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Optimization of Power Equipment Operation and Inspection Based on Big Data Technology

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Abstract:The advancement of big data technology, coupled with the development of smart grids and the rapid expansion of grid scales, has introduced significant challenges in the operation, maintenance, and efficient management of power equipment. This paper addresses these challenges by examining current issues in equipment operation and inspection management and proposing a solution through the application of big data analysis techniques. It explores how big data technology can be utilized to thoroughly mine, analyze, and uncover relationships, causal connections, and other valuable insights within the data. This analysis aims to provide a dependable reference for improving production operations, equipment investment planning, maintenance personnel allocation, and maintenance scheduling. Consequently, it enhances the overall management level of equipment operation and maintenance.

Keywords:Big data technology; smart grid; power equipment operation; Management of power equipment.

1. Introduction

In the era of digital economy, the explosive growth of the Internet, intelligent devices and other forms of information technology makes data grow at an equally impressive rate. All stages of enterprise operation can be recorded and equipment operation information can be collected [1, 2]. Data has become an important production factor, through data collection, storage, reorganization and analysis modeling, the important values and laws hidden in the data will be gradually revealed. This will help the company's transformation and upgrading, and promote the sustainable development of the company [3, 4].

In combination with the operation and maintenance of equipment, there are still many problems to be solved in the management of equipment inspection:

Based on the professional management system of equipment, such as pms2.0 system, transmission channel monitoring and early warning system, online monitoring system and other accumulated mass data of power transmission and transformation equipment operation inspection, equipment fault defects, meteorology and so on, are not fully utilized.

Traditional data reports, ad hoc queries and other simple analysis methods can not meet the needs of enterprises for deep information mining.

The occurrence of equipment failure is unpredictable. How to make full use of the analysis results of existing equipment operation and inspection data, failure data, etc., and make a reasonable and efficient equipment operation and inspection plan to ensure the stable operation of the power grid.

How to quickly dispatch the operation and maintenance team when the equipment is faulty, quickly complete the repair task, and restore normal power supply is also one of the problems worth

studying.

In view of the above problems, this paper will discuss how to use the big data analysis method to optimize the management of equipment inspection in the field of equipment inspection. Promote the transformation of operation and inspection mode of substation equipment to be more intelligent, efficient and safe, and improve work efficiency. Provide reliable reference for the future production and operation, equipment investment planning, maintenance personnel allocation and equipment maintenance plan of the company, and give full play to the comprehensive value of equipment operation and inspection data.

2. Key Technology of Big Data Analysis in Equipment Operation and Maintenance

The equipment operation and maintenance data has the characteristics of typical big data: (1) There are many data sources from various business application systems. (2) The volume of data is large and the growth rate is fast. (3) Data types are diverse, including unstructured and semi- structured data. (4)It contains great value, and the data is highly correlated and complex. Traditional data processing and analysis technology can not meet the requirements, so it needs to adapt to the key technologies of big data processing to process these data.

2.1. Data Preprocessing.

Due to the large number of sources of equipment inspection data, the amount of data is huge; rich in quantity types, including structured, semi-structured, unstructured. There are many "dirty data", such as: null value, misspelling data, data with the same value and different name, illegal data, duplicate data, etc. These "dirty data" will seriously affect the accuracy and quality of subsequent big data analysis and mining results. These characteristics of existing data bring difficulties to subsequent big data analysis. Therefore, it is a key step to identify and preprocess the data such as mass equipment inspection, equipment account, fault and defect from multiple data sources efficiently.

2.2. Distributed Storage and Management.

Distributed storage and access is the key technology of big data storage, which is economic, efficient and fault-tolerant. Distributed storage technology is directly related to the type of data storage medium and the form of data organization and management. At present, the economic and practical data storage medium is disk. The main data organization and management forms include organization by row, organization by column, organization by key value and organization by relationship. The main data organization and management levels include organization by block level, organization by file level and organization by database level. The storage form and management technology of big data directly affect the analysis and mining of big data, which is the basis of the successful application of big data analysis technology.

2.3. Big Data Analysis and Mining.

The purpose of data analysis and mining is to concentrate and extract the information hidden behind a large number of seemingly disordered data, and summarize the internal laws of the research objects. In the equipment inspection application, it is the process of analyzing and mining the collected massive, incomplete, noisy, fuzzy, and random equipment inspection data with appropriate statistical analysis methods and mining algorithms, and summarizes them, collect, understand and digest them, discover and dig out the inherent connections and laws implicit and valuable and potentially useful information and knowledge in them. In order to maximize the function and value of development data, play the role of data, and improve the efficiency of equipment operation and inspection management, it is also a decision support process.

