The Research of Highway Construction Project Information Comprehensive Management System

Hualong Cai¹, Chengyu Zhu¹,*, Ming Ouyang¹ and Chen Peng¹

¹School of Civil Engineering, Jiaying University, Meizhou, Guangdong, 514015, China

*Corresponding author’s email: whucad@whu.edu.cn

Abstract. With the development strategy of "Internet + Transportation" put forward, the paper advances the process of the new type of transportation construction in the province. Compared with the common highway, the freeway design speed is higher, vehicle capacity is larger, so the quality is more strict during the construction process. This system helps highway construction managers to understand the construction of the project at the first time, and effectively deal with emergencies. Based on the actual situation of the project, this paper expounds the information management system and its functions of expressway construction project.

1. Background of research
In order to implement the development strategy of "internet + traffic", using the current internet and internet of things network technology, the construction of information management system through informationization and intellectualization means is used to monitor the whole process of expressway construction projects, to realize the 100 % information-based management of newly-built highway projects so as to meet the requirements of high quality, achieve the goal of zero mistakes in construction and waste of materials, and improve the way of quality supervision and data-sharing.

2. System composition and functions
The system consists of five subsystems: key process construction control system, engineering construction project website, engineering construction project management platform, office OA and video conference. It has been shown in figure 1.
Figure 1. System Composition

2.1 Key Process Construction Control System
The system includes five subsystems, which are Concrete Mixing Plant Production Monitoring System, Laboratory Data Acquisition Monitoring Management System, Prestressed Construction Remote Monitoring System, Safe Construction Video Monitoring System, and Quality Safety Assistance System.

Concrete Mixing Plant Production Monitoring System monitors and manages the on-site concrete mixing equipment, and at the same time connects with the roadbed construction quality data collection platform of the Provincial Traffic Engineering Quality and Safety Supervision Administration. It has been shown in figure 2.

Laboratory Data Acquisition Monitoring Management System analyzes and judges the quality of all kinds of engineering materials, monitors the temperature and humidity of standard breeding room at the same time, realizes the data sharing of the three-level laboratory of the project and the third-party testing institutions, and connects with the test and testing management platform of Provincial Traffic Engineering Quality and Safety Supervision and Administration Bureau. It has been shown in figure 3.
Figure 3. Work Flow Chart of Laboratory Data Acquisition Monitoring Management System

Prestressed Construction Remote Monitoring System realizes the analysis, evaluation and query of the quality of site tensioning and grouting data, and connects with the quality control and management platform of prestressed bridge construction of Provincial Traffic Engineering Quality and Safety Supervision Administration. It has been shown in chart 4.

Safe Construction Video Monitoring System collects video images of key parts of the project (such as prefabricated yard, interchange, mechanics laboratory), and managers at all levels use the three-level monitoring center set up to monitor and store the collected video on the quality of the on-site construction process and production safety. It has been shown in chart 5.

Quality Safety Assistance System collects the quality assessment on the construction site, and supports the data access and download. It has been shown in chart 6.

2.2 Engineering Construction Project Website System
The system relies on the Internet to publicize the progress of the project, release a variety of public information to the public, let the public know the situation of the project construction in time, and carry out the public supervision.

2.3 Engineering Construction Project Management Platform System
The Engineering Construction Project Management Platform System includes ten modules, which are Project Information Management Module, Project Contract Management Module, Project Change Management Module, Project Progress Management Module, Project File Management Module, Project Measurement Management Module, Project Monthly Report Management Module, Project Quality Management Module, Project Safety Management Module and Third-party Interface Service.

Project Information Management Module allows the user to maintain and view information within the scope of authority, such as project overview, participating company and contact book.

Project Contract Management Module records and stores all kinds of contract materials of project participants in a standard format, and completes daily contract registration and dynamic update of execution progress.

Project Change Management Module is designed according to different levels of engineering changes, different approval and review processes. Combined with the approval process of engineering design change management, it provides the functions of application, approval and distribution of changes, and can update the bill of quantities automatically.

Project Progress Management Module can generate all kinds of charts in real time and clearly display the original progress, progress node and other information to provide the progress information of the project to the progress control personnel.

Project File Management Module is the classification management, induction organization and
preservation of the documents, drawings and other materials produced in the process of the implementation of the project construction management, as the materials and documents of the project completion acceptance.

