DESIGN AND ESTABLISHMENT OF QUALITY MODEL OF FUNDAMENTAL GEOGRAPHIC INFORMATION DATABASE

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ABSTRACT:

In order to make the quality evaluation for the Fundamental Geographic Information Databases(FGIDB) more comprehensive, objective and accurate, this paper studies and establishes a quality model of FGIDB, which formed by the standardization of database construction and quality control, the conformity of data set quality and the functionality of database management system, and also designs the overall principles, contents and methods of the quality evaluation for FGIDB, providing the basis and reference for carry out quality control and quality evaluation for FGIDB. This paper designs the quality elements, evaluation items and properties of the Fundamental Geographic Information Database gradually based on the quality model framework. Connected organically, these quality elements and evaluation items constitute the quality model of the Fundamental Geographic Information Database. This model is the foundation for the quality demand stipulation and quality evaluation of the Fundamental Geographic Information Database, and is of great significance on the quality assurance in the design and development stage, the demand formulation in the testing evaluation stage, and the standard system construction for quality evaluation technology of the Fundamental Geographic Information Database.

1. INTRODUCTION

The Fundamental Geographic Information Database (FGIDB) is a basic platform for national economic and social informatization, while the Geo-informatization constantly proposes new application demands for the construction of FGIDB. With the development of computer technology, spatial database and geographic information technology, great changes have been seen in technical indicators and achievement system for the construction of FGIDB. As a result, based on the realistic demands of quality control and quality evaluation for the FGIDB, fully considering the advancement, safety, openness, expansibility and compatibility of database system, studying and designing the quality model and quality evaluation method for the FGIDB, not only can provide the guiding suggestion on the construction of the new-type FGIDB, but also can offer the technical reference for carrying out the quality control, inspection and evaluation of the FGIDB.

2. EVALUATION PRINCIPLE

2.1 Comprehensiveness

As conducting the quality test, inspection and overall evaluation for the FGIDB, the evaluation objects includes the database model and structure, database construction method and quality control, function and performance of DBMS, as well as dataset quality. Faced with the differences of the above-mentioned evaluation objects, it is necessary to carry out a comprehensive and overall quality evaluation from the standardization of database construction and quality control, the conformity of dataset quality to the functionality of database management system, which follows the principle

2.2 Feasibility

Based on the structural features of the FGIDB, considering the restrictions on application demands, technical means, as well as software and hardware conditions in the construction and development period of each database, it is not suitable to measure database quality level depending on current technical standards, hardware and software development status quo. As a result, database quality evaluation must insist in the principle of reality, which requires full reference to the database construction demands, designing and conditions at that time, designing testing contents, indicators and methods scientifically and rationally, to evaluate the conformity of database construction design and the compliance with relevant technical standards.

3. QUALITY MODEL

In order to evaluate the quality of the FGIDB more comprehensively, objectively and accurately, based on the demands of the database construction quality control and quality evaluation of the FGIDB, under the guidance of the principles such as comprehensiveness and reality, this paper constructs the quality model of FGIDB, which is composed of 3 quality elements including the standardization of database construction and quality control, the conformity of dataset quality and the functionality of database management system, as well as 16 evaluation items.

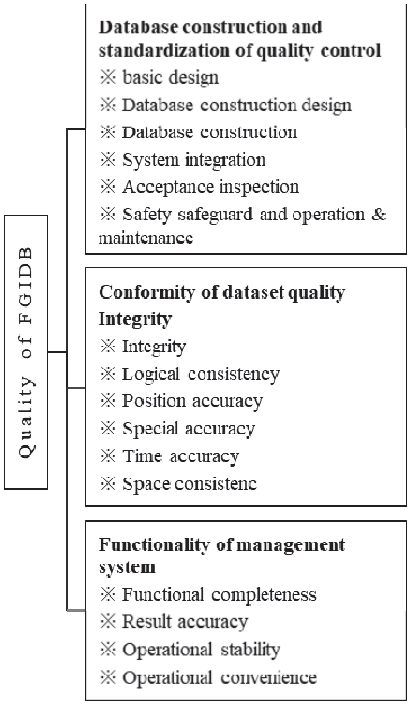

Figure 1. The Quality Model of FGIDB

3.1 The Database Construction and Standardization of Quality Control

The key is to test and evaluate database construction and quality control of the FGIDB from 2 aspects, including the standardization of database design and construction process, the standardization of database operation and construction design.The database construction and quality control testing evaluation ranges get involved in basic design, database construction design, database construction, system integration, acceptance, safety safeguard and operational management. The testing evaluation contents and evaluation requirements are present in Table 1. By combining with 18 specific testing items and referring to database construction and relevant code requirements, the specific evaluation indexes are confirmed to do standardization evaluation on various test results of database construction and quality control.

For all testing evaluation items, by using the analysis method relevant design documents, the physical operation situation of the database is combined to do standardization test, obtaining the evaluation results of “standardized”, “basically standardized” and “non-standardized”.

