Research on Improving the Precision Investment Level of Distribution Network Based on the Whole Process Control Means of Big Data

Anli Sun1,*, Nengsi Chen1, Hanxi Wu1
1Chongqing Electric Power Design Institute Co., Ltd, Chongqing, China, 401121

*Corresponding author e-mail: dlsjy-bgs@cq.sgcc.com.cn

Abstract. With the continuous and stable growth of China's national economy, the demand of the whole society for the total power supply is higher and higher, which requires the power enterprises to continuously improve the power supply. However, if the total power supply is increased, the power enterprises need to invest a lot of power transmission facilities, which requires a huge investment in the distribution network. Therefore, different economic development levels among regions will lead to the difference of distribution network investment, which is also an important content of distribution network investment decision. Therefore, we must control the whole process through big data, which will provide a better evaluation system of distribution network investment benefits. Through the whole process management and control mode, the State Grid can build a systematic and complete distribution network investment decision-making system, which will improve the accuracy of distribution network infrastructure project investment. By analyzing the income ratio, the power grid can get scientific economic investment analysis report. Through big data technology, the power grid can realize a variety of data of distribution network operation, such as maintenance plan optimization, distribution network operation process optimization, project investment income, equipment health status analysis, etc., which can provide auxiliary decision support. Through the three aspects of technical benefit, social benefit and economic benefit, we can evaluate the operation efficiency of equipment, which can construct the index system of project investment benefit. Firstly, this paper constructs the whole process management and control system of distribution network based on big data. Then, this paper constructs the accurate investment index system of distribution network. Finally, some suggestions are put forward.

Keywords: TCNTP, Advanced Mathematics, Course Teaching, Influence

1. Introduction
In 2015, the State Grid officially launched the application of the new technology on "big cloud physical transfer", which will comprehensively improve the carrying capacity of the information platform and the level of business application [1]. Through big data, State Grid can eliminate business
barriers, which will realize the integration of informatization into the whole business and whole process mode of the company. Through the centralized management of data assets, we can share data resources, which will ensure the safe and stable operation of the information system [2]. Through the whole process management and control mode, the State Grid can build a systematic and complete distribution network investment decision-making system, which will improve the accuracy of distribution network infrastructure project investment. By analyzing the income ratio, the power grid can get scientific economic investment analysis report. Through big data technology, the power grid can realize a variety of data of distribution network operation, such as maintenance plan optimization, distribution network operation process optimization, project investment income, equipment health status analysis, etc., which can provide auxiliary decision support [3]. Based on the historical data, this paper analyzes the input-output quantitative analysis of distribution network, which can build accurate investment strategy of distribution network. By improving the efficiency of power grid investment, we can promote the scientific and sustainable development of power grid [4].

2. Overall framework design of distribution network whole process management and control
The whole process management and control is a comprehensive analysis system of the state grid distribution network, which includes a variety of system information, such as dispatching automation system, distribution automation system, production management system, geographic information system, marketing management system, etc [5]. The overall structure of distribution network management and control is composed of data layer, processing and analysis layer, business application layer and display layer, as shown in Figure 1.

**Figure 1.** The overall structure of the whole process management and control of distribution network.
Through the whole process management and control, the State Grid can optimize the top-level design of distribution network planning, construction, regulation, transportation inspection and marketing [6]. Through the whole process management and control system, the State Grid can realize the comprehensive evaluation and analysis of distribution network, which will accurately reflect the overall operation level of distribution network. Through the control of distribution network business process indicators, management and decision-making personnel can grasp the overall development, which will fully support the lean management and control of distribution network [7].

3. Research on precise investment level of distribution network

3.1. Construction of power grid investment index system
Power grid investment is an important part of power grid planning, which directly affects the sustainable development ability of power grid. Power grid investment planning is a complex and complicated system work. In the power grid investment index system, we often use system analysis method and analytic hierarchy process, which are mainly composed of three index systems. Based on the load, loss, voltage and other operation information of power grid equipment, the index is mainly divided into three aspects: decibel time, technical, economic and social benefits. Therefore, the power grid investment index system is a multi-level index system. Referring to the basic theory of system analysis and analytic hierarchy process, the overall framework design of power grid investment index system is divided into three levels.

