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Research on the Key Role of Data Assets in Operation and Maintenance Retrospective Analysis Under Rail Transit Network Security Control

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Abstract: This paper takes the national railway ticketing system as the research object, and studies the role of data assets in the operation and maintenance retrospective analysis under the network security control situation. Comprehensively sort out the overall scheme of network security operation and maintenance of the railway passenger ticket system, and focus on the significance of data assets with asset accounts as the core in operation and maintenance management, including important links such as asset modeling, status monitoring, log correlation, and fault tracing. Based on this premise, this paper studies the data collection, correlation analysis, and retrospective analysis technology for security operation and maintenance, and explains the supporting significance of the data asset entity model and relationship model to improve the efficiency of fault location and security event analysis. Research and summarize the practical experience of data asset management, operation, and maintenance, and provide a reference for data asset management of other major information infrastructures in network security operation and maintenance.

Keywords: Railway ticketing system; Network security; Data assets; Operation and maintenance traceback

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1. Introduction

The national comprehensive three-dimensional transportation network planning outline issued in 2021 focuses on the main significance of transportation infrastructure safety. As an important operation system in the field of rail transit, the network security guarantee ability of the railway passenger ticket system is very important. This study focuses on the network security operation and maintenance of the railway passenger ticket system, focusing on the analysis of the basic framework of network security, the role of data assets in operation and maintenance management, as well as the asset account and dynamic management. Under the circumstances of policy guidance and continuous expansion of system scale, studying the role of data assets

in operation and maintenance retrospective analysis during network security management and control is not only conducive to summarizing the experience of data asset management of railway ticketing system, but also provides reference for operation and maintenance management of large information systems of the same type, and provides ideas for the integrated development of cross domain data governance framework.

2. Basic theories of rail transit network security and data assets

2.1. Basic framework of rail transit network security

The basic network security framework of the railway passenger ticket system includes many important aspects. From the perspective of system structure, the system forms a multi-layer structure of network layer, system layer, and application layer from the center to the station. Each layer depends on the others and operates cooperatively to ensure the stability of the ticket business. The main technical elements include access control, data encryption, intrusion monitoring, and prevention technologies. Access control restricts illegal access by setting rules and permissions to ensure the rational use of resources by authorized subjects; Encryption means to protect ticketing transactions and system data to avoid data leakage and tampering; Intrusion monitoring and prevention methods detect and block abnormal access in time by continuously monitoring network traffic and system activities [1]. During the implementation of management and control, a relatively complete network security protection scheme for the railway passenger ticket system has been gradually built by formulating a unified security strategy, clarifying the operation and maintenance responsibilities, strengthening the cultivation of personnel's security awareness, and combining with regular security assessment and detection.

2.2. Core status of data assets in operation and maintenance management

Data assets occupy a core position in the operation and maintenance management of the railway passenger ticket system. The data assets mentioned in this paper, in addition to the operation data of servers, networks, and security devices, also involve the information of operation and maintenance objects such as business system solutions, node software, and hardware configuration, service and process status, and related logs [2]. During system operation and maintenance, these data assets together form a comprehensive description of the system operation. On the one hand, the operation data of nodes and processes can reflect the real-time status of the business system and provide support for fault detection and early warning; On the other hand, transaction data and log information can be used to analyze business exceptions and security events, and help the operation and maintenance personnel find the root cause of the problem. Asset accounts and configuration baseline data provide a unified reference standard for operation and maintenance operations to ensure the standardization and controllability of operations. It can be seen that data assets are involved in all aspects of operation and maintenance management of the railway passenger ticket system, which is the main basis for ensuring safe operation and maintenance, and carrying out retrospective analysis.

3. Data processing technology in operation and maintenance retrospective analysis

3.1. Multi-source data collection and fusion technology

To carry out operation and maintenance retrospective analysis under the network security control of the railway passenger ticket system, it is necessary to effectively collect and integrate multi-source operation

and maintenance data. The system operation includes multiple nodes such as bureau-level servers, station terminals, and network and security equipment, with diverse data sources and obvious structural differences. In order to support retrospective analysis, it is necessary to build a collection system including asset static account, operation status, log, and alarm information, and obtain relevant data through agents, probes, and log interfaces. For heterogeneous data, we use data cleaning to eliminate invalid information, use standardized means to unify the data form, and establish the corresponding relationship among assets, states, and events through correlation analysis technology [3]. Through the integration and processing of multi-source data, it can provide relatively complete data support for the retrospective analysis of operation and maintenance, and strengthen the effectiveness of network security control and operation and maintenance analysis.

