Research on Strategy of Improving Intelligent Comprehensive Benefits of Distribution Network Based on Big Data

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Abstract: The business scale of intelligent DN(Distribution Network) is relatively large, and with the rapid development of intelligent DN, there is an important trend of centralized development of business parts in various industries. The function of DN is that the terminal power grid is directly connected with users to provide electricity, and its function is the most direct and key, so it is of great significance to be safe and reliable in the process of power supply. In this paper, firstly, an intelligent decision-making platform library for DN planning based on BD(Big Data) is constructed, and then an intelligent comprehensive benefit analysis model for DN based on BD is proposed. Deeply excavate the load data of distribution load, improve the access ability of DN, and effectively improve the statistical management level and statistical analysis ability of DN. The research results have achieved good social and economic benefits, which can provide reference for regional DN management.

1. Introduction

In the development of smart grid, DN(Distribution Network) needs to change from passive network to active network, which is beneficial to the participation of distributed generation and can connect the generation side and the user side more effectively, so that both sides can participate in the optimal operation of power system in real time [1]. The business scale of intelligent DN is relatively large, and with the rapid development of intelligent DN, the business parts in various industries have an important trend of centralized development. The concept of "smart grid" came into being to optimize the investment in power equipment and meet the needs of users' independent choice.

The previous distribution mode can no longer meet the development needs of BD(Big Data) era, so we need to reform DN management. Only by digging deeply into the law of urban DN and implementing refined DN management mode can the distribution efficiency be improved more effectively and the stability of power supply be improved. BD "and" internet plus "era, DN intelligent planning and design decision-making platform can help realize the informationization and intelligentization of intelligent DN planning system, realize the data value of the platform, and carry out intelligent distribution management.

2. Intelligent decision-making platform for DN planning based on BD

BD-based analysis and decision-making is gradually becoming a new impetus and inevitable trend to guide enterprise decision-making and social and economic development [2-3]. On the one hand, it realizes the integration, update, sharing and control of data resources related to DN planning, and provides the convergence and fusion of panoramic data needed for DN planning; On the other hand, on the basis of integrating massive data related to DN planning business, DN-related forecast analysis is carried out, and DN advanced auxiliary decision-making function is provided to realize DN investment benefit analysis, project optimization and sequencing, and intelligent comprehensive auxiliary decision-making. It is of great research significance and application value to give full play to the value of massive data, realize lean and intelligent DN planning and management, and comprehensively improve the planning, design and operation management level of intelligent DN.

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The function of DN is to directly connect the terminal power grid with users to provide electricity, and its function is the most direct and key, so it is of great significance to be safe and reliable in the power supply process [4]. DN intelligent planning and design decision-making platform has the following two functions: first, integrate, update, share and control DN planning data information resources, and present the consolidated data to DN for planning; Second, manage and analyze a large number of data information of DN planning system, predict the future development trend of power grid, and give the high-end decision-making scheme of DN.

The intelligent decision-making platform for DN planning based on BD realizes five functions: planning BD center, forecasting analysis, project optimization, project management and auxiliary functions on the unified panoramic visualization platform. BD-based DN planning intelligent decision-making platform is based on enterprise unified cloud platform, and BD storage, analysis and various planning decision-making applications are constructed. The information architecture of the platform is shown in Figure 1.

