Research on construction safety Evaluation and management system of water conservancy and hydropower projects

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Abstract. Along with our country economy sustained and stable growth, water resources and hydropower engineering industry development is rapid, a fairly long period of time in the future will be in the process of engineering construction, however, with the rapid development of water resources and hydropower engineering industries came the frequent safety accidents of water resources and hydropower engineering construction, cause huge casualties and property losses, and has a great influence on society. On the surface, most of the safety accidents are caused by improper human operation or mechanical equipment injury, but at the root of the problem, most of the accidents are caused by potential accidents in safety management. Therefore, how to improve the safety management level of water conservancy and hydropower project construction, improve the level of construction safety management information is the current urgent task of water conservancy and hydropower project construction enterprises.

1. Relevant evaluation methods

1.1. Summary of ANP

The system elements in network analysis are divided into two parts: the first part is called the control factor layer and includes

Problem objectives and decision criteria. All decision criteria are considered to be independent of each other and controlled only by the target element. The decision planning in the control factor may not have one goal, but at least one goal. The weight of each criterion in the control layer can be obtained by the AHP method. The second part is the network layer, which is composed of all element groups controlled by the control layer. Each element group contains multiple elements that are interdependent and controlled by each other. See Figure 1 for details of ANP.1-5
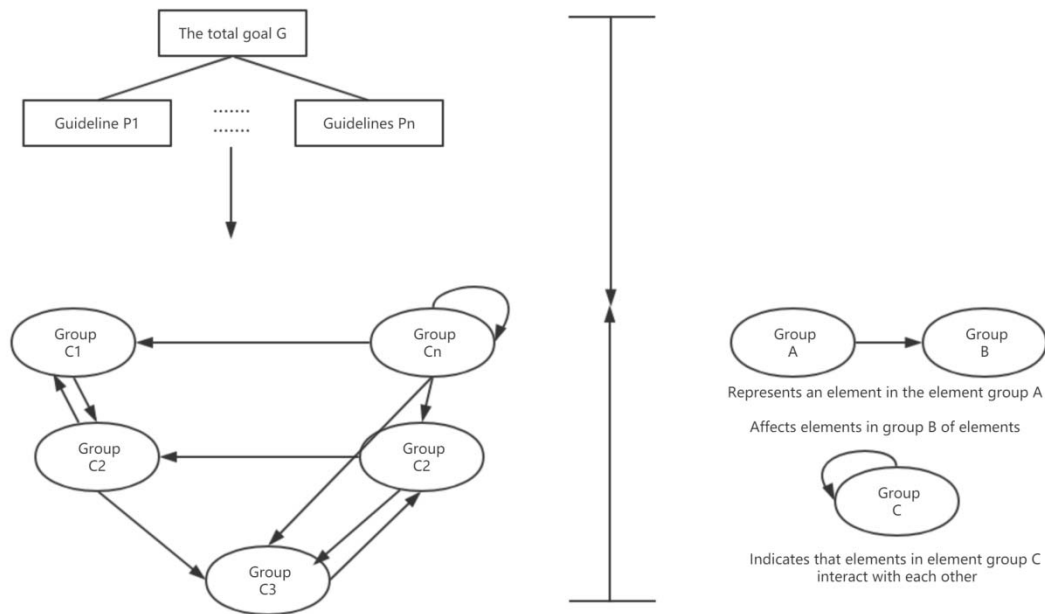
Figure 1 ANP model detail diagram

The specific steps of C1 are ANP and AHP, which have no strict requirements on hierarchical relationships. ANP USES network structure to show the relationship between system elements. Every two elements in the network structure may influence each other

AHP can be regarded as a special case of ANP to reflect the interaction between real things. Although the two models have different structures, their basic principles are the same. Therefore, the establishment steps of ANP model can also refer to AHP model and make reasonable changes based on their own characteristics.6-8.

Table 1 Element determination scale table

Scale	Describe
1	The i element is just as important as the j element
3	The i element is slightly more important than the j element
5	i element is obviously more important than j element
7	The i element is more important than the j element
9	i element is extremely important than j element
2, 4, 6, 8	Between these levels of importance

1.2. ANP Step

It is assumed that the total target of the control layer is P and the element of the control layer is the element set of the network layer, in which there are elements $ei_1, ei_2, ..., ei_n$ in the element set Ci. If all the elements in the ith element set have influence on the jth element set, the influence matrix of all the elements in the ith element set on the e^j_t elements in the jth element set can be established, and the details of the control matrix are shown in Figure 2 below.

e^{jt}	e_{i1} , e_{i2} , ... , e_{in}	Normalized vectors W_{ij}^{jt}
e_{i1}		W_{i1}^{jt}
e_{i2}		W_{i2}^{jt}
.		
.		
.		
e_{in}		W_{in}^{jt}

