Research on Risk Evaluation Index System and Model of Power Grid Construction Project

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Abstract: Power grid engineering projects mainly refer to the power grid infrastructure and technical transformation projects, such projects have the characteristics of huge investment amount, complex construction process, long cycle and many risk factors. The planning, construction and operation process are affected and restricted by many factors, and the consequences of risks are relatively serious. Firstly, this paper analyzes the risk theory of power grid construction project from the aspects of related concepts, project implementation process, risk assessment, risk prevention, etc. Secondly, the risk evaluation index system of power grid construction projects is constructed from the aspects of risk identification theory, index selection principle and design process. Thirdly, based on the analysis of evaluation methods, the relative evaluation models are compared, selected and improved, and the risk evaluation model of power grid construction projects is constructed. Finally, it put forward the grid construction project risk management measures, including the development of risk management plan, risk avoidance, risk control, risk transfer, unique risk prevention, risk monitoring and other risk prevention strategies.

Keywords: Power Grid Construction, Project Risk, Evaluation, Risk Management

1. Introduction

Electric power is the basic industry of the country and occupies a strategic core position in the development of the whole country. With complex process, large amount of capital, many participants and long construction period, power grid construction projects face increasingly complex risks in the construction process [1]. In recent years, there have been some cases of human casualties caused by substandard power grid construction projects, which makes people pay more attention to the risks of power grid construction projects. With the promotion of the new electricity reform, the risks of power grid construction projects need to be considered more diverse, and the project implementation process will face more uncertainties. Effectively identify and predict the risks of power grid construction projects under the new situation and conduct evaluation and analysis so as to formulate timely countermeasures. It is of great significance to reduce or avoid the risks of power grid construction projects and promote the smooth implementation of power grid construction projects [2].

Firstly, this paper analyzes the risk theories of power grid construction projects from the aspects of related concepts, project implementation process, risk assessment, risk prevention, etc. Secondly, the risk evaluation index system of power grid construction projects is constructed from the aspects of risk identification theory, index selection principle and design process. Thirdly, on the basis of the analysis and evaluation methods, the grey system theory is applied to improve the traditional tomographic analysis and evaluation model, and the grid construction project risk evaluation model based on grey hierarchical analysis is constructed, which makes the hierarchical analysis and evaluation model more reasonable.

Through the research of this paper, on the one hand, it can improve the research on the risk evaluation of power grid construction projects, on the other hand, through the identification and analysis of the risk of power grid construction projects under the new situation,

it has certain reference significance for the risk prevention of power grid construction projects and the response strategy in advance.

2. Related Background of Power Grid Construction Project Risk

The process of power grid construction project is complicated, the amount of capital is large, the participants are many, the construction period is long, and the risks faced in the project construction process are more and more complicated. Power grid construction projects need to consider more diversified risks, and will face more uncertainties in the process of project implementation. It is of great significance to effectively identify and predict the risks of power grid construction projects under the new situation, evaluate and analyze them, and formulate countermeasures in time to reduce or avoid the risks of power grid construction projects and promote the smooth implementation of power grid construction projects.

2.1 The Research Status of Risk Management of Power Grid Construction Projects

The risk management theory was first put forward after the First World War, as a new management theory proposed by Germany for post-war reconstruction [3]. Due to the economic recession and serious inflation in Germany at that time, some scholars put forward the theory of enterprise risk management. After years of development, risk management has gradually become systematic and professional, and has become a key research part in enterprise management [4]. Later, in the 1970s and 1980s, risk management gradually became known to all. Since the development of risk management, the research on risk assessment methods and management techniques has been relatively mature. Among them, the study on risk management in the United States is the earliest, and the research depth and breadth are better than those in other countries. In the 1970s, most schools in the United States began to offer risk management courses, and corresponding qualification examinations began to appear [5]. At that time, the United Kingdom had already formed a mature concept and used risk management in many engineering projects for risk assessment. For example, Hayes studied and analyzed the composition of risk factors in construction projects [6]. Mustafa et al. established the corresponding construction project evaluation index system [7-10] according to the risk components in construction projects. Foreign scholars such as Toakley studied risk assessment techniques, including stochastic control, decision simulation, sensitivity analysis, etc. [11-12].

