Construction and Empirical Analysis of Information Management System of Engineering Investigation Quality

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Abstract. The information management of engineering investigation quality is actually the process of producing, collecting, inputting, sharing and applying engineering investigation parameter data and management information. Using the theory of total quality management and the information technology such as blockchain, big data and cloud computing, this paper explores the possibility of constructing the information management system of engineering investigation quality from "data standard of engineering investigation quality information", "information management platform of engineering investigation project" and "geological information database of Engineering Investigation", and takes Chongqing as an example to carry out the engineering investigation quality. The construction and analysis of information management system verify the effectiveness of the information management system of engineering investigation quality.

1. Introduction

From the perspective of informatization, engineering investigation can be said to be a process of geotechnical parameters and data "information acquisition, information storage, information fusion, information understanding and information application"[1]. Therefore, engineering investigation quality informatization management is the result of this "information acquisition, information storage, information fusion, information understanding and information application". From the perspective of practice, the process of information management of engineering investigation quality can be said to be the process of information generation, collection and input of geotechnical parameters and data in engineering investigation[2]. Then the process of integration of engineering investigation quality management and information technology is the process of information forcing the construction of engineering investigation quality management system[3].

In order to realize the informatization management of engineering investigation quality, it is necessary to sort out the factors and elements in all aspects of engineering investigation quality, and use block chain, big data, cloud computing and other information technologies to informatization the factors and elements that constitute the quality of engineering investigation[4]; it is also necessary to abstract
or imitate the essence or main factors of the informatization management of engineering investigation quality, and analyze the relationship between these main factors[5-6], study the advanced and effective management process, management mode and management law in the engineering investigation industry, and make its management experience and management theory concrete and logical, so as to make effective management behavior landing[7].

2. Overall design of management system
The construction of management system needs to follow the basic principles of integrity, dynamics, openness, adaptability and comprehensiveness[8], mainly serving the objectives of reform of engineering investigation quality management system, high-quality development of engineering construction, informatization management of the whole process of engineering investigation quality, information data support of engineering investigation quality, etc[9].

To establish a quality management system of engineering investigation that can really play a role depends on the following three aspects: First, it is necessary to "formulate the data standard of engineering investigation quality informatization". Information data is the core content and basic condition of engineering investigation quality information management. It is necessary to study and formulate corresponding engineering investigation quality information standards for all relevant enterprises and personnel in the whole process of engineering investigation; Secondly, it is necessary to "build an engineering investigation project information management platform". It is necessary to provide the relevant enterprises and personnel with a management platform that can collect and input the quality management information of the engineering investigation project, as well as a management platform that can provide the construction administrative departments at all levels with comprehensive, accurate and dynamic basic data for the relevant enterprises, relevant personnel and all links of the whole process of the relevant engineering investigation project; Thirdly, it is necessary to "research and development of engineering investigation geological information" Database " To realize the data carrier of collection, input, submission, warehousing, management, query, download and other functions of engineering geological survey information data, it is necessary to research and develop the engineering geological survey information database which can be jointly built, shared and interconnected for the relevant enterprises and personnel of engineering survey. Therefore, the information management system of engineering investigation quality is constructed by "data standard of engineering investigation quality information", "information management platform of engineering investigation project" and "geological information database of engineering investigation", As shown in Figure 1.

![Figure 1. Information management system of engineering survey quality](image)

3. Informatization standard

3.1. Data collection standard of engineering investigation information
Including enterprise information collection, personnel information collection, project information collection, management information collection and other standards, specifically formulated six types of collection standards, including the construction unit, survey unit, witness unit, labor enterprise, test
agency, construction drawing review agency, legal person in charge, technical person in charge, registered person, non-registered engineering technical person, witness, reviewer And other collection standards are divided into four stages of project collection standards, i.e. field investigation declaration stage, witness registration stage, municipal test stage, construction drawing review stage, information management, account management, personnel management, project supervision and other management information collection standards.