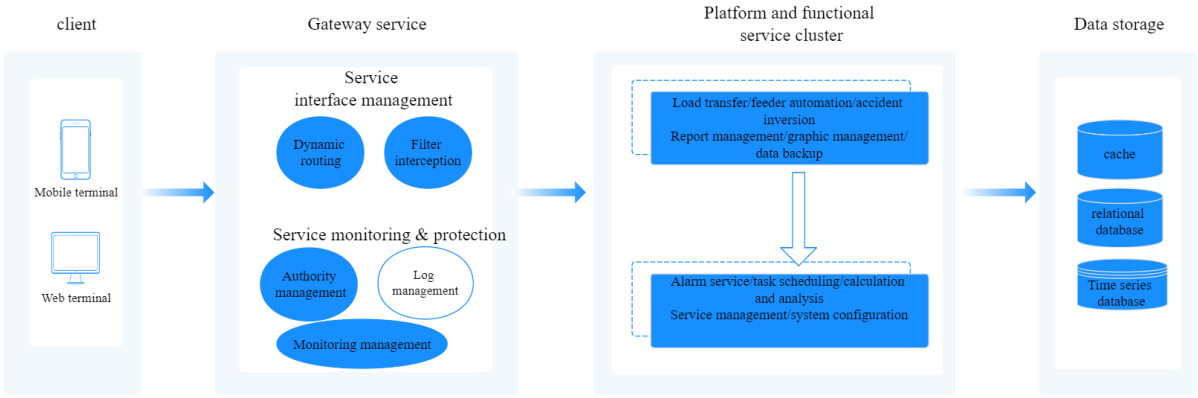

Figure 1 Information architecture of the platform

Based on BD, DN intelligent planning and design decision-making platform can accurately query the power supply information status between 380 V and 110 kV, and then make prediction and analysis, and predict the electricity quantity and load. Accurately predict the power and load of the power grid; Comprehensive analysis and evaluation of existing grid and equipment information, find out the weak parts in the operation process of DN; According to the demand for electricity in DN, a decision-making scheme for DN planning is given. Timely discover the existing or possible problems in each part of DN planning project, make treatment and prevention plans, and improve the management level and scheme formulation level of DN planning project [5].

Operating in the enterprise unified cloud platform, the data of DN intelligent planning and design decision-making platform is integrated with the data in other information systems. This paper analyzes the data of power consumption information collection system, load control system and distribution transformer online monitoring system in multi-source DN statistical database, and extracts the information needed for power consumption characteristics analysis. In addition, according to the needs of functional design, collect other technical and economic information. Comprehensively sort out the above two points, and establish the basic database of user electricity consumption characteristics [6].

At the same time of BD mining, taking other cities at the same level in China as reference, the development trend of load demand coefficient of typical DN users is investigated, and the revised conclusion is further verified to determine the recommended value of load demand coefficient.

3. An intelligent comprehensive benefit analysis model of DN based on BD

The key and main foothold of the development of smart grid is the distribution of electricity, and the development of smart DN is also the concrete embodiment of smart grid. In order to strengthen the further management of electric power operation, electric power managers should provide correct supervision mode, and make a comprehensive breakthrough in the form of fuel management by

using power plants, which can further strengthen online measurement, coal supply management, and fully reflect the procurement scheme and inventory form of coal fuel, which can further achieve the effect of energy saving and emission reduction. With the massive access of renewable energy and the promotion of micro-grid construction, DN planning has also changed accordingly, such as the power generation mode has changed from centralized power generation to decentralized power generation, and the distribution characteristics have changed from the traditional passive network with substation power supply to the active network with two-way energy exchange capacity. These changes have put forward new requirements for the optimization and screening of distribution network investment projects.

DN automatic management system is a comprehensive monitoring system that integrates computer technology, data transmission and processing, control strategy, modern DN equipment and management, and is an important means to ensure the safe, stable, reliable and economical operation of power system [7-8]. Comprehensive benefit analysis of DN automation project, rational and optimal use of limited funds to improve the economy of power network, and establishment of high-level DN and practical DN automation system are of great guiding significance for improving the efficiency of power enterprises and opening up the power market.

In order to realize the intelligent comprehensive benefit analysis of DN based on BD analysis, it is necessary to first establish an index analysis model for the intelligent comprehensive benefit evaluation of differentiated investment incremental DN, and use BD analysis method to analyze the intelligent comprehensive benefit of differentiated investment incremental DN. The combined structure model for the intelligent comprehensive benefit evaluation of incremental DN is shown in Figure 2.