In terms of the risk management of power grid construction projects, Guo Xiangmei pointed out that the system risk of electric power enterprises not only includes the technical risk of system operation in the traditional sense, but also includes the financial risk from market factors to table. The financial risk faced by the electric power industry is an objective existence. Financial risks in the electric power industry may bring direct or potential losses to the electric power industry [13]. Through analysis, Yu Song believes that the current risk management of power grid construction projects is not systematic enough, and most decision makers adopt control-type risk management strategies, but it is difficult to effectively evaluate risks with control-type strategies [14]. Ren Yaqin pointed out that with the rapid development of science and technology, people gradually realize the technical feasibility and practical necessity of developing smart grid. However, due to the complexity of power grid construction projects, risk management is the key to ensure the success of the project [15]. Hu Bo believes that the construction and improvement of power grid is the foundation of economic development, and power grid projects have a large scale, a long construction period, and many difficulties in the early stage and construction process. The investment risk in power grid construction projects is increasing, and investment risk is one of the important risks in power grid construction projects [16]. Qu Ningning believed that legal risks in power grid construction could not be ignored, and took Xiaoshan Power Supply Company receiving a letter of assistance investigation from Zhejiang Electricity Regulatory Office in 2012 on the failure to do EIA for single-modification dual-high-voltage lines as an example, focusing on the possibility of legal risks that the EIA documents of single-modification dual-high-voltage lines

had not been re-reviewed [17]. Guo Ying pointed out that as an important infrastructure construction project, power grid is related to the development of national economy and is the basis of all other industrial development. However, based on the characteristics of power grid itself and the complex and arduous characteristics of power grid construction, the risks faced by power grid construction are everywhere [18].

2.2 Research Status of Risk Assessment of Power Grid Construction Projects

In terms of evaluation methods and evaluation models, Behret Hulya, Yang Wanbin, Hosseini-Firouz, Dowling N. A et al. applied mathematical analysis models such as fuzzy mathematics [19], grey correlation degree method [20], unascertained mathematics method and blind number method [21] and project simulation method [22] to evaluate the risk of power grid construction projects. Domestic literature on the risk assessment of power grid construction projects is relatively abundant. Many domestic experts and scholars begin to analyze the factors that produce these risks and identify the risks. In the Study on Risk Evaluation of Power Grid Construction Projects, Zhang Dong et al took economic risk and environmental risk as the first-level indicators of risk evaluation in power grid project construction, and divided the second-level indicators according to the corresponding organizational structure [23, 24]. Literature [25] put forward the fuzzy network analysis method, analyzed the risk according to the risk characteristics, and established the risk assessment system of construction projects by relying on uncertainty theory and fuzziness theory. Literature [26-29] points out that risk evaluation index system establishes a risk evaluation model, and commonly used risk evaluation methods include analytic hierarchy process and network analysis. For the risk and loss degree that may occur in the whole process of power grid construction project, the fuzzy uncertainty membership degree principle is applied to carry out comprehensive quantitative risk evaluation. In general, the corresponding questionnaire is designed, and relevant experts are invited to give corresponding scores according to their own knowledge [30-37].

3. Theoretical Basis of risk Management for Power Grid Construction Projects

3.1 The Concept of Power Grid Construction Project Risk

Risk covers a wide range of content, in different situations contain different content, it is difficult to carry out theoretical analysis of risk. The definition of risk was first proposed by American researcher A.H. Moowbray, who pointed out that risk is the uncertainty that occurs in the event of undesired occurrence. Later research literature proposed that risk is the uncertainty of future loss, that is, loss is a result of risk, for example, in a project. The increase of construction cost and project delay are all different forms of loss [38,39].

