# Research on Ticketing Data Information Management System

**Ming Lei, Yu Zhang, Guiqin Ouyang**

The Third Operation Branch Company Affiliated with Beijing Mass Transit Railway Operation Corp. Ltd, Beijing, 100082, China

**Keywords:** Informatization, Ticket, Specification, Subway

**Abstract:** With the development of informatization and the continuous improvement of the network operation pattern of metro, metro has entered a new stage of development. Ticketing information has become the management of fine management consensus. In order to solve the problem of tedious, delayed time, high error rate, inconvenient statistical analysis and consumables in the ticketing work in the traditional mode, build a ticketing data informatization management system can help improve operational efficiency, reduce personnel and material costs, optimize resource utilization, and improve work efficiency. At the same time, optimize the multi-level management mode and workflow of ticketing, and establish a good business logic and working model could provide favorable guarantee for standardizing ticket management and strong support for improving the information level of first-line ticket management and also improving the quality of subway operation services as well. Through rigorous scientific management and advanced effective working methods, we will play the role of informatization, integrate and optimize resources, standardize management, save labor costs, improve operational efficiency, and better provide quality services for passengers.

## 1. Introduction

With the development of information technology and the continuous improvement of the subway network operation pattern, the subway has entered a new stage of development. Informatization of ticketing work has become the consensus of the management of fine management, concerning cash income management and audit management of income work [1]. In order to solve the problems of cumbersome ledger process, time delay, high error rate, inconvenient statistical analysis, more consumables, and inability to monitor the ticket inventory caused by imbalanced passenger flow direction [2] in the traditional way of ticketing. Building an information management system for ticketing data will help improve operational efficiency, reduce personnel and material costs, optimize resource utilization, and improve work efficiency. At the same time, it optimizes the multi-level ticket management mode and work process, and establishes a good business logic and work model, which provides a favorable guarantee for standardizing ticket management, and provides strong support for improving the information level of frontline ticket management and improving the quality of subway operation services . Through rigorous scientific management and advanced and effective working methods, we will play the role of informatization, integrate and optimize resources, standardize management, save labor costs, improve operational efficiency, and better provide quality services to passengers.

The ticketing data information management system realizes the information management of ticketing data through network technology, statistical analysis and other technologies, and automatically completes data verification and inspection, threshold warning, data audit and other functions. It also covers invoice management, IC card management, one-ticket management, and backup A series of functions such as gold management, ticket and card allocation, inventory management, system reports, etc.