It is mainly based on artificial intelligence, machine learning, pattern learning, statistics, etc. common methods include collaborative filtering, classification, regression analysis, clustering, association rules, neural network methods, etc. Through highly automatic analysis of big data, making inductive reasoning, mining potential patterns from it, can help enterprises reduce risks and make correct decisions.

2.4. Big Data Visualization.

Big data visualization is the process of representing the data in large data sets in the form of graphics and images, and using data analysis and other technical means to find unknown information. Clearly and effectively communicating and communicating information between big data and users is an important goal of data visualization. Data visualization technology represents each data item as a single element, a large number of data sets constitute a data image. At the same time, each attribute value of data is expressed in the form of multidimensional data, which can observe data from different dimensions, so as to conduct more in-depth observation and analysis of data. In general, symbol expression technology of data information, data rendering technology, data interaction technology, data expression model technology can be used to realize big data visualization.

3. Typical Application of Big Data Analysis for Equipment Operation and Maintenance

In view of the equipment inspection data, the first step is to carry out the data extraction and processing, that is, the equipment inspection data preprocessing research. Then, we fully analyze and mine the comprehensive value of big data in equipment operation and inspection by using big data and artificial intelligence technology, including: Multi-source massive data preprocessing, distributed storage and management, big data analysis and mining, visualization and other technologies. Finally, the analysis results are used to support the operation inspection plan, decision-making and equipment investment plan, promote the development of data business, and provide support for the development of ubiquitous power Internet of things. The following is the overall scheme flow:

(1) The existing multi-source mass equipment inspection data are sorted out, the key data is extracted and analyzed, and then the big data preprocessing method is determined, and the preprocessing scheme is developed. Preprocess the extracted key original data, including equipment account, operation inspection plan, personnel allocation, equipment status, equipment failure, equipment defect and other data. Data cleaning technology is used to complete the preprocessing work, providing data quality assurance for the subsequent data storage, analysis and mining.

(2) Distributed storage and management of pre-processing data, collection of equipment operation and maintenance data, mastering the connection between equipment operation and status, between equipment and account data table, reducing data island and redundancy, and improving the intrinsic value of data.

(3) According to the data of equipment maintenance, using big data analysis and mining technology, optimize the equipment maintenance plan. Equipment operation and maintenance work involves a wide range of departments and personnel that need to be coordinated. It is necessary to formulate efficient equipment maintenance plan. Through big data analysis of maintenance data, clear the relationship between account data, optimize equipment maintenance plan and improve operation and inspection efficiency.

(4) Integrate the information of equipment operation account, defect data, fault data, operation time, etc., use big data analysis technology to provide support for the reasonable deployment of maintenance personnel, optimize the configuration of maintenance personnel, improve the efficiency of maintenance personnel, make the equipment maintenance work smoothly, and ensure the safe and stable operation of equipment and power grid.

(5) According to the equipment status data, analyze the defects and faults, and support the equipment investment planning. According to the existing equipment status, fault, defect, substation operation and other basic data, as well as the operation of the operation and inspection business, conduct status analysis and defect analysis, excavate the possible risks of the equipment, update the auxiliary equipment, ensure the safe and stable operation of the equipment, optimize the equipment investment planning, and fully improve the life cycle of the equipment.

(6) Comprehensive application and decision support. Make full use of the valuable information analyzed and mined above to provide auxiliary decision support for equipment operation and

maintenance, show the connection between equipment, optimize equipment maintenance plan, optimize the team of operation and maintenance personnel and equipment investment plan, ensure the safe, stable and efficient operation of power grid, and promote the effective implementation of ubiquitous power Internet of things.

4. Summary

With the development of on-line monitoring technology, information technology and big data technology, how to make these technologies more effective for equipment inspection service is a problem worthy of high attention. IN the management of equipment operation and maintenance, big data technology is used to fully mine and analyze the relevant massive data to find out the connection, causality and key information among the data, improve the utilization rate of data, change invalid and unrelated data into effective and related data. Provide reliable reference for future production operation, equipment investment planning, maintenance personnel allocation and equipment maintenance plan of the company, effectively improve the management level of equipment operation and maintenance, make the operation and maintenance of field equipment more real-time and accurate, and the asset management of many equipment more cost-effective.

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