The Research on Big Data Platform based on Timetable Management

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The Research on Big Data Platform based on Timetable Management

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Abstract. Timetable is the core technical plan of the railway transportation organization, and it is the basis for the daily work. However, at present, China's timetable management technology is relatively backward, which cannot meet the safety and efficiency of actual transportation. This paper analyzes the problems in the current situation of tiemetable management. Starting from the problem, the application research of big data platform is proposed. Firstly, the data is collected and normalized, then the safety analysis and index analysis are carried out, and finally the intelligent optimization is carried out.

1. Introduction

With the development and maturity of big data technology, the combination with big data has become the perfect choice for breakthroughs in various industries. In recent years, the research on computer drawing timetable in China has made remarkable progress, but the research mainly focuses on the establishment of the compilation system, and it is obviously insufficient in other aspects. For example, the research on information management and data sharing during the execution of the timetable is not enough, and the information technology is lacking. When the timetable changes, the workload is huge and there is a security risk. If a big data platform based on timetable is established, it will promote the transformation from human control to machine-based control, reduce the adverse effects of human factors on management quality, ensure safety and improve efficiency.

2. Overview of Big Data

With the maturity of information collection, storage and analysis technology, big data has gradually become the driving force for promoting industry progress and social development, and has become a national basic strategic resource.

The concept of big data has been a concern of the railway industry for many years. Over the past decade, the development of the computer industry has made this concept even more mainstream. Big data technology has become more and more popular in the field of railway transportation.

There are many mature cases in the application of foreign big data in the railway industry, such as:

Big data technology has made some progress in the analysis and forecasting of German railways, decision support and automation applications. By planning and constructing a unified data platform,

German railway has realized a comprehensive data application platform for accurate analysis functions such as business conditions and equipment failure analysis, and carried out data analysis work in many aspects.

In recent years, the Italian railway company Trenitalia has used the big data to carry out the predictive maintenance of digitalization of rolling stock, and uses the Dynamic Management Maintenance System (DMMS) to combine the Internet of Things, analytical technology and memory computing technology.

The US Federal Railway Administration (FRA) attaches great importance to the application of railway big data. Since 2002, it has initiated a number of projects involving large databases, image processing, neural networks, and machine learning.

With the popularity of sensor technology in the railway and the maturity of big data technology, the time for big data to run the application of timetable management has matured and is urgent.

3. Overview of Timetable Management

At present, China has adopted a computerized train timetable system version 4.0 to drawing the timetable. Every time the timetable is drawing, each railway bureau is composed of a drawing group for manual drawing, which takes a long time. At present, the timetable only gives the train arrival time of the online section and the station, and stipulates the basic train arrival point and the transmission point. It only guarantees that the train runs in the interval as little as possible, which is equivalent to running only on the surface of the timetable. The line is constrained, and the deep-level transportation requirements and security requirements for the timetable are not covered. Moreover, the timetable does not cover the comprehensive planning information of lines, points, vehicles, people, etc. required by the whole system, and cannot be directly put into use after the completion of the compilation. It also needs a lot of proofreading and planning work. In order to ensure the safety and implementation of the transportation organization, it still needs manual control, refinement and expansion, which consumes a lot of manpower, material resources and financial resources, and it is difficult to improve the work efficiency. At the same time, it is still difficult to avoid mishandling and leakage, and there are security risks. Therefore, the current timetable is not suitable for the increasing transportation needs and transportation scale of today's railways, and cannot meet the needs of railway transportation management methods. The following problems exist:

3.1. Safety problem

Safety problem has always been a top priority for the railway system and all departments. The current timetable management system has the following security issues.

- Each department has its own data type and data structure, so there may be misunderstandings that can cause safety problems. For example, a complex marshalling station is divided into two stations in electricity department, meanwhile, it may be divided into three stations in other departments.
- The station's receiving and dispatching trains are all carried out manually according to experience, and the system will not carry out inspections. Therefore, accidents caused by wrong station track line and the like often occur.
- The real-time status of the device is not recorded, such as the station's switch, signal lights and other equipment. Therefore, if the equipment fails during the time outside the maintenance period, it cannot be found in time, which may cause a safety accident.

