supply enterprises under a regional power company were selected as the research objects, combined with the optimization technical methods, for the next year of the overhaul investment allocation quota for optimization analysis. Details are as follows:

(1) Basic data collection

In 2021, eight county-level power supply enterprises estimated 500 million yuan. By investigating the index data of each company, the actual data is collected as follows:

Table 2. The Original Statistical Table.

No ial	Unit name	Scale of the old assets	Average equipment operating life	Equipment defect rate	Equipment failure rate	Line heavy-load ratio	Transformer heavy-load ratio	Electricity quantity is sold	Annual annual number of natural

									disasters (times)
		One hundred 0 million yuan	"Year"	(Secondary / One Hundred Units / Year)	(Secondary / One Hundred Units / Year)	%	%	Ten kilowatt hours	Times on
1	A	5.56	12.1	4.34	5.43	5.24	4.72	45234	6
2	B	6.43	11.3	4.86	5.78	4.23	5.42	35674	5
3	C	5.68	9.7	6.45	5.11	3.85	5.22	54344	5
4	D	7.23	11.9	5.39	5.69	4.35	3.83	53112	6
5	E	6.33	12.6	6.11	7.45	4.56	4.22	64332	7
6	F	6.27	10.4	5.51	6.89	3.55	4.23	45789	4
7	G	6.69	10.8	5.32	6.12	5.34	5.87	46932	6
8	H	5.98	11.3	4.65	5.82	4.84	4.98	56443	4

(2) Initial investment allocation scheme

First, the data collected from 8 companies was normalized and calculated the standard values and weights by entropy method.

Table 3. Normalization processing, and weight results table.

Unit name	Scale of the old assets	Average equipment operating life	Equipment defect rate	Equipment failure rate	Line heavy-load ratio	Transformer heavy-load ratio	Electricity quantity is sold	Annual annual number of natural disasters (times)
A	0.77	0.96	0.67	0.73	0.98	0.80	0.70	0.86
B	0.89	0.90	0.75	0.78	0.79	0.92	0.55	0.71
C	0.79	0.77	1.00	0.69	0.72	0.89	0.84	0.71
D	1.00	0.94	0.84	0.76	0.81	0.65	0.83	0.86
E	0.88	1.00	0.95	1.00	0.85	0.72	1.00	1.00
F	0.87	0.83	0.85	0.92	0.66	0.72	0.71	0.57
G	0.93	0.86	0.82	0.82	1.00	1.00	0.73	0.86
H	0.83	0.90	0.72	0.78	0.91	0.85	0.88	0.57
Weight	0.05	0.05	0.11	0.10	0.13	0.13	0.19	0.25

Then comprehensively evaluate the actual data and the weight determination results of each index, and obtain the allocation proportion of the overhaul input of each unit according to the above calculation company. The calculation results are as follows:

Table 4. Allocation Situation Table.

Serial number	Unit name	Allocation ratio
1	A	12.43%
2	B	11.57%
3	C	12.35%
4	D	12.66%
5	E	14.45%
6	F	11.18%
7	G	13.39%
8	H	11.96%

5. Conclusion

Based on the characteristics of power grid equipment overhaul investment, this paper proposes an overhaul investment allocation method that takes into account the scale and operating status of old assets. This method can further improve the rationality and scientificity of the overhaul investment of power grid enterprises, realize the reasonable allocation of resources, and improve the efficiency of overhaul investment management of the enterprise.

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