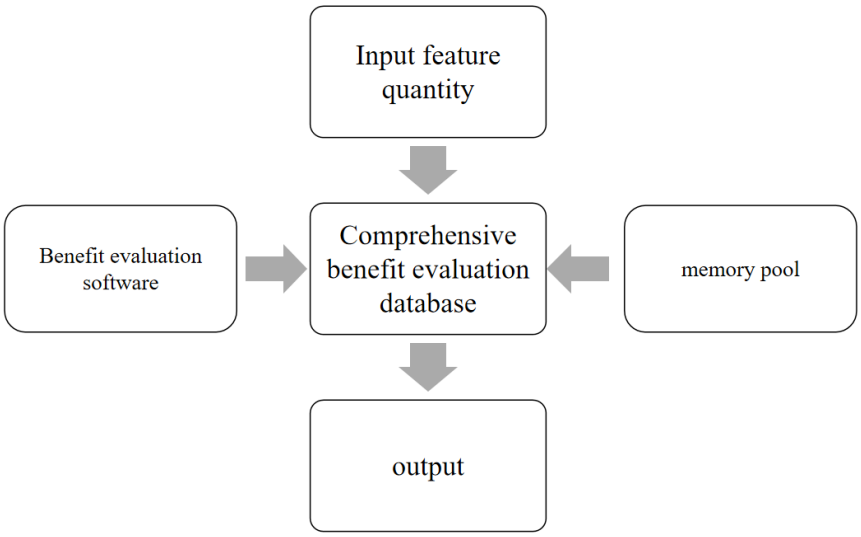

Figure 2 An intelligent comprehensive benefit analysis model of DN based on BD

The distribution BD in the multi-source DN statistical database is statistically analyzed, aiming at improving the short-,medium-and long-term power load forecasting and management level, analyzing the power consumption characteristics by industry and region, and considering the influence of external economic environment on the load and electricity quantity, the optimization model of power load forecasting is established. Through BD statistical analysis and research, the utilization efficiency of distribution resources can be optimized to the greatest extent, and at the same time, the phenomenon of "random pull and random connection" of distribution lines can be solved, and the economy and stability of DN operation can be improved in an all-round way.

In addition, according to the lines of different industries, we should give more targeted research and analysis on power consumption. In a certain period of time, the data of electricity consumption are deeply analyzed and the characteristics of electricity consumption in different periods are recorded. The analysis of all data should lay the foundation for practice. After in-depth analysis of the use of power distribution users, the theory should be scientifically transformed into a model. Multi-source DN statistical database can divide users into four types: commercial users, industrial

users, administrative office users and resident users [9]. The average load of DN line is studied intensively, and the load analysis of DN line is detailed. According to the average load rate, the distribution situation of network line is understood, and the problems of borrowing capacity of each substation are effectively analyzed, and finally the distribution interval of the line is effectively evaluated.

The analysis of DN intelligent comprehensive benefits adopts the input-output method, combined with the whole life cycle theory, and establishes the economic model of comprehensive benefits on the basis of analyzing the economic benefits of individual businesses. The annual comprehensive benefit model of intelligent power distribution system can be expressed as:

$$W = E - C_a \tag{1}$$

Where: E is the annual comprehensive benefit value of the system when multiple intelligent services coexist; C_a is the annual cost value.

The fuzzy correlation detection method is used to carry out anti-interference processing on the intelligent comprehensive benefit distribution BD of DN, and the neural network learning method is used to predict the benefit of DN from the extracted characteristic quantity of intelligent comprehensive benefit distribution of incremental DN of differentiated investment [10], and the optimization solution vector of intelligent comprehensive benefit prediction of incremental DN under differentiated investment is obtained as follows:

$$S_b = \sum_{i=1}^{c} p_i (\vec{m}_i - \vec{m})(\vec{m}_i - \vec{m})^T \tag{2}$$

Where $\vec{m}_i = \sum_{i=1}^{c} p_i \vec{m}_i$ is the characteristic quantity of investment structure difference, according to the above analysis, the incremental allocation model of differentiated investment is established, and the benefit prediction and ambiguity detection are carried out according to the incremental allocation results.

According to the autocorrelation feature matching, the incremental matching and phase space reconstruction of differentiated investment are carried out by the methods of spatial gain adjustment and ambiguity optimization. Under the differentiated investment, the optimal game function of incremental DN intelligent comprehensive benefit prediction is expressed as follows:

$$Q(a, b_i) = \sum_i \sum_j \left[y_{ij} - \left(\hat{a} x_{ij} + \hat{b}_i \right) \right]^2 \tag{3}$$

Where a, b_i is the correlation coefficient and $\hat{a}, \hat{b}_i$ is the optimal estimated value.