3.2. Intelligent retrospective analysis algorithm model

In the operation and maintenance retrospective analysis of the railway passenger ticket system, the intelligent analysis model realizes anomaly identification and fault tracing through the study of operation and maintenance data assets. The model takes the asset status, network traffic, and log data as inputs to refine the typical characteristics of system operation to identify abnormal actions that deviate from the normal baseline. In the process of troubleshooting, according to the business scheme and asset association status, reverse reasoning is carried out for performance degradation or business interruption to determine the possible fault node. For example, through the comprehensive analysis of equipment parameters, process status, and network connection changes, and the combination of decision tree, neural network, and other methods, a retrospective analysis model is built to assist the operation and maintenance decision [4]. This model can improve the efficiency of fault location and provide technical support for the safe and stable operation of the railway passenger ticket system through the accumulation of historical data and continuous optimization analysis.

4. Data asset management requirements under the security control of the rail transit network

4.1 Analysis of data asset characteristics

4.1.1. Types and standards of data assets

There are clear and strict requirements for data asset management in the operation and maintenance retrospective analysis of the urban rail transit ticketing system. In the organizational structure and the collection and management process of data assets such as personnel, business systems, network environment (traditional network, distributed network, cloud service), products, and physical devices, nodes, etc., it is necessary to follow the network security and operation and maintenance specifications uniformly. The above data assets show the characteristics of multi-faceted, multi-faceted, and multi-source heterogeneity. The management objects include business, system, network, equipment, nodes, and other aspects. Its accuracy directly affects the effectiveness of operation and maintenance retrospective analysis and security event positioning. At the same time, data assets should maintain a high degree of integrity, focusing on recording the baseline information of hardware, system software, application software, middleware, database under the node, as well as services, processes, ports, network connections, dependent resource files, and other operations, so as to provide a reliable basis for fault tracing and safety audit. Through unified and standardized modeling and association management and control of data asset entities and their access,

Association and log characteristics, the consistency and traceability of data asset baselines can be ensured, providing support for automated security operation and maintenance and retrospective analysis [5].

4.1.2. Construction of the operation and maintenance retrospective data asset relationship chain

In the asset management of the railway passenger ticket system, data assets show obvious characteristics of hierarchy, relevance, and complexity. From the bureau level core to the end of the station, the data assets are structured, including different levels and types of organizational units, business systems, network conditions, equipment, and software nodes. Its association characteristics are mainly reflected in organizational affiliation, physical connection, association, network topology association, and service invocation Association. The complex characteristics are derived from the diversity of data assets, the richness of attributes, and the dynamic change of operation status.

In order to support operation and maintenance backtracking and security incident tracing, a complete data asset relationship chain should be built on the premise of clearly defining the entity attributes of data assets. By establishing an all-factor correlation model from the organization and business system to the supporting software and hardware, and including the network connection and service dependency, we can clearly describe the dependence and influence path between data assets [6]. In case of failure or a safety event, it can carry out rapid backtracking along the relationship chain and accurately locate the root cause and impact area of the problem. This requires the asset ledger to have excellent structural modeling and association management capabilities, ensure the accuracy, integrity, and traceability of data asset information, and provide a reliable data basis for the safe and stable operation of the passenger ticket system and the operation and maintenance retrospective analysis.

4.2. Operation and maintenance monitoring data governance system

4.2.1. Quality control mechanism for operation and maintenance monitoring data

In the operation and maintenance of the railway passenger ticket system, a data asset dynamic monitoring and governance system is established for security control and retrospective analysis. The data quality control mechanism of the system is very important. From the perspective of management requirements, real-time and quasi-real-time data collection mechanisms should be designed. Because the operation status of equipment, process, network connection, and other data assets in the ticketing system directly reflects the business and security situation, any missed acquisition, MIS acquisition, or inaccurate status may affect the accuracy of operation and maintenance judgment and retrospective analysis, so it is necessary to ensure the timeliness and consistency of status data through standardized acquisition methods. According to the defined data asset entities and baselines, it is necessary to formulate status determination and verification criteria, set clear normal and abnormal determination conditions for different types of assets, and identify abnormal conditions that deviate from the baseline through rule constraints. Only through reliable collection and a unified determination mechanism can the dynamic status data be credible and provide effective data support for real-time monitoring, anomaly identification, and operation and maintenance retrospective analysis [7].