3.2. Format standard of engineering investigation quality information management results
From the stages of investigation field work, test, report preparation, report review, etc., we have respectively formulated engineering drilling labor record, engineering investigation field witness log (sample), engineering investigation field witness report, engineering investigation geotechnical test report (title page), engineering investigation geotechnical test report acceptance sheet, engineering investigation report title page Format, engineering investigation document review certificate and other engineering investigation results format standards.

3.3. Storage standard of engineering survey geological data results
It mainly includes database contents (including basic geographic information data, underground pipeline data, geological data, underground building (structure) data, metadata, etc.), database basic requirements (including mathematical basis, basic geographic information data requirements, underground space data requirements, etc.), data building process (including data preparation, data preprocessing, data processing, data warehousing, etc.), engineering geological attribute information (including project basic information, drilling attribute, layered attribute, in-situ test basic information, indoor test basic information, load test basic information, geological disaster, slope attribute, cavern attribute, engineering geological element dictionary, etc.), submission format and quality requirements, engineering geological data requirements, engineering geological map (exploration point layout plan, engineering geological profile, histogram, special drawing, stratum code), engineering geological database, engineering geological results table (in-situ test chart, indoor test chart, load test chart) and other results warehousing standards.

4. Information management platform

4.1. Demand analysis
Including field application of engineering survey, field witness filing of engineering survey, review filing of construction drawings, spot check supervision and other requirements of District, county and municipal urban and rural construction committees.

4.2. Functional analysis
The management platform is mainly used by the construction unit, survey unit, witness unit, review organization, laboratory and construction administrative department. The main functions of the management platform include: field application and filing of survey units, filing of survey witness units, synchronization of construction drawing project review information, spot check and supervision of district and County Construction Committee, supervision of design office of Municipal Construction Committee, etc.

4.3. Technical route

4.3.1. Platform structure. The structure of B / S (Browser / server) is to use web browser technology, ActiveX technology and multiple scripting languages of browser, and common browser, which can have the powerful function that the original complex special software can have. Users can use the management platform through the Internet without installing any special software.
4.3.2. Development tools. Vs is Microsoft Visual Studio is the abbreviation of studio. As the main integrated development environment of the most popular windows platform application program, vs is a relatively complete development tool set. It has most of the tools needed in the whole software life cycle, including code control tools, UML tools, integrated development environment (IDE), etc., and the target code it compiles can be applied to the windows supported by Microsoft All platforms including mobile, Microsoft Windows, Windows CE,. Net compact framework.net framework, Microsoft Silverlight, and windows phone. . net as the platform of Microsoft XML Web services, XML Web services can allow its applications to share data and communicate through the Internet, not limited by the selected devices or operating systems or programming languages; while Microsoft. Net platform can provide the creation of XML Web services, and can integrate these services.

5. Geological information data center

5.1. Demand analysis
By using block chain, cloud computing, big data and other information technologies, the geological information database of engineering investigation is established, which can automatically detect, import, browse, query, export and statistics geological drilling data through warehousing, management, query and download of engineering geological investigation results, and automatically generate special maps such as drilling histogram, isoline map and drilling profile map, etc. Simulate the geological conditions such as 3D entity, geological body model and geological body cutting of geological borehole, automatically display the spatial relationship and stratigraphic connection of surrounding borehole in the underground 3D space environment, and automatically realize the integrated display of the underground 3D scene on the ground, so as to serve the urban engineering investigation project, urban underground space utilization and urban infrastructure construction, improve the disaster prediction and Decision support service level.

5.2. Technical route
Based on the advantages of data confidentiality, security and performance, C / S mode, B / S mode and skyline mode can be adopted for the geological information database of engineering investigation. In version 6.5 development, according to the complexity of different engineering geology, a comprehensive solution including multiple strategies and methods is developed, including complex interactive modeling method, 3D geological modeling method based on horizon calibration and contour modeling method, which can meet the function of data management, analysis and evaluation, simplify deployment and maximize sharing, and can be used Large amount of digital elevation data, remote sensing aerial survey image data and other two-dimensional and three-dimensional geological data are used to simulate the three-dimensional scene of the geological environment of engineering investigation.