Therefore, from the above analysis, it can be concluded that risk is defined as the loss that occurs when something happens in a way that is different from the expected (usually referring to a worse result than expected). In economics, risk is defined as the likelihood of a loss occurring, while in investment, it is defined as the degree to which the uncertainty of the risk causes the outcome to deviate from the expectation.

For power grid construction projects, many situations will be faced before the construction and implementation of the project. These risk factors can occur throughout the project phase, from design and construction to production and beyond.

In the power grid construction project, the risk factors are mainly composed of two factors, subjective factors and objective factors. Subjective factors are caused by personnel operation and technical level, and this uncertainty is difficult to predict and quantify accurately.

3.2 The Implementation Process of Power Grid Construction Project

(1) Power grid planning

The initial phase of construction project is often considered by the state, department and local authorities according to the situation and strategy of the existing grid. By systematically analyzing the actual situation of the existing power grid in the region, referring to the historical data and the current situation of the power grid, and making a reasonable prediction of the future situation, the current

actual situation and future development make a preliminary evaluation. The power Grid Project Investment plan systematically describes in writing the structure and completion method of the power grid construction project. Through the systematic analysis of the intuitive scheme, a reasonable project proposal is formed, which is at the milestone node of the project target design. Project investment planning mainly includes the following contents:

1) Ask questions. Make a comprehensive analysis of the planning of the power grid construction project, analyze the problems faced, and explain the need to solve the problems.

2) Solve the problem. Through multi-party communication and discussion, give corresponding solutions to the problems raised, and explain the impact and significance of the solutions to the overall planning of the power grid construction project, and make plans for the measures taken in the near, medium and long-term stages.

3) Summary and analysis. Make use of market analysis and necessary complex measures to put forward overall suggestions according to the solution, including the overall policy and strategy, and carry out an overall analysis of the construction project to evaluate the pros and cons of the project construction.

(2) Feasibility study

After the investment planning of the project, it is necessary to carry out the project feasibility study, which mainly includes the following aspects: 1) the necessity of the construction project; 2) whether the conditions of the construction project conform to the construction; 3) Whether relevant processes, technologies and equipment are applicable to the project; 4) Profitability of the project; 5) Project implementation time; 6) Project uncertainty analysis.

Project feasibility study is the basis for project investment decision, the basis for project fund raising and bank loans, the basis for contract signing with relevant departments, the basis for preliminary design of the project, and the basis for relevant departments to review the project. Therefore, the project feasibility study will play an important role in the whole process of the project. It is a reference for planning and carrying out the project.

(3) Make plans

After the completion of the project feasibility study, because the power grid construction project involves a wide range of content, so it is necessary to prepare a corresponding plan for each task, the general plan content is: time plan, resource plan, cost plan, quality plan, other plans.

(4) Project construction

After preparing the project plan, start the project construction, carry out progress control in the process of construction, and deal with it in time according to possible situations.

3.3 Characteristics of Power Grid Construction Projects

Due to its long construction period, large investment, many units involved, and high technical content, power grid construction projects are prone to design changes and project delays, which directly affect the operation of power grid enterprises, cause huge losses to the power grid operation of the whole region, directly affect the normal production of enterprises and the normal consumption of electricity in residents' lives, and have a great social impact. In summary, the risk characteristics of power grid construction projects mainly include the following points:

(1) Large investment and long construction period

Power grid construction project planning and construction period is long, the amount of capital investment is large, and the investment payback period is long. Especially some major projects, such as large thermal power stations, substations, long-distance transmission lines, etc.

(2) There are many factors affecting the investment effect, and the investment decision is complicated

Power grid construction projects are subject to social, political, economic, technical, natural and other constraints, any link of the failure, may lead to a decline in investment benefits, and the topology of the power grid continues to evolve, a variety of change factors and their uncertainties make the construction project investment decisions become complicated and difficult.

