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Risk Assessment Method of Project Whole Process Based on Fuzzy Comprehensive Evaluation

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Abstract: the whole process of risk assessment is a necessary part of the project preparation stage, which can avoid the risk factors and ensure the safety of the project. However, the existing assessment methods have the problem of weak control. Given this situation, a project whole process risk assessment method based on fuzzy comprehensive evaluation is proposed. Based on fuzzy comprehensive evaluation model, the risk weight is solved. The relevant influencing parameters are combined. The value range of the interdependence index is determined, and the calculation of risk factors is completed. Then, the standard evaluation data is fused by filtering high-risk data so as to deduce the core evaluation criteria. Complete the design of the whole process risk assessment method of the project based on a fuzzy comprehensive evaluation. The experimental results indicate that the fuzzy comprehensive evaluation model can greatly reduce the value of the key evaluation parameters, which can play a promoting role in avoiding risk factors and completing the accurate evaluation of the whole process of project risk.

1. INTRODUCTION

Compared with other types of evaluation methods, the establishment of a fuzzy comprehensive evaluation method follows the theory of membership degree. While following the idea of fuzzy mathematical analysis, it pays attention to the transformation between qualitative data and quantitative data, and can complete the quantitative evaluation of objects according to the final results. Because there is no need to solve the real value of the target object, the fuzzy comprehensive evaluation method can break the inhibitory effect of the constraints on the authenticity of the evaluation results [1]. Although the final results are not entirely clear, they can reflect the objective law of development of things, and can better solve the uncertainty problems that are difficult to quantify.

For project engineering, the whole process risk assessment is the most critical execution task in the preparation stage, which not only affects the speed of follow-up projects, but also relates to the implementation safety of the whole project system [2]. In recent years, with the continuous development of society, the relevant units have put forward higher requirements for the safety of the project. How to ensure the orderly implementation of the project system on the basis of ensuring the quality of the project has become an urgent problem to be solved. In view of the above situation, this paper puts forward the risk assessment method of the whole process of the project based on fuzzy comprehensive evaluation, and studies the specific implementation plan.

2. CALCULATION OF RISK FACTORS BASED ON A FUZZY COMPREHENSIVE EVALUATION

The calculation of project risk factors needs to solve the risk weight index and interdependence parameters on the basis of a fuzzy comprehensive evaluation model. This section will study the above content.

2.1 Fuzzy comprehensive evaluation model

The fuzzy comprehensive evaluation model is composed of five basic application units: input layer, discussion layer, analysis layer, processing layer and output layer. Among them, the input layer, as a data input window, is the only channel for information parameters to enter the evaluation network system. The discussion layer, the analysis layer and the processing layer are responsible for filtering the unnecessary factors in the data information parameters at the same time, and can connect the input layer units with the output layer units, which is the key application structure of the fuzzy comprehensive evaluation model. The output layer is the final application unit of the fuzzy comprehensive evaluation model, which can extract the key application information in the network system and feed it back to

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other structural organizations [3]. The connection form of the complete fuzzy comprehensive evaluation model architecture is displayed in Figure 1.

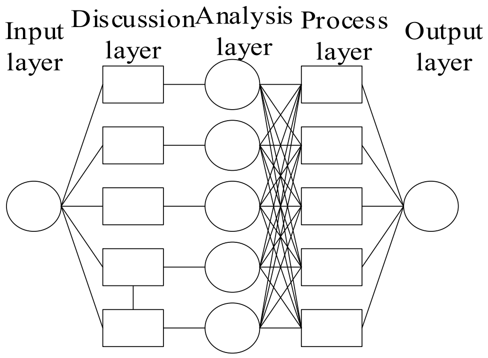

Figure 1. Application architecture of fuzzy comprehensive evaluation model

In the application engineering of the evaluation model, the input layer and output layer units are only responsible for transmitting data information parameters and do not have other processing capabilities.