  DOI: 10.25236/mmmce.2020.024

## 2. Demand Analysis

### 2.1 Functional Requirements Analysis

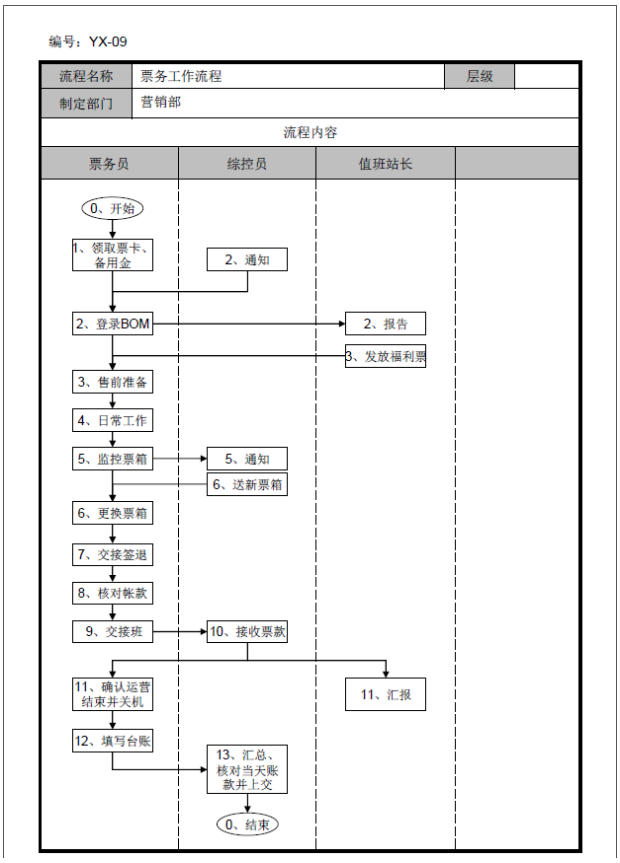


Fig.1 Workflow Diagram

Ticket business is divided into three levels from the management level: company level, station area level, and station level; from the type to four categories: invoice business, one-ticket business, IC card business, and cash business. Invoice business includes: application, receipt, registration, allotment, return, inventory, stub handing in, etc.; one-way ticket business includes: counting the number of lost days, applying for allocation, issuing distribution plans, receiving faulty tickets, handing in faulty tickets, and receiving , Registration, inventory, implementation of deployment; IC card business includes: application for deployment, issuing distribution plans, receiving and returning cards, handing in and returning cards, receiving faulty IC cards, handing in faulty IC cards, receiving white cards, registration, allotment, and inventory ; Cash business includes: reserve fund receipt, reserve fund application, reserve fund allotment, reserve fund adjustment, reserve fund delivery to the company, reserve fund use, reserve fund return, ticket receipt, ticket payment verification, ticket difference investigation, Ticket payment; other business: emergency paper ticket allotment, emergency paper ticket application, emergency paper ticket delivery, emergency paper ticket reception, emergency paper ticket registration, management of certification card distribution, management of certification card recycling, management of certification card Receive and manage certification card registration, and manage certification card inventory.

The system functions are based on ticketing rules and regulations and work processes, and the existing paper ledgers and processes are optimized and integrated on the basis of the rules and processes. System login uses employee card number. The data retention period shall meet the company's data retention requirements. At the station level, mobile devices are used in the ticket office to meet the needs of the ticketing post (such as welfare tickets, invoices, post settlement) to fill in, while taking into account the convenience, it has wireless network transmission.

In order to meet the requirements of the above-mentioned business types, the functions that need to be developed mainly include the post management module, the ticketing handover module, the

material allocation module, the inventory management module, and the statistical analysis module. The main function of the post management module is to complete the receipt and transfer record functions of invoices, reserve funds, IC cards, etc., and to supplement functions such as reserve funds, all-in-one cards and invoices. The ticket transfer module is mainly the record management of the transfer of AFC job posts. The material allocation module completes the management of reserve funds, invoices, IC cards, and one-ticket pass applications, receipts, allotments, warehousing, and issuance. Inventory management mainly manages the inventory of Yitongtong, IC card, invoice, reserve fund and ticket payment. Statistical analysis mainly includes statistical reports such as station daily settlement, station area daily settlement, post handover record, ticket handover record and so on. The functional module is shown in Figure 2.


Fig.2 Functional Module Diagram

### 2.2 Performance Requirement Analysis

The system supports 200 concurrent users, with no less than 1,000 registered users, the response time for opening the interface and submitting transactions is less than 1 second, the processing time for simple thousands of data in online real-time query business operations is less than 3 seconds, and the software deployment is simple. The system supports 7×24 hours of continuous work, business availability reaches 99.9%, network availability reaches 99.9%, and the mean time between failures MTBF is greater than 20,000 hours. The security protection level of system equipment security, software security, network security, data security, etc. complies with “Computer Information System Security Protection Level Classification Guidelines” (GB17859-1999) [3]

## 3. System Design

The ticketing information system should be applied to multiple lines under the jurisdiction of the operating company, so the reasonable needs of the operating company should be fully considered in the design, and the functional positioning should be grasped [4]. The system adopts the B/S architecture, the server is deployed in the company's information computer room, the data is transmitted through the OA network, the workstation is deployed in the company marketing department, station area ticket office and station ticket office, the mobile terminal equipment is in the station ticket office, and data is carried out through wireless router Interactive. The communication between the wireless router and the mobile device uses 5G signals. The system topology is shown in Figure 3. The station ticket office is equipped with a workstation to query the system’s own station data, and the query results can be exported and printed. When the conductor is on duty, he uses the mobile terminal to process and enter passenger handling information, and when off duty, he enters post settlement and other information. A workstation is installed in the ticket office of the station area to query the data of the station area in the system, and the query results can be exported and printed. The company’s marketing department is equipped with workstations to query the company’s data, and the query results can be exported and printed.

### 3.1 Architecture Design

In order to limit the dependencies between subsystems, reduce the coupling degree of system modules, improve the maintainability of the application, and make it easier to expand and improve the performance, the system adopts layered architecture [5]. Specific level is divided into: man-machine interaction layer, service module layer, basic service layer. Man-machine interaction layer includes: post settlement, ticketing handover, material allocation, inventory management, statistical statements, and other businesses. The service module layer includes one-way ticket management, IC card management, invoice management, cash management, work ticket management, emergency paper ticket management, process management, authorization management. The basic service layer includes: report service, historical data service, user service, log service, data synchronization service, authority management. The system adopts a layered architecture, which means grouping the programs into groups: application-specific functions are located at the upper level, functions that span application domains are located at the middle level, and configuration environment-specific functions are located at the bottom. Layers logically divide subsystems into many sets, and the formation of inter-layer relations must follow certain rules. By layering, you limit dependencies between subsystems, making the system more loosely coupled and thus easier to maintain. A subsystem in the same layer can only be dependent on the system of the current layer and the system of the next layer. For example, the service module layer can access the service module layer and the base service layer, but the base service layer cannot access the service module layer. After the architectural design is completed, the detailed design of the system is carried out and the detailed design is reviewed [6].

