

Research on Risk Management of Green Construction Based On Fuzzy Comprehensive Evaluation

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Abstract. Green construction researched in China are mostly about the concept definition, technology introduction and application, policies and regulations of green construction development. However the risk management of green construction are rarely involved. This paper analyzes the risk factors in the process of the construction plan, establishes a fuzzy comprehensive evaluation model of the risk of green construction scheme and puts forward the corresponding risk control measures, which could establish risk consciousness of green construction planner, and make more scientific plans.

Keywords: Green construction, Risk management, Fuzzy comprehensive evaluation.

1. Introduction

As ordinary construction projects, uncertainty of the green construction is greater than some other economic activities, so the predictability of project risk is very difficult.

Different phase of green constructions will have different risk, especially construction stage. Due to the wide range and large scale, long cycle, resource consumption more, the impact on the environment and other reasons, bring the most uncertain factors. If in the construction scheme of the managers in the process of planning because of lack of knowledge or not enough attention to control them, the results are often beyond people's expectations, sometimes not only did not achieve the intended purpose of energy-saving and emission reduction, green environmental protection, but also brought a variety of losses[1].

At present, the value standard and behavior pattern of green construction has not yet fully formed, and risk identification and risk assessment of green construction are rarely studied.

On the basis of the domestic and foreign research results, this paper attempts to construct a objective risk evaluation index system of green construction project, and established a scientific risk assessment model, and proposed the corresponding countermeasures.

2. Risk identification of green construction scheme

Green construction plan is through the investigation and the collection of information in full possession of the information on the basis, for the implementation of green construction projects, organization, management, economic and technological aspects of scientific analysis and demonstration. The task is how to organize the green construction scheme, and the basic content of the planning scheme is: (1) green construction of the environment and conditions for the investigation and analysis; (2) construction target analysis and argument; (3) construction of the organization, management, contract, economy, technology, risk planning.

In the planning process of green construction project, influence of habitual thought in the traditional operation mode, and the lack of green construction experience, make planning from "green" targets, this deviation from the "green" goal of uncertainty are the risks in the planning of green construction scheme. This risk is significantly different from other risks in the "green" concept, and the "green" concept is closely related to the ultimate goal of human sustainable development. Therefore, the risk in the construction scheme of the green construction can be defined as the uncertainty of the various factors that affect the sustainable development objectives [2]. The risk has 3 basic characteristics: objectivity, loss and uncertainty. Objectivity refers to whether people realize that the risk of green construction plan is the objective existence, such as construction waste, noise

pollution, etc. Loss refers to the realization of the loss of the green construction objectives, such as steel consumption, water consumption. Uncertainty is the result of the loss of accuracy, such as the construction of water saving, energy saving quantitative calculation [3].

According to the Ministry of Construction issued the "green construction guide" on September 10, 2007, which gives overall framework of green construction. In this paper, in the planning of green construction scheme of risk factors can be divided into the following several aspects: construction management, environment protection, saving material and resource utilization, water saving and water resources utilization, energy saving and utilization, quarter and construction with protection.

In recent years, China construction industry has made great efforts to introduce and promote BIM. However, many difficulties and challenges are confronted and need to be conquered during the implementation. First of all, it's not be easy for the designers to accept the three-dimensional model design, maybe they need a longer time to accept BIM. Besides, many differences existence between import software products and our country's standard, which is another big challenge. For example, BIM couldn't automatically transfer the three-dimensional model to the two-dimensional design drawings, conforming to the standards of our country. What's more, BIM is not in accordance with our specifications for structural design and calculations [4]. These resistances hamper the use of BIM in China, resulting in a phenomenon that a great number of design institutes are still using two-dimension design tool when designing the construction, only occasionally Construction a not very accurate three-dimensional model if they really need. Therefore, it's urgent for us to eliminate the barrier for the BIM adoption in Chinese construction industry.

3. Risk evaluation model of green construction

The risk in the planning of green construction scheme has the uncertainty factors, it is difficult to give a specific risk rate, has a significant ambiguity. At the same time, the risk assessment is also a multi - objective process involving many factors. For green construction scheme planning the emerging project management process, due to lack of experience will often appear deviation, not even objectively forecast the risk to lose the meaning of guidance to the construction of. Fuzzy mathematics focuses on fuzzy problems, the application of fuzzy mathematics in strategy planning of green construction in risk decision, to reduce the people's subjective, subjective judgment into the quantitative calculation of unified objective discrimination of track, risk assessment data, the procedures, which makes the evaluation results more scientific [5]. So this method is adopted in this paper.

The evaluation index system is divided into two levels, and the first and two indicators are shown in the following table:

The index weight is the weight of a single index in the whole evaluation index system, and it has the function of balancing the difference between different evaluation indexes [6]. According to the index of green construction scheme, the quantitative index and qualitative index are used to determine the weight of expert scoring method, and the weight is determined by 04. For example: construction management risk index terms of the weights of the indicators to determine the following table:

Table 1: Risk in green construction

First level indicator	Second level indicator
Construction management risk	Organization and management
	Planning and management
	Implement management
	Evaluation management
	Personnel safety and health management
Environmental protection risk	Dust control
	Noise vibration control
	Light pollution control
	Water pollution control
	Soil conservation
	Construction waste control
	Underground facilities, cultural relics and resources protection
Section material and material resource utilization risk	Section material measure
	Structural material utilization
	Maintenance material utilization
Water saving and water resource utilization risk	Decoration materials
	Turnover material utilization
	Water use efficiency
	Non conventional water resources utilization
Energy saving and energy utilization risk	Water safety
	Energy saving measures
	Machinery and equipment
	Production and office facilities
	Construction and lighting
Section and land protection risk	Temporary land targets
	Temporary protection
	Construction drawing plane layout