2.2 Risk weight

Risk weight is a necessary known condition to deduce the risk factors of project engineering, which can reflect the evaluation ability of the whole process risk assessment method for project engineering to avoid the emergence of non-safety engineering behavior and ensure the smooth implementation of the project. The so-called risk refers to the possibility of unsafe engineering behavior. The fuzzy comprehensive evaluation model stipulates that the higher the risk level is, the greater the engineering risk faced by the engineering unit is. Therefore, for the solution of the risk weight index, the calculation result is required to be as close as possible to the physical minimum [4-5]. Assuming that $\dot{I}$ represents the risk characteristics in the whole process of the project, α represents the minimum value of the comprehensive evaluation parameters, χ represents the fuzzy measurement parameters, $e_{\max}$ represents the maximum value of the project risk factors, and $e_{\min}$ represents the minimum value of risk factors, the risk weight calculation result can be expressed as:

$$R = \dot{I} \times \sum_{\alpha=1}^{+\infty} \left| e_{\max} - e_{\min} \right|^{\frac{2}{\chi}} \quad (1)$$

Due to the limited carrying capacity of the discussion layer, analysis layer and processing layer of the fuzzy comprehensive evaluation model to the data information samples, the values of the fuzzy measurement parameter and the risk characteristic index should not be too large in unit time.

2.3 Interdependence

The degree of interdependence means the degree of association between the risk factors and the non-essential factors of the project. Generally speaking, the greater the value of the index of interdependence, the stronger the association between the risk factors and the non-essential factors, and the more data samples need to be processed when assessing the risks of the whole process of the project [6]. The so-called interdependence refers to the interaction between factors and indicators. In the process of assessing the risks in the whole process of the project, if the value of the interdependence index cannot be effectively controlled, it may lead to inaccurate assessment behavior, thus leading to non-safety engineering behavior [7]. Let δ be the correlation measure between risk factors and unnecessary factors, $\bar{q}$ be the unit accumulation of project risk data in the comprehensive evaluation process, and γ be the discrimination coefficient of data samples. With the support of the above physical quantities, the formula (1) is established simultaneously, and the expression of the degree of interdependence based on fuzzy comprehensive evaluation is derived as follows:

$$W = \frac{1}{\delta^2} \times R \times \frac{\bar{q}}{\gamma - 1} \quad (2)$$

Using fuzzy comprehensive evaluation model to evaluate the whole process risk of the project requires that the value of interdependence index must belong to the numerical interval of(0,1).

3. THE DESIGN OF RISK ASSESSMENT METHOD IN THE WHOLE PROCESS OF PROJECT

Based on the fuzzy comprehensive evaluation model, to realize the accurate evaluation of the whole process risk of the project, it needs to filter the high-risk data and determine the specific evaluation criteria by combining the standard data fusion conditions.

3.1 High-risk data filtering

High-risk data filtering is the process of extracting and processing the parameters with lower evaluation reliability from the existing risk data set, and establishing a new data set based on these information samples. Under the action of fuzzy comprehensive evaluation model, filtering high-risk data can realize the safe progress of the project, so as to accurately assess the risk of the whole process and effectively control the key assessment parameters [8]. The solution of the filtering expression for high-risk data satisfies the formula (3).

$$A = \beta W + p\tilde{d}^2 \quad (3)$$

Where, β represents the discrimination parameter of the high-risk assessment coefficient, $\tilde{d}$ represents the assessment benchmark value of the risk elements in the whole process, and p represents the standard filtering parameter. In the process of evaluating the risk of the whole process of the project, the value of the high-risk data filtering expression is always less than the risk data discrimination condition.

3.2 Standard data fusion

Standard data fusion is to combine controllable risk parameters and uncontrollable risk parameters, and to assure the safety of the project on the basis of meeting the applicable standards of fuzzy comprehensive evaluation model. Due to a large number of uncertain risks in the process of project implementation, standard data fusion must be a relatively broad condition, which not only summarizes the risk behavior of the evaluation parameters involved, but also describes the real-time progress of the project [9]. When there are uncontrollable risk parameters, for the fusion of assessment data, it is also necessary to consider that the value of the interdependence index under the current situation can meet the numerical relationship between risk factors and unnecessary factors. If the matching degree is low, it can be resolved by changing the data sample.