4.2.2. Multi-party collaborative operation and maintenance data sharing platform

In the operation and maintenance of the railway passenger ticket system, it is necessary to build an operation and maintenance data collaborative analysis platform that can support data asset governance and operation and maintenance retrospective analysis, so as to realize the unified management and correlation analysis of

asset static accounts, dynamic state data, logs, and event data. The platform needs to carry out standardized access and associated identification of data from different operation and maintenance support subjects in the data aggregation link to ensure the consistency and associativity of data assets. In the field of data storage and processing, it is necessary to have the ability to efficiently process status data and log data, and to support context analysis based on the relationship between data assets. The association between static asset attributes and dynamic operation changes can support the whole process retrospective analysis of fault and safety events according to the timeline, so as to improve the efficiency of problem location and impact analysis. This collaborative analysis platform can effectively improve the utilization efficiency of operation and maintenance data assets, support the safe operation and maintenance, and rapid recovery of complex systems, and meet the main role of operation and maintenance collaboration and correlation analysis in improving efficiency highlighted in [8].

5. Application of data assets in project management

5.1. Security data-driven decision model

5.1.1. Risk assessment data modeling

In the operation and maintenance management of network security control of the railway passenger ticket system, the risk assessment data modeling establishes a dynamic risk assessment matrix by integrating asset vulnerability information, Threat Intelligence, and operation status data. The asset vulnerability information reflects the known vulnerabilities and configuration weaknesses of servers and applications, and the health data includes performance indicators, abnormal alarms, and other instant information. Integrate the two with external threat intelligence, and give weights to different data according to the importance of assets, vulnerability severity, threat activity, and other factors, and establish a matrix [8]. For example, the high-risk vulnerability data of the core business server is provided with a high weight. This matrix can dynamically show the system risk situation, assist the manager to accurately assess the risk, and timely adjust the security strategy or patch planning. The dynamic risk assessment matrix established based on the risk assessment data has become the main basis for safety data-driven decision-making, providing core support for the retrospective analysis of ticket system safety operation and maintenance, and improving the overall operation and maintenance management efficiency [9].

5.1.2. Design of an intelligent warning system

In the operation and maintenance traceability analysis of network security management and control of the railway passenger ticket system, the design of the intelligent early warning system is the main step. Through data assets, the business anomaly early warning decision tree model can be developed through the analysis of asset status and log characteristics. Extract main features from data assets such as performance benchmarks, process performance, and network traffic patterns, and conduct in-depth analysis of these data using data mining and machine learning algorithms [10]. According to the analysis results, a decision tree model is built. The nodes of the model set judgment conditions according to different data characteristics. Once the real-time data reaches the specific conditions, the system can send out an early warning in time. For example, by monitoring the abnormal exit of the core process, the deviation of transaction response time from the baseline, and the increase in the number of abnormal network connections, the decision tree can quickly identify the abnormal trend, provide accurate early warning messages for the operation and maintenance

workers, so as to take countermeasures in advance, prevent business interruption or decline in service quality, and ensure the safe and stable operation of the railway passenger ticket system.

5.2. Digital control of the detection process

5.2.1. Data integration of mobile detection terminals

In the application practice of data assets for network security control of the railway passenger ticket system, the data integration generated by operation and maintenance terminals and tools is very important for the digital control of the detection process. Through the specific technical scheme, it can realize the real-time upload of inspection results, vulnerability scanning reports, configuration verification data, etc., and synchronize with the central platform. The collected data can be quickly integrated by developing a data interface suitable for a variety of operation and maintenance tools and terminals. Ensure that the data is transmitted to the operation and maintenance data platform in a stable and efficient mode through the Railway internal network or a safe channel. A data encryption algorithm is adopted to ensure the security and integrity of data during transmission. A data integration module is built on the platform side to carry out standardized processing and classified storage of the uploaded data, so that the relevant data assets can be quickly and accurately called during the subsequent operation and maintenance retrospective analysis, providing strong support for the operation and maintenance decision, and further improving the efficiency and quality of the safe operation and maintenance of the railway passenger ticket system.