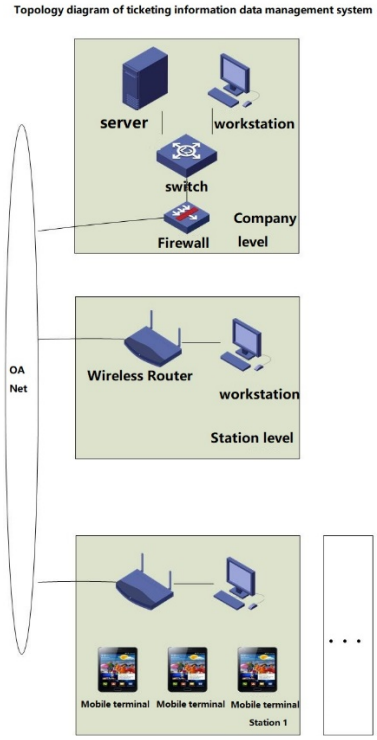


Fig.3 System Topology

### 3.2 Main Technique

The system uses MySQL database. MySQL database is a relational database, widely used in Internet systems, with its small size, high speed, and open source code. The framework adopts Spring + Springmvc + Mybatis + Shiro + Ehcache open source framework. This framework is very flexible, non-invasive, and configurable. It includes controllers, validators, command objects, model objects, handler mapping view parsers, etc. The realization of each function is completed by a dedicated object. Support multiple view technologies to simplify the development process. The mobile terminal is developed using the MVC framework. M refers to the data model, V refers to the

interface display, and C is the controller. The purpose of using MVC is to separate the realization of M (data model) and V (interface display) and improve page interactivity. The Apache + Tomcat container is used, which is characterized by a wide range of use, stability and reliability.

### 3.3 Permission Design

In order to adapt to the current situation of frequent personnel transfers and higher levels of authority. When designing authority management, the authority is divided into two types: data authority (as shown in Table 1) and operation authority (as shown in Table 2)

Tab.1 Data authority management

| | Station ticket clerk | Interstation interval ticket clerk | Company ticket clerk |
|---|---|---|---|
| Station data | Have | Have | Have |
| Interstation interval data | No | Have | Have |
| Company-wide data | No | No | Have |

Tab.2 Operation authority management

| | Station ticket clerk | Station Ticketing staff | Interstation interval Ticketing staff | Company Ticketing staff |
|---|---|---|---|---|
| Mobile terminal operation | Have | No | No | No |
| Job management | No | Have | No | No |
| Ticket Handover | No | Have | No | No |
| Material allocation | No | Have | Have | Have |
| Inventory management | No | Have | Have | Have |
| Report | No | Have | Have | Have |
| other | No | Have | Have | Have |

Data authority is to divide all data. Station level personnel can only view the data generated by the station, station level can only view the data of the station area and the station under the jurisdiction of the station area, and the company level can view all data under the jurisdiction of the company. . Operation authority is the division of authority for system interface menu operation. Authority is divided for each page and operation. Station ticket attendants can view and operate the business interface of station ticket attendants, and station zone ticket attendants can view and operate station zone tickets. Staff’s business interface. When designing a role, a role can correspond to multiple permissions, including data permissions and operation permissions. In actual business, positions are associated with roles. Each position can have multiple different roles, and each role contains different permissions. Then through the user authorization to complete the different permissions of different login users. When the user's position is adjusted, the authority is changed by changing the authorization.

## 4. Business Realization

Subway ticketing management can be abstracted into a model of inventory and personnel transfer management. The company's marketing department, station area ticket office, and station ticket office are divided into three levels of warehouses to store invoices, one-ticket passes, IC cards, and reserve funds. The staff work in four shifts a day. When the staff is handed over to and from get off work, the responsible items should be counted and handed over and recorded.

When the one-ticket pass and IC card at the station are sold to passengers, they receive a ticket of the same value. At this time, corresponding to each sale, a piece of inventory change information is recorded, and the real-time inventory changes at the same time. When the invoice, one-ticket pass, and IC card inventory are below a certain level When the safety threshold is high, the station ticket attendant needs to apply for materials through the material allocation function. The station ticket attendant allocates materials or allocates materials from other stations according to the situation of the station area. If the station area is insufficient, it will apply to the company Material request. In order to track the entire process of invoices and other items, each step of the application and

distribution are recorded, and the entire process of any invoice can be tracked in the inventory list. From entering the company's inventory, to the station area inventory, to the station warehouse, to deposit to the passengers, and then to the stub to return to the company in turn.