Figure 2 Control layer criterion diagram

The sorting vector formula obtained by the eigenroot method is as follows:

$$W_{ij} = \begin{bmatrix} W_{i1}^{\ j1} & W_{i1}^{\ j2} & \cdots & W_{i1}^{\ jn} \\ W_{i2}^{\ j1} & W_{i2}^{\ j2} & \cdots & W_{i2}^{\ jn} \\ . & . & \cdots & . \\ W_{in}^{\ j1} & W_{in}^{\ j2} & \cdots & W_{in}^{\ jn} \end{bmatrix} \quad (1)$$

If the element in Cj is not affected by the element in the Ci element group, the corresponding W value is 0. In this way, the supermatrix W composed of all elements can be finally obtained, as shown in the formula:

$$W_{ij} = \begin{matrix} 1 \\ \vdots \\ n_1 \\ 1 \\ \vdots \\ n_2 \\ \vdots \\ 1 \\ \vdots \\ n_N \end{matrix} \begin{matrix} 1\cdots n_1 & 1\cdots n_2 & \cdots & 1\cdots n_N \end{matrix} \begin{bmatrix} W_{11} & W_{12} & \cdots & W_{1N} \\ \\ W_{21} & W_{22} & \cdots & W_{2N} \\ \\ \vdots & \vdots & \vdots & \vdots \\ \\ W_{N1} & W_{N2} & \cdots & W_{NN} \end{bmatrix} \quad (2)$$

The supermatrix W is a block matrix, and each part of the matrix represents the phase of the different two elements in the whole system. The subblock Wij of the supermatrix is normalized, but the supermatrix W is not normalized. Therefore, the supermatrix W is normalized, and the matrix A is obtained. The formula details are as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (3)$$

2. Design of safety management system

2.1. System Analysis

In the construction of water conservancy and hydropower projects, the application of a human-oriented, with the help of network information system, the role of expert system in the system is the most important. For example, the determination of elements of evaluation index system and evaluation methods of selection, the establishment of evaluation index system, evaluation result authenticity judgment, etc., these links are very common in the safety management, but in large water conservancy and hydropower engineering construction project only by expert group of experience and knowledge to handle the work. In this paper, the expert system is formed by the dynamic combination of cross-field and cross-level experts. The expert system consists of five parts: government departments, industry departments, construction units (including supervision), construction enterprises and safety experts. The five-in-one mode of coordinated management of five forces is shown in Figure 3 for details.
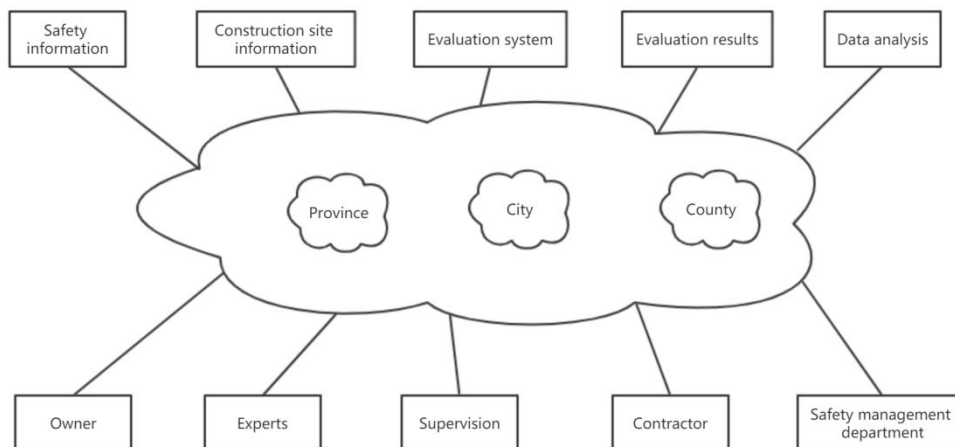