3.3 Assessment criteria

The evaluation criterion is the core reference condition for completing the risk evaluation of the whole process of the project. On the basis of the known standard data fusion principle, the solution of the evaluation criterion also involves standard fusion parameters and evaluation benchmark values [10]. The standard fusion parameter is often expressed as k, and the fuzzy comprehensive evaluation principle stipulates that the value of the physical coefficient should belong to the numerical interval of $(1,+\infty)$. The assessment reference value is often expressed as g'. As a necessary reference condition, the larger the value of this physical quantity is, the higher the accuracy of the assessment criteria in judging the risk parameters is. With the support of the above physical quantities, the definition formula of the evaluation criterion can be expressed by the simultaneous formula (3):

$$H = \left| g' \frac{k}{A} \right|^2 \tag{4}$$

So far, the calculation and processing of relevant parameters and indicators have been completed, and the accurate assessment of the whole process risk of the project has been realized with the support of the fuzzy comprehensive evaluation model.

4. THE EXAMPLE ANALYSIS

In this paper, an aeronautical engineering project in Reference [5] is taken as an example, and the fuzzy analytic hierarchy process is adopted to evaluate the project risk. The following comparative experiments are designed, in which the former is used as the experimental group to apply technology. The latter is used as the control group to apply technology. The paper selects a project as the research object, before the formal implementation of the project, uses the experimental group and the control group to evaluate the whole process risk in the project area, and compares the experimental results.

The value of the key assessment parameter determines the ability of the selected assessment method to avoid risk elements. Without considering other interference conditions, the smaller the actual value of the key assessment parameter is, the stronger the ability of the selected assessment method to avoid risk elements is. Under the current situation, the higher the safety implementation level of subsequent projects is.

Figure 2 reflects the specific experimental values of the key evaluation parameters of the experimental group and the control group.

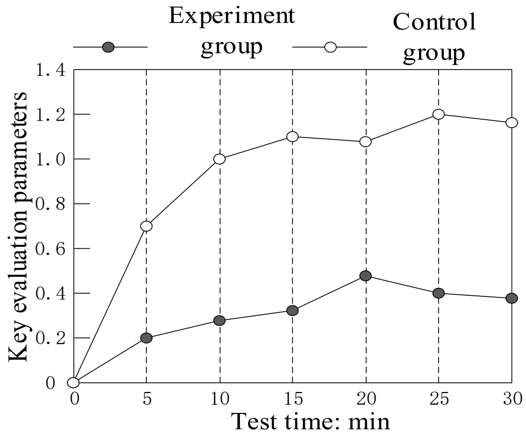

Figure 2. Key evaluation parameters

In Figure 2, the average value of the key evaluation parameters in the experimental group is relatively low. At five minutes, the gap becomes larger. The maximum experimental value can only reach 0.48 during the whole experiment; while the average value of the key evaluation parameters in the control group is relatively high. Over time, the gap between the control group and the experimental group has been larger. The maximum experimental value of the control group reached 1.20, which increased by 0.72 compared with the maximum value of the experimental group.

To sum up, the evaluation method based on the fuzzy comprehensive evaluation model can effectively avoid risk factors, and the application of this evaluation method in the project preparation stage can indeed provide a guarantee for the smooth progress of the follow-up project.

5. CONCLUSION

Compared with the evaluation method based on the analytic hierarchy process (AHP), the new risk evaluation method of the whole process of the project is based on the fuzzy comprehensive evaluation model, which solves the risk weight and interdependence index respectively. Then, it completes the fusion processing of standard data according to the filtering conditions of high-risk data so as to deduce the accurate evaluation criteria. Practicality, this new evaluation method can avoid the risk factors and ensure the safety of the project at the same time. In the project preparation stage, this method does have a strong practical value.

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