3.2. Economic benefit index system of power grid investment
According to the input and output levels of power grid elements, this paper constructs the evaluation index system of investment economic benefits from investment benefits and financial benefits, as shown in Figure 2.

| Economic benefit index system | Investment benefit | Financial benefits |
|------------------------------|--------------------|--------------------|
|                              | Asset income ratio of power grid | Internal rate of return |
|                              | Line loss rate | Payback period of investment |
|                              | Unit asset power supply | Unit power supply cost |
|                              | Unit investment to increase power supply | |
|                              | Unit investment increases supply load | |

**Figure 2.** Economic benefit index system of power grid investment.
4. An example analysis of precise investment in distribution network

4.1. The influence of investment amount on income

This paper takes the pilot project of incremental distribution business of Sino German ecological park in Qingdao, Shandong Province as an example, which includes the impact of investment amount and cooperation mode on the income distribution of multiple investors. This paper only considers the influence of equity cooperation mode on the change of principal investment amount. With the gradual increase of investment in power companies, social capital holding gradually changes to provincial power company holding. The four risk factors that each participant may face are shown in Table 1.

Table 1. The proportion of risk sharing in the form of equity cooperation.

|                      | Policy risk | Construction risk | Operational risk | Social risk |
|----------------------|------------|------------------|-----------------|-------------|
| Electric power company | 0.2        | 0.5              | 0.6             | 0.4         |
| Government sector    | 0.6        | 0.2              | 0.1             | 0.1         |
| Social capital       | 0.2        | 0.3              | 0.3             | 0.5         |

With the investment proportion of power companies increasing from 10% to 70%, the proportion of investment entities' income has also changed. Among them, the income of each investment entity accounts for as shown in Table 2.

Table 2. The influence of different investment proportion on the income of each investor.

| Proportion of investment | Revenue share | Revenue share | Revenue share |
|--------------------------|---------------|---------------|---------------|
|                          | Electric power company | Government sector | Social capital |
| 1:2:7                    | 0.11          | 0.19          | 0.7           |
| 2:2:6                    | 0.24          | 0.19          | 0.57          |
| 3:2:5                    | 0.38          | 0.19          | 0.43          |
| 4:2:4                    | 0.52          | 0.19          | 0.29          |
| 5:2:3                    | 0.57          | 0.19          | 0.24          |
| 6:2:2                    | 0.63          | 0.19          | 0.18          |
| 7:2:1                    | 0.7           | 0.19          | 0.11          |

The revenue of power companies also gradually changes, as shown in Figure 3.

Figure 3. Investment income curve of power companies.
4.2. Result analysis
The State Grid controls the operation right of distribution network, which will get the majority of benefit distribution by means of fund examples. Therefore, the State Grid is the largest contributor to the construction of incremental distribution network. Social capital will obtain new profit growth point by actively fulfilling the contractual obligations. With the improvement of investment environment, social capital accumulation will improve the level of professional technology, which will gradually enhance their competitiveness.

5. Conclusion
In the early stage of project approval, we should conduct full investigation, which is mainly divided into two parts. First, collect the distribution network structure and operation and maintenance situation, which can be used to investigate the distribution network structure in the area to be reconstructed. Combined with the usual operation and maintenance data, we can query the power supply bayonets, low voltage, line and substation area overload, which can be used as the status quo of operation and maintenance. At present, the situation of power grid enterprises is still grim, which needs to improve the demand of power grid development. By increasing the working pressure, the reform of power grid enterprises will increase the risk of market competition. By strengthening the project reserve management, we can improve the input-output level of power grid, which is the key to achieve accurate investment.

References
[1] Lai Yifei. Correlation model of interest rate fluctuation, real estate investment and real estate price [J]. Journal of Wuhan University: Engineering Edition, 2014, 47 (1): 96-99
[2] Liu Jie, Li Wenjing. Basic data quality improvement scheme and its application in power marketing system [J]. Guangxi electric power, 2016, 39 (1): 65-72.
[3] Shi Jun. Research on joint optimization strategy and modeling of day ahead power transmission and receiving and generation plan in Shenzhen Power Grid [J]. China Southern Power Grid technology, 2015, 9 (1): 88-93.
[4] Wang Yongqiang. Refined daily generation planning method for large hydropower stations based on comprehensive unit state evaluation strategy [J]. Power grid technology, 2012, 36 (7): 94-99
[5] Yan Lei. Life cycle characteristics of investment value of science and technology-based SMEs and financing matching analysis [J]. Contemporary economic science, 2016, (3): 114-123
[6] Yan Yuping, Xiao Zhanhui. Diagnosis of power grid equipment account data quality problems and improvement countermeasures [J]. Modern electronic technology, 2016, 39 (13): 164-166.
[7] Zheng Zhenlong. Spatial measurement of RMB exchange rate elasticity: comparison of basket portfolio and multi-scale pattern recognition [J]. International finance research, 2016, (6): 32-34.