(3) The objective existence of risks

Risk always exists objectively, it will not change with people's will, although in the process of project construction will face a lot

of risks, these risks can not be completely eliminated, but by summarizing and analyzing the principles and laws of risk generation, reduce the occurrence of risks or weaken the consequences caused by risk occurrence. The power grid construction project contains a lot of content, during the whole project construction will face many conditions, the risk is inevitable, therefore, the power grid construction risk has the objective existence.

(4) Risk transmission

Power grid construction projects involve many links, in the whole design, construction, operation and operation of these stages are linked, the risk of these stages are also transitive, that is, the risk of the previous stage will have an impact on the later stage, this risk transmission is very common in power grid construction projects. For example, the technical management in the construction of the project does not meet the norms will lead to problems in the later power grid operation, and further affect the efficiency of power grid enterprises, especially the power grid enterprises in the form of new electricity reform.

(5) The risk concurrency

There are many risk factors in the whole power grid construction project, and the interaction between different risks may lead to the occurrence of accidents and even increase the risk of accident consequences. The interaction between the factors in the project leads to the risk joint reaction, and the result may make the risk occur in a certain period of time. Through the overall risk analysis of power grid construction projects, identify the interaction of possible risk factors in the project and timely understand the risk mechanism, which can effectively reduce the impact of risk concurrency on power grid construction projects.

(6) Risk variability

There are many risks in power grid construction projects, but construction projects are always in a dynamic process of change, so the risk factors are constantly changing, and the risk factors at different stages will lead to different consequences. In the process of constantly changing project process and construction plan, the risks in the early stage may disappear, while other risks will appear. For example, the use of a new technology in a power grid construction project may solve a risk in the past, but it may bring new risks and become a new source of risk.

3.4 The Risk Management Process

The main content of risk management includes four parts: formulating risk management plan, risk analysis, risk evaluation and risk control [40]. The risk management plan is mainly made from the internal and external factor analysis of the project, and the risk management plan is formulated, which is the charter of the implementation and management of the whole risk management. After that, risk identification, including the search for risk factors and analysis of risk factors, this is the most important step in risk management, it is the main content is the identification of risk factors, that is, to determine which risks will pose a threat to the project, and then focus on analysis. On the basis of risk identification, risk analysis is carried out, quantitative and qualitative analysis methods are adopted to evaluate the risk, determine the risk level, and judge whether the risk can be accepted by referring to the corresponding risk standards. After risk control, corresponding measures and programs are taken according to the risk situation, so as to control, restrain and reduce the risk. Especially in construction projects, the use of risk management can give decision-makers an intuitive situation, the specific risk management process is shown in Figure 1.

(1) Develop a risk management plan

Before the power grid construction project starts construction, the project department will prepare the project risk management plan according to the experience of previous construction projects, which includes the problems that may be encountered in each stage of the project and the corresponding solution measures to provide guidance for the project risk management.

(2) Risk identification

Risk identification refers to the systematic classification of project risks by relevant managers and researchers after careful investigation, using relevant theories and methods, referring to previous project experiences and current projects, and mastering the existing factors and consequences of risks.

(3) Risk analysis

After the project risk is identified, the risk that

is determined to constitute the project needs to be assessed to determine the level of risk. Usually, quantitative and qualitative methods are used for risk analysis. The risk with low risk level is usually not considered or simply qualitative analysis is carried out, while the risk with greater impact on the construction project should be quantitatively analyzed on the basis of qualitative analysis. Quantitative analysis of risk is to accurately calculate the identified risks using mathematical methods, and classify the analyzed risks according to their probability of occurrence and loss results. Usually, the following methods are adopted for quantitative analysis in risk analysis: analytic hierarchy process, direct method and expert scoring method.