4. Result analysis

In order to verify the application performance of the proposed method in realizing DN intelligent comprehensive benefit prediction under differentiated investment, the simulation test was carried out with MATLAB, and the statistical analysis of benefit evaluation was carried out with SPSS statistical analysis software. The processing platform was built with Simulink tool, and the relevant data of power Internet of Things were collected, and the above data were analyzed for DN intelligent comprehensive benefit of differentiated investment increment.

The loss benefit and reliability benefit of intelligent distribution system are related to network calculation, so when different intelligent services exist in the same DN network at the same time, the simple sum of the loss benefit (reliability benefit) generated by various single intelligent services is not equal to the comprehensive loss benefit generated by the system. Through the simulation of an example, the change curve of the optimal cumulative income value is shown in

Figure 3:

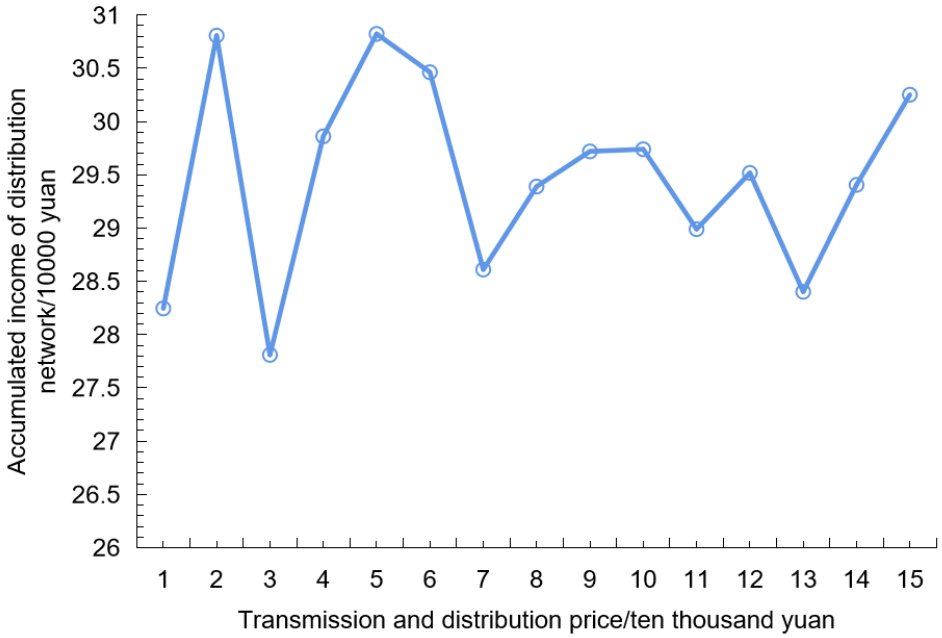

Figure 3 Variation curve of optimal cumulative income value

The cumulative income of DN increases with the increase of transmission and distribution price. When the government relaxes the control of transmission and distribution price, the investment activities of power grid increase, and the cumulative income also increases. On the contrary, when the government strictly restricts transmission and distribution price, the growth rate of cumulative income leads to the decline of investment income. The analysis shows that the method proposed in this study has high accuracy and sensitivity in predicting the intelligent comprehensive benefits of differentiated investment increment DN.

5. Conclusions

The previous distribution mode can no longer meet the development needs of BD era, so we need to reform DN management. Only by digging deeply into the law of urban DN and implementing refined DN management mode can the distribution efficiency be improved more effectively and the stability of power supply be improved. BD-based DN planning intelligent decision-making platform is based on enterprise unified cloud platform, and BD storage, analysis and various planning decision-making applications are constructed. At the same time of BD mining, taking other cities at the same level in China as reference, the development trend of load demand coefficient of typical DN users is investigated, and the revised conclusion is further verified to determine the recommended value of load demand coefficient. The method proposed in this study has high accuracy and sensitivity in predicting the intelligent comprehensive benefits of differentiated investment increment DN.

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