5.2.2. Topology visualization monitoring system

In the operation and maintenance management of the railway passenger ticket system, the topology visualization monitoring system is the main way of digital control of the detection process, which can visually display and analyze the data assets. Based on data assets, this system maps the real-time status and alarm messages of network equipment, servers, terminals, and other assets to the network topology and service topology model. By collecting the online status, link traffic, business service operation status, and other data of the equipment, accurate search and dynamic display can be realized in the visual interface, so that the operation and maintenance personnel can intuitively grasp the overall operation situation of the system, and improve the monitoring and control efficiency. At the same time, by virtue of the data asset relationship model, it can carry out the analysis of fault impact fields and the identification of abnormal situations. In case of failure, it can carry out rapid backtracking analysis according to data assets and topology association, determine the failed node, affected links, and related businesses, provide comprehensive and intuitive data support for operation and maintenance decisions, and indeed improve the efficiency and accuracy of backtracking analysis of the railway passenger ticket system operation and maintenance.

5.3. Project performance data analysis

5.3.1. Quantitative evaluation of detection efficiency

In the operation and maintenance of network security management and control of the railway passenger ticket system, the quantitative evaluation of operation and maintenance efficiency is very important for the application of data assets. By building a KPI system including fault discovery timeliness (mttd), fault repair timeliness (MTTR), and other aspects, the scientific quantification of operation and maintenance efficiency can be achieved. For example, MTTR can accurately measure the length of time from failure to business recovery. A shorter repair time represents a higher operation and maintenance efficiency. Data assets

accurately record the occurrence, response, processing, recovery time, and other relevant data of each event. Through in-depth analysis, we can gain insight into the long-term links in the operation and maintenance process and further carry out targeted optimization. In terms of compliance rate, the actual configuration will be compared with the compliance status of the security baseline, and the relevant data of configuration verification will be recorded through data assets to analyze the causes of deviation, so as to carry out timely rectification, improve the quality and efficiency of operation and maintenance, ensure the stable operation of the ticket system under the established SLA standards, and fully reflect the value of data assets in the quantitative evaluation of operation and maintenance efficiency.

5.3.2. Path of data value conversion

In the operation and maintenance work of network security management and control of the railway passenger ticket system, it is analyzed that the operation and maintenance data has the main way of data value conversion in fault tracing and preventive maintenance. In the fault processing stage, the deep correlation analysis of logs, monitoring, and topology data in data assets can quickly locate the root cause, reduce the duration of business interruption, further avoid the economic losses caused by long-term shutdown, and realize the transformation of economic value in business continuity guarantee. In the preventive maintenance phase, data assets can help identify performance deterioration trends and potential risks, analyze their causes, transform passive response into active intervention, reduce the probability of major failures and the consumed emergency resources and costs, and help improve the overall reliability of the system, save potential losses for enterprises, create more economic benefits, and ultimately promote the optimization of operation and maintenance costs and benefit improvement of the passenger ticket system in the whole life cycle.

6. Conclusion

Through the research on the data assets of the railway passenger ticket system in the context of rail transit network security control in the retrospective analysis of operation and maintenance, we can conclude the data asset governance concept based on the entity model and relationship model of data assets, with the asset Ledger as the core, supported by status monitoring and log analysis, and with the purpose of retrospective analysis. This idea focuses on asset modeling at all levels, from organization, system, network, equipment, to process and log, providing clear and verifiable data support for operation and maintenance backtracking. The relevant practice has important enlightenment value for the operation and maintenance management of other large-scale major information infrastructures, which is conducive to the establishment of a data management system for the full life cycle of assets, improving the ability of asset state perception, dependency identification, and problem location, and further improving the accuracy and efficiency of fault and safety event retrospective analysis.

From a more macro perspective, the asset data governance scheme for operation, maintenance, and security has strong versatility. Although there are differences in business models and technical conditions among various industries, they have common features in the core logic of asset identification, relationship establishment, baseline control, and retrospective analysis. Future research can further focus on the standardization of data asset models and the establishment of automated operation and maintenance capabilities, explore data asset governance solutions with reusability and scalability, and promote the value of data assets in ensuring safe operation and maintenance and stable business operation.

Disclosure statement

The author declares no conflict of interest.

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