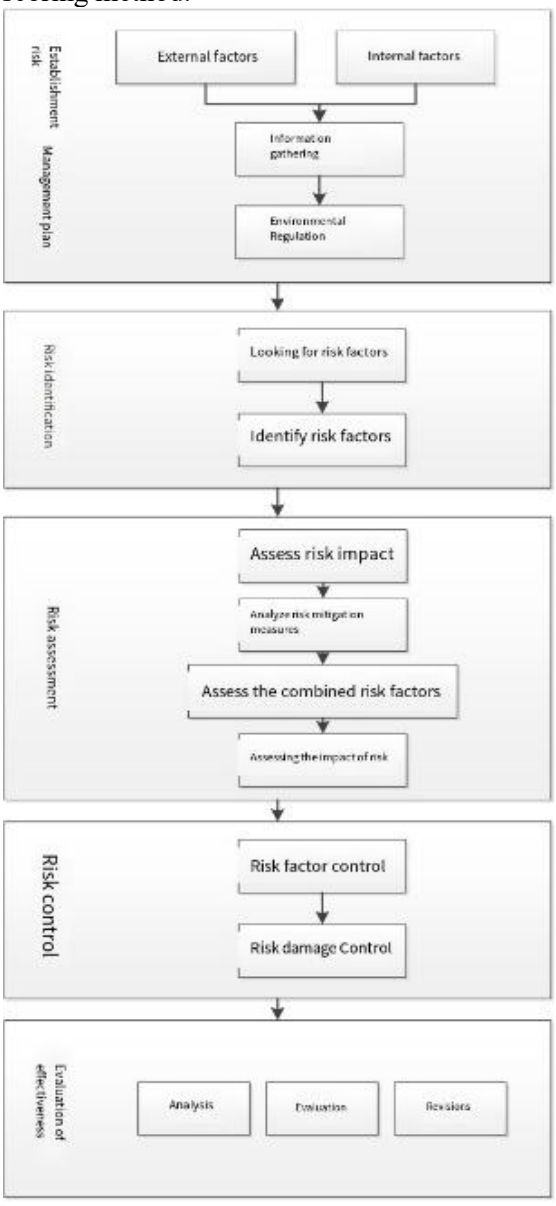

Figure 1. Risk Management Flow Chart

(4) Risk evaluation

Risk evaluation is a comprehensive evaluation of risk occurrence probability and loss degree and other related factors on the basis of risk analysis to form a risk index value, indicating the possibility of risk occurrence and loss. The project decision manager can make a comparative analysis according to the results obtained from the analysis and evaluation and refer to the standard risk of power grid construction projects to determine the risk situation. According to the comparative results, determine whether to take risk prevention measures and what measures to take. At the same time, the principle of the lowest reasonable feasibility should be adopted for the acceptability of risks. Since there will be risks in any project, and the lower the risks in the project, risk reduction on the basis of it will increase the cost of risk improvement, showing an exponential curve rise, and the marginal effect of risk improvement investment shows a diminishing situation, resulting in the reduced risk is not proportional to the input cost and cannot reach the maximum utilization rate of funds. Therefore, In this case, we need to measure the level of risk and the cost. Generally, there are three measurement methods. First, if the risk level of power grid construction project is higher than the unacceptable level of the enterprise, the risk will be rejected, and the link related to risk will be directly cancelled. The second is that the risk of the project is between acceptable and unacceptable, which requires risk investment analysis and risk return analysis; The third case is that the project risk is below the acceptable line, and there is no need to take improvement measures for the project risk.

It is precisely because of the large investment in power grid construction projects, the many links involved, and the corresponding number of risk factors, risk analysis can determine whether to take measures according to different risk situations. Because the risk improvement of factors with low risk requires high input cost, but the return after improvement is far less than the input cost, it is often adopted to accept the risk and save costs. Marginal benefit analysis is also applicable to the risk considerations in power grid construction projects.

(5) Risk control

Risk control is to take appropriate control methods for the risks that need to be improved after evaluating the risks, and to use scientific methods and means for risk control with reference to the goals and purposes of production safety. Usually there are risk monitoring, risk transfer, risk control and other methods, according to the actual situation of different projects to take the best project control method, with the lowest control cost to obtain the greatest safety guarantee.