In addition to the inventory management of invoices, one-ticket pass, IC card, and reserve funds, it is also necessary to clearly record the handover of personnel. The system records the transfer of goods between the conductor and the station ticket clerk to work. If the goods are not enough during the time, the system will make an additional record and return the record of the goods when off duty. It ensures that the accounts between the ticket seller and the station ticket clerk are clear. In addition, because the original account has the same data repeatedly, there is no need to repeat the same data in the system, and the system directly calls the records. When handing over between the station ticket clerk and the station ticket clerk, the information of all the items in the current warehouse and the items that have been issued are clearly recorded. At the end of the daily operation, it is necessary to carry out statistical summarization of the operation situation of the day, and the system will automatically complete the statistical summarization, saving staff time. The material allocation process between the station ticket clerk and the station area fare clerk is recorded throughout the entire process. The station area fare clerk can receive the fare at the station and can consult the ticketing data of each station in the station area. The material allocation between the station area fare clerk and the company's marketing department is also recorded throughout the entire process, and the company's marketing department can view the company's ticketing data. The system interface is shown in Figure 4.

Due to the risk of loss of ticket revenue, investigation and evidence collection is more difficult [7], so the audit of the system is retained, and the data interaction is backed up and stored. The interface data generated when the mobile terminal, workstation and back-end server are interacted are stored in In the server, when there is a problem in the business, the problem in the business process can be audited through the log. The log retention time is the most recent 12 months, and the logs are stored on a monthly basis. Each time a new log is added, first check whether it exceeds 12 months. If it exceeds 12 months, delete the log of the earliest month. When the log exceeds 500G, the system pops up to remind the staff to proceed. deal with.

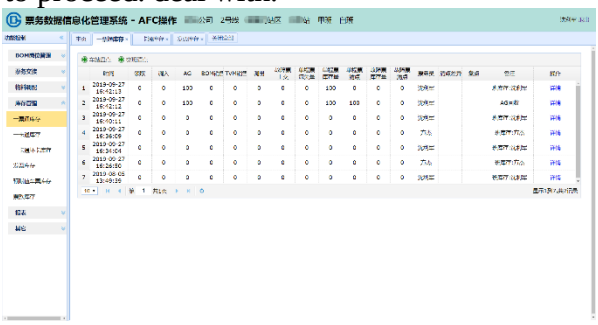


Fig.4 System Interface

In the actual development process, problems with cross-calendar data statistics were discovered. The current subway operating time generally exceeds 0 am, and the end time has reached more than 1 am at the latest. The operating data during this period should be included in the statistics of the previous day. Later in the system, the time was managed by operating time and natural time[8].

## 5. Conclusion

The subway ticketing information system realizes the three-level hierarchical and sub-authority management of the company, station area, and station, and realizes the rapid recording of ticketing data, business processing, data query, verification, statistical analysis and other functions, and solves the printing and production of paper ledgers. In the process of filling and archiving, the process is cumbersome, the error rate is high, it is inconvenient for statistical inquiry, it takes up a lot of space, and the problem of more consumables [9].

To sum up, the subway ticketing information system has strong practical significance. It monitors

the operation of station ticketing as a whole, integrates and optimizes resources, and installs all business processes in the system, so that personnel work is standardized and management is precise [10]. This system needs to study how to deal with the parallel efficiency of multi-threading and the security issues when connecting with other systems.

## References


[1] Chen Yu (2009,). On the Ticket Work 0rganization and Management of Urban Rail Transit. Urban rapid rail transit, vol.22, no.6, pp.55-57.

[2] Ding Geng, Lu Shuguang, Liu Le (2007). On the Ticket Affairs of AFC System for Multi-line Operation. Urban rapid rail transit, vol.20, no.1, pp.26-29.

[3] Criteria for classification of security protection level of computer information system: GB17859-1999.

[4] Zhang Weixi (2016). Main Points of Design Work on the Basis of an Analysis of the Service for Rail Transit Construction. Urban rapid rail transit, vol.29, no.4, pp. 71-74.

[5] Software engineering-Specification for software development cost measurement: GB/T 36964-2018.

[6] Guidelines for computer software product development documentation: GB/T 8567-1988.

[7] Chen Min (2019). Research on the safety management of ticket revenue of Urban Rail Transit. Enterprise Reform and Management, vol. 2019, no.11, pp.219-220.

[8] Liu Chunhong (2019). Ticket management system of Kunming Metro with application analysis. Enterprise Reform and Management, vol.2019, no.09, pp.45-45+50.

[9] Wang Zhipeng (2016). Research on ticket management of metro station. Intelligent City, vol.2016, no.05, pp.153.

[10] Tang Wenbi (2014). Analysis of ticket management in metro station. Technology Innovation and Application, vol.2014, no.18, pp.275.