Evaluation items	Testing contents	Evaluation requirements
Basic design	Spatial reference	Apply the uniform geographic space reference system stipulated by the nation, such as geodetic datum, height datum, depth datum, gravity datum, projection and zoning.
	Time reference	Date format and time format satisfy database construction design and relevant standard requirements
Database construction design	Document data	Complete document data and contents and compilation standards
	Demand analysis	Conduct demand investigation and analysis and compile a report
	Conceptual design	By aiming at different types of data features in the database management, construct the conceptual data model
	Functional design	Fully consider user demands and functional completeness and carry out the database management system function design(database management system function design is the basis to designate the database management system function testing range)
	Logical design	Construct the logical database model and confirm organizational forms of data
	Physical design	Software modeling design: facing to the application demands, give the standardized modeling for the operating system, database software platform, GIS software platform, middleware and application software
		Hardware modeling design: facing to the application demands, give the standardized modeling for input output equipment, data processing equipment, data storage and backup devices
		Network modeling design: facing to the application demands and safe and reliable requirements of network system, give the standardized modeling for the network framework, network equipment and network system
	Safety design	Carry out the standardized safety design in physical environment, safety protection, cryptosecurity, backup and recovery strategy
Database construction	Database construction process	Step and process standardization of data preparation, database construction, inspection before data storage, data disposal, inspection after data disposal, data storage and inspection after database storage
System integration	Integration testing	Carry out the necessary integration testing
Acceptance	Acceptance testing	According to requirements of the client, give the necessary third-party acceptance testing for database system before acceptance
	Acceptance work	Carry out the database acceptance as the requirements of the client
Safety safeguard and operation maintenance	Operation management	Construct and effectively execute the database operation management system in security management, database operation management and working environment management
	Performance optimization	According to database operation situation, suitably and rationally adjust the corresponding parameters and configuration to ensure high-efficient operation
	Maintenance upgrading	According to database operation situation and physical demands, carry out the standardized hardware and software maintenance and upgrading

Table 1. The Testing Evaluation Ranges and Requirements of Database Construction and Quality Control.

3.2 Conformance Evaluation of Dataset Quality

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The evaluation items of dataset quality include integrity, logical consistency, position accuracy, special accuracy, time accuracy, and spatial accuracy. For digital line graphic, digital elevation model(DEM), digital orthoimage and topographic map drawing

data in database management, according to the testing ranges stipulated in Table 2 and database construction design or relevant standard requirements, results of each testing item in the dataset are conducted the conformance evaluation, giving the single testing evaluation result of "conformity", "basicly conformity" or "inconformity".

The main reference basis of dataset testing evaluation is the database construction and technical summary, including project design books, task commission contract, technical summary report, relevant standards, specification and technical stipulation. Testing methods mainly include report auditing, quality testing conclusion affirmation, statistical check and human-computer interaction check. The physical truth should be based on testing contents and requirements to select one or multiple integrated testing methods. When it is hard to obtain the testing results in report auditing and quality inspection conclusion, the necessary statistical check and human-computer interaction check methods can be used.

Evaluation items	Testing contents
Integrity	Whether data coverage area, data size, mapsheet number, vector data layer, vector data attribute item, and vector data elements are consistent with database construction design.
Logical consistency	Whether plane coordinates, height system, projection(zoning), framing(slicing), data organization structure, data format, vector data layer naming, vector data attribute item definition, vector data element hierarchy, vector data element expression and relationship between elements conform to database construction design requirements.
Positional accuracy	Whether data accuracy, graphic connection, DOM resolution ratio, DEM starting-ending point coordinates and gridding size, map margin size and mapborder point coordinates within drawing data, square rid size or coordinate precision in drawing data conform to database construction design requirements
Special accuracy	Whether DLG data attributes, DEM elevation value, DOM image quality and marking quality of drawing data conform to database construction design requirements
Time accuracy	Whether data presentalism conforms to the database construction design requirements
Spatial consistency	Elevation consistency between DLG and DEM, positional consistency between DLG and DOM and expressional consistency between DLG and elements between drawing data

Table 2. Conformance Evaluation of Dataset Quality

3.3 Functional Evaluation of Management System

The testing range for functionality of the FGIDB covers management function and service function of database system and gets involved view expression, inquiry index, spatial analysis, database storage, disposal and output, database management and maintenance, and system management.

The functional testing of management system includes completeness of system functions, stability of system operation, convenience of system operation, and accuracy of system operation results. In the specific functional testing, based on functional design of each basic geographic information database system function, testing items and testing indexes are respectively formulated to confirm testing function points or functional stream by referring to the system operation manual. The testing example is compiled to complete the functional testing. Stability of system operation, convenience of system operation and accuracy of system operation results are completed together.

The functional testing of management system mainly applies document auditing, operation demonstration and operation testing. Operation testing applies the black-box testing. By referring to evaluation indexes of each testing item, testing results of each testing item are evaluated to give the single-item test result of "pass", "basicly pass" or "not pass".

Functional Module	Functions
View expression	Basic view operation, view positioning, bookmark management, overlaying display of vector and grid, layer control, symbol configuration management and projection setting
Query index	Geometrical condition query, spatial positional condition query, element attribute condition query, spatial condition query, metadata condition query and combined condition query
Spatial analysis	Spatial measurement, statistical analysis, buffer analysis, overlay analysis, DEM analysis, statistical image data analysis
Data storage	Data pretreatment, storage inspection, database construction and data storage
Disposal and output	Data extraction, data transformation, data splicing, format conversion, image adjustment, data disposal, map drawing and distribution services
Database management and maintenance	Vector database management, DEM database management, image database management, drawing database management, meta-database management, symbolic library, historical library management and database statistics
System management	User management, log management, data backup and recovery

Table 3. Functional Evaluation Range of Management System

4. CONCLUSIONS

According to the basic geographic information database system structure, we start from database construction and standardization of quality control, conformance of dataset quality and functionality of database management system. This paper designs the quality elements, evaluation items and properties of the FGIDB gradually based on the quality model framework. Connected organically, these quality elements and evaluation items constitute the quality model of the FGIDB. This model is the foundation for the quality demand stipulation and quality evaluation of the FGIDB, and is of great significance on the quality assurance in the design and development stage, the demand formulation in the testing evaluation stage, and the standard system construction for quality evaluation technology of the FGIDB.

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