5.3. Functional analysis
The geological information database of engineering investigation is divided into two modules: data visualization and management, three-dimensional geological modeling and analysis. Data visualization and management mainly include data automatic quality inspection and warehousing, geological drilling management and geological data display, drilling thematic map drawing and other functions.

6. Practical application and effect analysis
In order to check and verify the effectiveness of the construction of the engineering investigation quality information management system, it is necessary to start from the construction, application and evaluation of the engineering investigation quality information management system, taking Chongqing as an example, through the construction and operation of the corresponding engineering investigation quality information management system, and in its provincial and municipal engineering investigation enterprises, engineering investigation personnel and engineering investigation projects Practical application and evaluation of its practical effect.
6.1. Practical application and development effect analysis of survey quality management
Since the construction and operation of Chongqing engineering investigation quality information management system, information management has further improved the efficiency of engineering investigation quality supervision, changed the focus of investigation quality management from "focusing on investigation report results" to "focusing on both investigation process and report results", and strengthened the accuracy and dimension of engineering quality supervision and management; investigation quality from the results of investigation report. The records are extended to the process management of engineering investigation. The quality management dimension of engineering investigation is implemented by the relevant units of the investigation to the specific operators. It effectively improves the quality awareness of the investigation industry.

According to the preliminary statistical analysis, the number of articles violating the compulsory standard for engineering construction of engineering investigation projects is decreasing year by year. By 2018, the number of articles violating the compulsory standard for every 100 investigation projects in the city will be reduced to 0.03. The quality of engineering investigation in the city will continue to improve, and the quality of engineering investigation will continue to improve.

6.2. Analysis of management practice and development effect of survey industry
Through the engineering investigation quality information management, the order of the industry has been further standardized gradually, promoting the steady development of the investigation industry. As shown in Figure 2.

![Figure 2. Comparisons of various kinds of expenditures of engineering survey projects in Chongqing in recent years](image)

As the core indicator to measure the development of the survey industry, the income of engineering survey mainly consists of field witness fee, test fee, survey review fee and survey fee. In addition to the increase of test and test fee, survey review fee and survey fee by no less than 10%, field witness fee is the new survey income, and the proportion is no less than 5% of the survey fee. When the income from engineering investigation is directly increased, the share shall not be less than 5%. As shown in Table 1.

Engineering survey revenue increased from 2.17 billion yuan in 2016 to 2.64 billion yuan in 2018, with an average annual growth of 10.3%, from 1.2 percentage points lower than the national average to more than 3.1 percentage points, far higher than the national growth level; the annual growth rate of the benefit index "survey and design ratio" was 23.19%, significantly higher than that of other similar industries in the same period. At the same time, in recent three years, the income of survey industry in
Chongqing continues to increase, which further proves the effectiveness of engineering survey quality information management system in Chongqing.

Table 1. List of revenue of engineering survey and design in Chongqing in recent years

| Particular year | Business income of survey and design industry (100 million yuan) | Income from engineering investigation | Income from engineering design | General contracting |
|-----------------|---------------------------------------------------------------|-------------------------------------|--------------------------------|---------------------|
| 2018            | 481.5                                                         | 26.4                                | 126.6                          | 205.9               |
| 2017            | 452.3                                                         | 23.9                                | 106.4                          | 238.1               |
| 2016            | 422.0                                                         | 21.7                                | 88.0                           | 158.4               |

7. Conclusion
This paper systematically analyzes the necessity of building the information management system of engineering investigation quality, clarifies the main objectives, main functions and realization path of the information management system of engineering investigation, and explores the feasibility of constructing the engineering investigation quality management system from "data standard of engineering investigation quality informatization", "information management platform of engineering investigation project" and "geological information database of engineering investigation".

Taking Chongqing as an example, the paper constructs the information management system of engineering survey quality in Chongqing. It also analyzes the operation effect of engineering investigation quality information management system from two aspects of investigation quality development and investigation industry development, so as to verify the effectiveness of engineering investigation quality information management system.

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