Application of High-speed Railway Digital Asset Management Based on Spatial Information Technology

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01 Introduction
Our Team

A group of young people with geographic thinking to explore the application of railway industry from the perspective of geospatial big data.

- Start from 2013, We focus on Natural Resources, City’s Construction & Management.

- From 2015, We focus on Transportation, Road and High-speed Railway, especial Digital Asset Management.
High-speed rail asset management is becoming more important.

In 2020, China's high-speed railway operation mileage will reach 30,000 kilometers, forming a high-speed railway network of eight vertical and eight horizontal, covering all cities with a population more than 500,000.

The scientific management of high-speed railway assets is the main task of enterprises. How to improve operational capacity and reduce costs have become an urgent need of enterprises.

High-speed railway asset equipment management is a multi-disciplinary integrated management system, is the basis for efficient operation, scientific operation and maintenance of railway enterprises.
Railway Digital Asset Management Platform Based on Spatial Information Technology
Effect of Spatial Information Technology

Unified coordinate
Provide the basic information, technical information, equipment status information and surrounding environment information to unified coordinates

Unified integration
Provide unified integration of information on the basis of unified coordinates

Unified dimension
Building three unified dimensions of components, equipment and assets

Unified analysis
Based on information integration, perform spatio-temporal analysis of multi-source data, to provide a basis for asset science management

Who  When  Where  Why  What

Spatial location
Data Collection

Paper blueprint  On-site account  Electronic blueprint

Two-dimensional data  Three-dimensional data

Spatial information collection based on basic data
Data Structure of Railway Digital Asset Management Platform

- Geodatabase
- Power Supply
- Communication
- Signalling
- Permanent way
- Passenger Service
- Water Supply
- Housing Construction

Functional location system classification model:

- Component location
- Equipment location
- Device location
- Management position

Position of function layer vs. Linked property:

- Entity attribute of Bridge
- Entity attribute of span structures
- Entity attribute of Abutment
- Entity attribute of pile foundation
- Entity attribute of cushion cap
- Entity attribute of beam
- Entity attribute of Bearing
Data Integration

All kinds of basic information are integrated through the unified spatial position coordinate system of equipment facilities. Providing quick and efficient access to basic information for overhaul monitoring, event handling and maintenance decisions.

What Our Platform Do

1. Basic Data integration
2. Quickly Data Search
3. A wealth of related information
Data Results
System Architecture of Railway Digital Asset Management Platform

Access Layer
- APP Access
- Browser Access
- Mobile Access
- System Access Interface

Application Layer
- Position Management
- Space-time Analysis
- Network Analysis
- Asset Integration
- 3D Viewing
- View control
- Location
- Position
- Spatial query
- Fixed Assets Management
- Device Management
- Comprehensive Analysis

Network Layer
- Network Device
- Host System
- Storage System
- Workstation & Auxiliary Equipment
- Handheld Device

Hardware Layer
- Network Device
- Host System
- Storage System
- Workstation & Auxiliary Equipment
- Handheld Device

Data Resource Layer
- Space Database
- Basic Database
- External Data DB
- Unstructured Data

Informa on Processing Layer
- WEB SERVICE interface
- DBLINK interface
- FTP interface
- HTTP interface

Integrated Environment of Database
- 2D GIS
- 3D GIS

Other Network
- Access Frontend
- Firewall/AGAP
- LAN
- Access Frontend
- Railway Internal Service network

System Architecture Diagram

Textual Content
- Network Layer
- Hardware Layer
- Data Resource Layer
- Information Processing Layer
- Application Layer
- Access Layer

Diagram Components
- Switch
- Server
- Backup Device
- Portable Computer
- Tablet PC
Functions of Railway Digital Asset Management Platform

High Speed Railway Digital Asset Management Platform

Location Management
- Location of Ledger
  - Location of Professional Ledger
  - Location of Device Type
- Mileage Location
  - Point Location
  - Section Location
  - Around Search
- Management Section Location
  - Spure Parts
    - Inventory

Spatial Analysis
- Inundation Analysis
  - Environmental Display
  - Inundation Analysis
- Rescue Path Analysis
  - Joint Analysis

Association Analysis
- Logical Association
  - Power Supply Logic Analysis
  - Communication Device Logic Analysis
- Track Slab Unit Management
- Subgrade Unit Management
- Pillar Unit Management

Information Integration
- Fixed Assets
  - Fixed Assets Management
  - Renovation Management
- Basic Information
  - Ledger Information
- Field Picture
  - Technical Information
    - Completion Materials
    - Technical Drawings
  - Real-Time Video

Device Status
- Fixed Assets
- Comprehensive Inspection
  - Manual Inspection
- Maintenance Commitment
  - Operation and Maintenance Record
  - Maintenance Result

Surrounding Environment
- Issue Report
- Regional Analysis
03 Application and practice of asset management in high speed railway enterprise
Function Implementation

7 First-level Functions, 23 First-level Functions, 614 Function points
Function Implementation

- Device Management, Query, and Location
- Device Interrelationships Association
- Detecting and monitoring Dynamic States
- Supervision of Maintenance
- Spatio-temporal Analysis
Function implementation

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Innovation and Application Effect of Digital Asset Management Platform
Key Technologies and Innovations

Data modeling of multi-source & heterogeneous

Realizing spatial information modeling for refine management requirements of high-speed railway operation and maintenance. At the same time, solving the stratification of asset management and equipment management, and realizing data fusion of multi-dimensional information.
Key Technologies and Innovations

Unified integration coordinates of high-speed railway asset equipment information

Under the uniform coordinates of the spatial position, to realize the integration of basic data, technical data, equipment testing, maintenance and other information, and promote the exchange and sharing of information among railway professions.
"Two & three-dimension + reality" multi-scale high-speed railway digital asset equipment virtual environment combined with BIM technology

Combining large scene GIS environment with refined BIM model, to realize digital simulation of entire asset from geographical environment to the micro-components, and form a digital twin high-speed rail model.
Key Technologies and Innovations

Spatio-temporal big data analysis of high-speed railway equipment and surrounding environment

Construct a fusion channel between high-speed railway equipment and social data such as population, meteorology and environment, to realize spatio-temporal dual-dimensional big data analysis for high-speed railway operation and maintenance.
Correlation analysis of logical relation and spatial location

Based on the relationship of geographic information and logical topology, to realize the joint analysis of logical association and equipment location of the high-speed railway assets equipment, and auxiliary equipment troubleshooting.
Application effect of digital asset management platform

In the two stations and one interval - 57 km, platform:

1. Manages 7 majors, 39 sub-professionals, 311 categories of high-speed rail equipment.
2. Collects 199020 basic data, 6360 blueprints of various professions.
3. Forms a model library of 96-class high-speed railway asset equipment.
4. Sets up high-precision digital twin high speed railway equipment environment with size of 160GB.
5. Forms 2 standard processes and 1 set of technical specification.
Application effect of digital asset management platform

**Before**

- The files are classified into 8 professions and 5 major categories.
- Data retrieval takes **several days**
- Device status information belong to more than 50 application systems
- Disease prevention depends on **experience**
- Environmental safety depends on **people's eye**

**After**

- Digital **integration** of technical data
- Indexed in real geographic location, retrieval takes **few seconds**
- Device status is **unified**
- Equipment disease environmental indicators quantified, disease prevention accuracy increased by **42%**
- Digital environment simulation, work efficiency increased by more than **41%**
Thank You!