Table 2: Weight of the two stage index under the risk of construction management

Second level indicator	Organization management	Planning management	Implement management	Evaluation management	Personnel safety	Weight
Organization management	*	1	2	1	1	0.125
Planning management	3	*	3	2	2	0.25
Implement management	2	1	*	1	1	0.125
Evaluation management	3	2	3	*	2	0.25
Personnel safety	3	2	3	2	*	0.25
Total	11	6	11	6	6	1

4. Evaluation method application procedure

Risk assessment process of green construction scheme:

$U = \{u_1, U_2, U_3, U_4, U_5, u_6\} = \{\text{construction management, environment protection, saving material and resource use, water saving and water resources utilization, energy saving and utilization,}$

quarter and construction land protection}, $u1 = \{u11, U12, u13, U14, u15\} = \{\text{organization management, planning management, implementation and management, evaluation management, personnel safety and health management}\}$

Set up weight set

According to the important degree of each factor in each layer, by using expert scoring method, respectively to each factor give corresponding weight, get a set of each factor corresponding weight. Such as the first level $A = (A1, A3, A4, A5, A6, A2)$, second layer weight sets: $A1 = (a11, A12, A13, A15, A14)$

Determine the evaluation set

Regardless of the number of evaluation indicators, the evaluation set is only 1. The risk level is set to five levels: low risk V1; low risk V2, medium risk V3, high risk V4, high risk V5. Five risk assessment levels constitute the $V = \{V1, V2, V3, V4, V5\}$.

Establish factor score of membership function and single factor fuzzy evaluation matrix

Project management staff and experts evaluate each of the second level indicators in the construction plan. And single factor fuzzy evaluation matrix can be obtained by statistics. Such as the evaluation index of construction risk management "20% of the members that it is low risk, 30% of the member that it is low risk, and 20% of the members think it is medium risk, 20% of the members that it is high risk. Then it can be concluded that the membership degree of U11 on all levels of evaluation is: $u11 = (0.2, 0.3, 0.2, 0.2, \text{ and } 0.1)$, and the other is the single factor fuzzy evaluation matrix:

$$R_i = \begin{bmatrix} r_{i1} & r_{i2} & r_{i3} & r_{i4} & r_{i5} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ \dots & \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & r_{n3} & r_{n4} & r_{n5} \end{bmatrix}$$

Formula of the n for each sub concentrated contains secondary index, indicators of factor i (i = 1, 2, n) on the degree of membership of evaluation grade j (j=1~5) as well. Fuzzy comprehensive evaluation of the two level indicators $B_i = A_i R_i$, and $A_i = (ai1, ai2, ai3, ai4, Ai5)$, $i=1\sim6$.

Fuzzy comprehensive evaluation of the level of the index

$$B = AR, A2 (a1, a2, a3, a4, a5, a6),$$

$$R = [B_1, B_2, B_3, B_4, B_5, B_6]^T$$

Evaluation conclusion

By the elements of B, according to the principle of maximum membership degree, the comprehensive evaluation of the risk of green construction scheme is obtained. Project planning personnel in the green construction scheme planning should give attention, take corresponding measures to improve the quality of planning.

5. Risk control of green construction scheme

Facing the worldwide resources, energy and environmental crisis, and China's accession to the WTO may encounter "green barrier", the author thinks that in the green construction project risk management is very necessary, and risk control mainly has the following several points:

Risk control is to take a certain technical management method to make the risk event does not happen or at the time of the occurrence. For the green construction project decision, risk control methods of risk transfer and risk retention. Risk transfer is a risk that may arise from other people. For example, in the construction scheme to reduce the use of high energy consumption, high cost and high pollution of construction materials, etc. Risk retention is by their own bear the consequences caused by the green risk, construction scheme in which cause the loss is smaller, high repeatability, through strengthening management can avoid the risk is suitable for retention. In view of the uncertainty of the risk, decision-making and management personnel should also establish internal risk management information system, with the aid of computer of a variety of data collection, collation, analysis

summed up the rules and experience of the previous occurrence of risk, to predict and evaluate the risk of construction scheme, make the choice of the optimal solution. And in the project construction process, construction enterprises should establish perfect risk management system of green construction, strengthen risk education and enhance people's environment, resources and energy crisis consciousness, deepen the concept of sustainable development.

In addition, the state should formulate a set of effective administrative rules and regulations, and to encourage implementation of and measures to encourage scientific research institutions, large and medium-sized institutions to green construction risk management system of research, to explore effective ways of risk management and the development of green construction risk management of software integration.

6. Conclusions

Planning the construction of green construction is a systematic project, which requires effective coordination of various measures. The advantages and disadvantages of green construction plan directly affect the construction cost, the consumption of social resources and the degree of interference to the environment. Due to the existence of risk of green construction plan, in the planning scheme introduced the concept of risk, enables the planner to mind to establish the risk of awareness, to improve the construction planning of scientific, so that the project to achieve green goals, and has economic, social and environmental benefits. Fuzzy mathematics into the green construction plan of the research field of risk, a combination of qualitative and quantitative analysis of the risk, and puts forward the countermeasures to the existence of the risk, to learn to play the role of the risk management of green construction, it has positive significance to construction project sustainable development.

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