(6) Evaluation effect

After the risk control in the project, the result after the control will appear. According to the result, the corresponding risk management plan will be formulated to constantly improve the project risk management.

4. Construction of Risk Identification and Evaluation Index System for Power Grid Construction Projects

4.1 Risk Identification of Power Grid Construction Projects

The risk identification of power grid construction projects is the basis of the risk assessment of power grid construction projects. A series of methods are used to identify the factors affecting the risk of power grid construction projects [41]. Due to the complexity of construction projects, it is necessary to carry out risk management for power grid construction projects, so it is necessary to identify project risks, that is, to adopt specific methods, systematically summarize, infer and predict the factors that have not yet happened and may have an impact on the normal construction of the project, understand the causes of risks, and analyze the sources of risks. Master the characteristics of risk factors and the phenomenon of risk generation, when necessary, quantitative evaluation of the consequences of risks, so that managers can discover risks in time, improve the reliability and security of management, therefore, the use of relevant methods for risk identification is helpful to understand the risk and control the risk generation. At present, risk identification mainly includes accident statistical analysis, failure mode and impact analysis, failure number analysis, safety checklist analysis, accident tree analysis, risk analysis questionnaire, asset risk exposure analysis table, risk trend estimation table, etc. [42-43].

4.2 Construction of Risk Evaluation Index System for Power Grid Construction Projects

4.2.1 The basic function of evaluation index system

(1) Evaluation function

The risk evaluation index system of power grid construction projects is composed of various influencing factors. Each evaluation index is judged collectively by the expert group and given weight, and the comprehensive score value of the elements can be calculated, according to which the risk of the power grid construction project can be comprehensively evaluated. At the same time, by analyzing the score value of each factor index, the influence of each factor on the risk of power grid construction project can be evaluated.

(2) Monitoring function

Through the continuous analysis and sorting of the risk evaluation index in a certain period, the static state and changing trend of the risk of the construction project can be reflected from different angles, and the required result report can be generated to realize the monitoring function.

(3) Forecasting function

According to the prediction conditions of the risk evaluation index system, the index is calculated and judged, the forecast information is obtained, and the risk prediction function is realized, which is convenient for the dynamic risk management of the power grid project.

In fact, the risk evaluation index system of power grid construction projects can be used as a set of early warning tools, so that power grid enterprises can evaluate, measure and warn their various capabilities and functions, and call corresponding schemes in the scheme library according to different early warning results, so as to facilitate the management to make timely decisions.

4.2.2 The basic principles of evaluation index system construction

From the evaluation object of the project risk evaluation index system, it involves each stage of construction and various influencing factors. The evaluation index can reflect the risk of the project, and the setting of the evaluation index must obey the special law of the development and change of the risk of power grid

construction. Whether the index is scientific or not is directly related to the evaluation result. Therefore, in the construction of electrical risk management evaluation index system, the following principles should be followed:

(1) Scientific principles

The project risk assessment index system should have a clear hierarchical structure, from local to whole, from simple to complex, and can draw an intuitive conclusion on the project risk level on the basis of quantitative and qualitative analysis. Only a comprehensive risk evaluation index system for power grid construction projects can truly reflect the actual situation of project risks and provide support for project construction to make correct judgments and decisions.

(2) Feasibility principle

When designing the risk rating evaluation index system of power grid construction projects, representative main indicators should be selected as far as possible. While considering the relative systematicness and integrity, feasibility is particularly important. It is necessary not only to prevent all aspects but also to prevent too simple. If the indicators are too complex, it will be difficult to reflect the full picture of the risks. Therefore, when setting the index system, we should try our best to avoid forming a complex index number or too large index group. Therefore, it is necessary to ensure that the risk assessment indicators have strong practicability and operability, so that the indicator data is easy to collect, the calculation formula is scientific and reasonable, and the evaluation process is simple, so as to ensure the timeliness of the indicator data collection and facilitate the assessment personnel to master and operate.