Figure 3 System structure diagram

2.2. System Architecture

Software structure fundamentally determines the merits and demerits of the application system, good architecture design is the guarantee of the success of the project, can provide superior performance for the project, the software structure of the system according to the current unified standards of the industry to build a good platform for the application implementation. The system adopts the B/S implementation scheme, which can not only guarantee the flexibility and simplicity of the system, but also guarantee the remote customer access to the system. The unified interface is used as the client program to facilitate the remote customer access to the system.
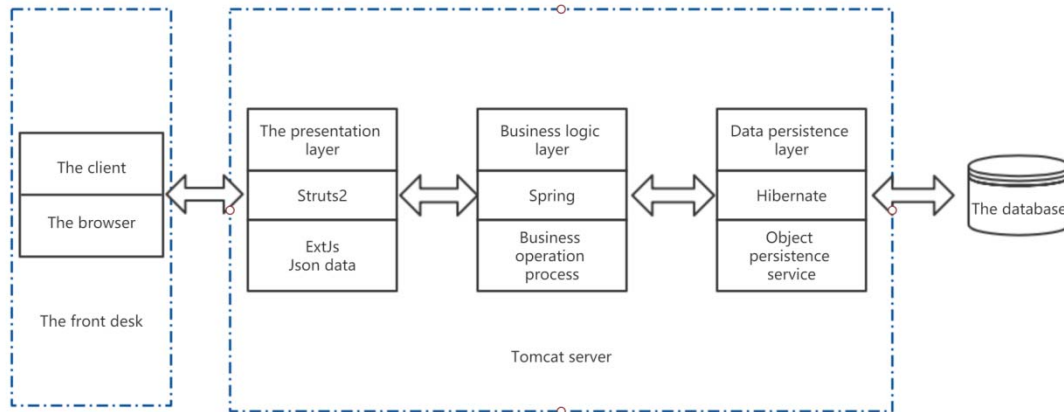
Figure 4 System development architecture diagram

3. Overview of system functions

According to the water conservancy and hydropower, building construction safety management needs to carry on the system analysis, the water resources and hydropower engineering construction safety management system shall be carried out in accordance with the modular design, the system according to the function is divided into six modules, namely: safety data module, the evaluation system module, project management module, score management module, security early warning module, user management module, its function structure as shown in figure 5.
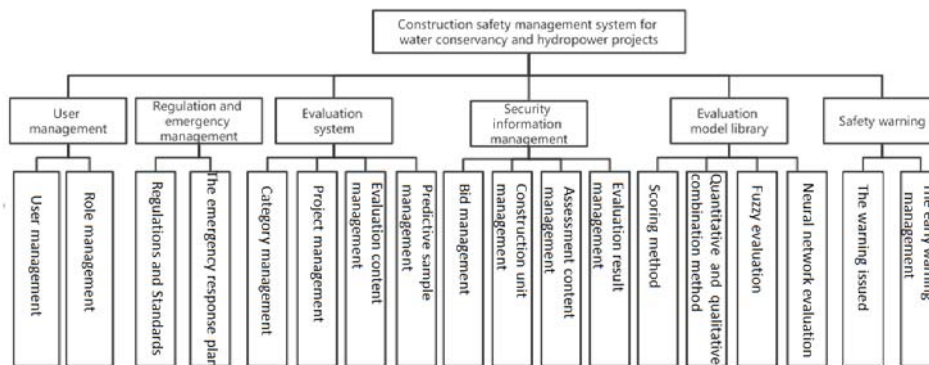

Figure 5 System functional structure diagram

The user management module mainly provides users with all kinds of construction safety documents; Regulations and emergency management models.Block is mainly responsible for the construction of water conservancy and hydropower projects laws and standards and emergency plan data query and management; As the core part of the construction safety management system of water conservancy and hydropower projects, the evaluation system and safety information management module give full play to their professional skills, manage the safety of construction scientifically, and ensure the progress, quality and safety of construction. Grade evaluation model of library module mainly through quantitative and qualitative method, combination with fuzzy evaluation, evaluation of neural network, the network analysis method for construction project evaluation, and can validate each other between each other, improve the integrity and accuracy of evaluation, the construction unit must according to the water resources and hydropower engineering construction quality inspection system

and the construction standards of the industry, relying on the related national construction law and related industry standard, scientific and reasonable formulation of the project quality control system and inspection standards, to ensure the engineering construction progress and construction progress of the acceptance of engineering management module is used to manage the projects under construction, The project can be segmented, the information of bid section can be managed, different construction units of bid section can be managed, and different evaluation contents can be specified for different construction units according to the evaluation system; The safety warning module is mainly used for the management and release of construction safety warning. Throughout the beginning and end of the project management, it can effectively warn the unsafe factors in the construction process, so as to achieve the prevention and safety precautions in advance.

4.Conclusion

The construction safety management system of water conservancy and hydropower projects is an innovation based on summarizing the current advanced technology at home and abroad. In terms of management mode, make the construction safety management system of water conservancy and hydropower projects more comprehensive, more systematic and more scientific. In terms of management system, the management system of organization system, operation mechanism, legal basis and guarantee system has been proposed, and a set of construction safety management mode and theoretical system based on construction site safety inspection has been established. In terms of evaluation methods, this system applies computational intelligence to safety evaluation and management, achieves the perfect combination of quantitative and qualitative, and improves the accuracy of evaluation results.

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