3.2. Efficiency problem

Every two months, the timetable will be adjusted. Each time the timetable is adjusted, the railway head office will set up leadership team consists of the responsible persons of the relevant departments, responsible for determining the principles, tasks and procedures for the preparation of the timetable, and drafting the inter-transit passenger trains. The railway bureaus also set up drawing team by relevant departments, carefully prepare the drawing materials, and complete the timetable compilation

and adjustment of the bureau according to the principles, tasks and steps of the timetable. After the adjustment is completed, the text file of the text version is generated by the head office, and each department performs manual analysis and excerpt to form files in different formats. For example, after the timetable is adjusted, thousands of stations need to be manually extracted, and the information contained in the station is manually extracted from the hundreds of pages of the file.

That is to say, every time the timetable is adjusted, the railway will spend a lot of manpower, material and financial resources, and the efficiency is very low.

4. Applied Research

At present, in China's railway transportation production process, the structure, form and format of the operational system database such as timetable and construction are different, and it is difficult to achieve cross-system data sharing. This phenomenon has been unable to meet the requirements of pursuing more efficient, safe and intelligent railway transportation production. To this end, with the big data technology as the method, with the goal of high security, high efficiency and high profit, the big data management platform based on timetable that covers all the data needed for daily railway production is the first problem to be solved.

4.1. Data collection and normalization

In today's big data analysis and various artificial intelligence algorithms, data is the foundation of everything and the most important resource. Therefore, the collection and normalization of data is very important, and it is also a prerequisite for the establishment of big data platform.

The data required by the platform is distributed among the various railway systems. The data is not only different in structure, form and format, but also the statistical management of data is very different. Especially important is the real-time update of data. Therefore, it is first necessary to design a complete set of standardized computer language descriptions, unify the data formats and specifications, and establish a corresponding meta-database. It is necessary to study and *analyse* the characteristics of massive data and process them.

4.2. Safety analysis and indicator analysis

The timetable is manually compiled, and it is inevitable that there will be omissions. In the original work flow, it is necessary for the bureau and the station to arrange a large number of personnel to check. Not only is it time consuming and laborious, but accuracy is not always guaranteed. Therefore, it is necessary to carry out automated re-inspection. The feasibility analysis of the timetable data is mainly divided into two parts: the interval and the station. Among them, the interval is divided into rationality and feasibility check; the station is divided into capacity test and stop time reasonable test.

After the timetable is executed, the actual performance timetable reflecting the execution of the timetable can be obtained. The performance timetable records the entire execution of the timetable from start to finish. Relevant departments need to collect statistics on their implementation effects, to analyse the smoothness of the execution of the timetable, the level of capacity utilization, the size of the space that can be improved, and so on, to summarize the experience for the next drawing. The above assessment cannot be directly seen, and it is necessary to perform statistical and intelligent analysis on the relevant transportation indicators of the actual performance timetable. Therefore, the indicator statistics and intelligent analysis of the performance chart play a role in providing back-track reference materials and reflecting implementation problems in the work of transport organizations. It is necessary to carry out comprehensive and in-depth research on statistical analysis techniques based on actual performance indicators, and design statistical indicators for statistical indicators and several indicators.

4.3. Intelligent optimization

After data collection and normalization, it provides data support for the platform; safety analysis and indicator analysis make it easy for us to find the advantages and disadvantages of the timetable, laying the foundation for further intelligent optimization. The platform should optimize the following aspects. The number of EMUs directly affects the cost of using mobile equipment during high-speed rail operations.

The number of motor train set directly affects the cost of using mobile equipment during high-speed rail operations. In order to complete the transportation task, the number of motor train set required is not only related to the construction of the connection relationship of the motor train set tasks, but also related to the structure of the timetable itself. Therefore, after finding a reasonable number of trains under the goal of high-density driving, it is of great significance to coordinate the optimization of the timetable structure of the motor train set to improve the input and output effect of the railway enterprises.

The bottleneck of China's high-speed rail timetable is mainly the high-speed railway station, especially the junction terminal. Due to the high level of the high-speed railway station at the important node of the road network, the high wiring and the busy operation of the station, the operation plan of the station directly affects the feasibility and implementation effect of the timetable. In addition, the high-speed rail station operation planning work is complicated. The existing method is still traditional manual or human-computer interaction. It is difficult to consider the robust optimization of the station operation plan. Therefore, it is meaningful to adopt intelligent optimization based on big data.

5. Conclusion

Now, with the rapid development of high-speed railway in China, the management problem of the timetable has become an issue of increasing concern to the railway. Based on the characteristics of big data and based on the problems of current timetable management, this paper proposes the frame of big data platform, including data collection, data normalization, security analysis, index analysis and intelligent optimization. In general, the establishment of a big data management platform based on timetable can solve the problems existing in the current timetable management and ensure the safety and efficiency of the railway.

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