Project Measurement Management Module performs network measurement on list measurement, change list measurement and measurement statistics.

Project Monthly Report Management Module provides the function of compiling monthly report of engineering, supervision and construction.

Project Quality Management Module stores and updates the national standards and project requirements in real time, and processes, statistics and aggregates the test, inspection, evaluation and other form data.

Project Safety Management Module is to establish and check the safety management objectives and systems of each project department, and connect the Quality Safety Assistance System to carry out safety management of the project.

Third-party Interface Service makes the system have good compatibility, which meets the docking of project supervision and management units and Office OA System.

2.4 Office OA System
The system uses important sections, scrolling screen, business information label page display and other ways to announce the notice, government information, work focus and other information.

2.5 Video Conference System
The system manages and monitors the construction of projects, and understands the construction status of projects in its jurisdiction in real time.

3. System architecture

3.1 Software Structure
The system software is divided into three layers, which are Basic Layer, Business Logic Layer and Data Access Layer. Base Layer includes project specific execution department and project information upload interface. Business Logic Layer completes the core business, including project safety management, project contract management, project quality management, project information management, official document management, project schedule management, project financial management and project budget management. It has been shown in figure 4.

![Software Structure Diagram]

Figure 4. Software Structure

3.2 Hardware Structure
In the context of the rapid development of the Internet, big data and 5G technology, a large number of cloud data centers and cloud computing platforms appear on the market, which meet the requirements of the system hardware system. The hardware structure of this system is the use of cloud service, which stores the data of the production site, construction site, site laboratory, supervision unit, central laboratory and owner server data center in the cloud server to facilitate the retrieval of the client. It has
been shown in figure 5.

![Network Topology Diagram](image)

Figure 5. Network Topology Diagram

4. System implementation

4.1 System Main Interface

The data of the user (not the system administrator) is uploaded by the background administrator together, and the user is informed of the initialization password and other information, but not being able to register personally. The login interface has been shown in figure 6.

![Expressway Construction Project](image)

Figure 6. Network Topology Diagram

When users (who are not system administrators) log in, they see that the system interface is divided into four areas. The title bar is at the top, the functional navigation area is on the left, the content display area is on the right, and the copyright notice area is at the bottom. It has been shown in figure 7.
4.2 System Main Interface
Uploading photos of the construction site based on the PHP development environment is done as shown in the figure below (code parts):

```javascript
window.onload = function () {
    var fileTag = document.getElementById('file');
    fileTag onchange = function () {
        var file = fileTag.files[0];
        if(!/image\/.test(file.type)){
            alert("Note that images should be used here!");
            return false;
        }
        var fileReader = new FileReader();
        fileReader.onloadend = function () {
            if (fileReader.readyState == fileReader.DONE) {
                document.getElementById('img').setAttribute('src', fileReader.result); }
        };
        fileReader.readAsDataURL(file); }
};
</script>
```

5. Conclusions and prospects
Since the construction of highway construction project information integrated management system, in the management, support road bridge investment company' s project strategic management and centralized management to realize the three-level management of "roadbridge investing company, project office, construction site". In the operation, supports the distribution of projects, projects and projects throughout the lifecycle management so as to promote project information-sharing, improve operational efficiency and achieve cooperative project management.

References
[1] Yanping Wang. Construction of Gansu Provincial Expressway Comprehensive Information Management Platform [J]. Gansu Science and Technology, 2012, 41 (05): 23-24
[2] Junmei Fu, Zhigang Deng. Baotian Expressway Project Information Management Platform Implementation System [J]. Science and Technology Wind,2009(15):131-132
[3] Hongjun Wang. Demand analysis of expressway management information construction [J]. Chinese and foreign entrepreneurs,2019(35):74
[4] Xuewen Huang, Zening Xu, Lijun Xiao. Research on application of information platform of expressway visual project construction management system [J]. China Traffic
Informatization, 2015(03): 71-74

[5] Menglu Yang. Talking about the intelligent expressway system [A]. "Construction Technology and Management" Organizing Committee. Proceedings of the April 2016 Construction Technology and Management Academic Exchange Conference [C]. "Construction Technology and Management" Organizing Committee Meeting: Beijing Hengsheng Boya International Cultural Exchange Center, 2016: 2

[6] Hongchuan Du. Design of Jilin Province Highway Comprehensive Management Information System[D]. Jilin University, 2008.