(3) Principle of comparability

When setting the risk evaluation index, it is necessary to consider that the evaluation index should be convenient for vertical and horizontal comparison. That is to say, it can be used for sequential comparative analysis, and can also be used for comparative analysis between different construction projects. The so-called vertical comparison, that is, compared with historical figures, the risk assessment index of power grid construction projects should be relatively stable. The so-called horizontal comparison, that is, the risk level between different construction projects should be comparable.

(4) The principle of completeness

When selecting indicators, the content of evaluation should be covered as much as possible. If there are omissions, the evaluation will be biased. Therefore, the selection of indicators should start from the whole and reflect the risk level of power network infrastructure from multiple angles and in all aspects, including spatial integrity and time integrity. Spatial completeness means that the evaluation index system forms a system, which should include the main aspects of power grid project risk; Time completeness means that the evaluation index system, as an organic whole, can reflect the project risk operating status from different angles and also reflect the project risk operating status. Only the established index system can fully reflect the characteristics of all aspects of the research object, in order to conduct comprehensive evaluation of the research object.

(5) The principle of reference and innovation

In the process of constructing the risk assessment index evaluation system of projects, the practical experience in the construction of risk management index of other projects should be used for reference, and then innovation and breakthrough should be achieved according to the characteristics of the power industry and the market characteristics. We should start from the objective reality, after systematic analysis and scientific abstraction, to design the risk index evaluation system, so that the evaluation indicators can objectively reflect the risk level of power grid construction projects.

4.2.3 Power grid construction project risk index selection

The construction of the risk assessment index system is based on the identification of the risk factors of power grid projects. According to the analysis, induction and summary of different risk factors, seemingly scattered and unrelated factors are integrated to form a risk assessment index system and conduct systematic analysis. Based on the characteristics of power grid construction projects, the selected index basis is shown in Figure 2.

To construct the risk evaluation index system of power grid construction projects, the most important is to determine the risk factors. In this paper, risk factors are proposed by risk tree method. At the same time, combined with

the opinions of relevant power grid construction project managers and power grid construction project experts, brainstorm. Risk analysis of power grid construction projects is mainly determined from the aspects of political risk, economic risk, environmental risk, management risk, technical risk and social risk [44], as shown in Table 1.

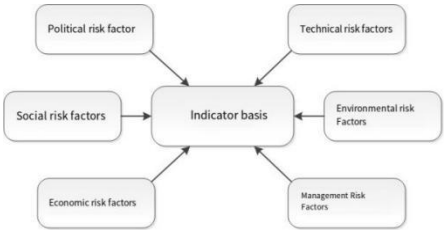

Figure 2. Fundamentals of Risk Indicators

Table 1. Risk Model Index System of Power Grid Construction Projects

Target layer	Level 1 Indicators	Secondary indicators
Grid construction project risk	Policy risk indicators	Actions of government authorities Changes in policies and regulations
	Economic risk indicators	Financing risk Degree of difficulty in capital turnover Cost of capital risk profitability
	Environmental risk indicators	Geological risk Meteorological risks Natural disasters
	Management risk indicators	Degree of informatization Ability to distinguish and process information
	Technical factors Indicators	Design changes Technical difficulty Use of new technology
	Social risk indicators	Planning risk Land acquisition Public opinion risk

5. Power Grid Construction Project Evaluation Model

5.1 Model Construction Ideas

The main content of the risk assessment of power grid construction projects is to use the specified standards and indicators and scientific methods to judge the size of the risk, analyze the risk ranking of each construction project index in the fields of economy, security, politics, society, environment and so on, show the real risk status of the project and provide a strong basis for the final decision of the project. The project risk value can be studied from different perspectives. It should be pointed out that each sub-item in the project is independent and each sub-item is professional. The overall risk of the project is not determined by the risk size of a specific index, so it is necessary to build an overall comprehensive risk assessment model and comprehensively evaluate each sub-item. Finally, a reliable risk conclusion can be drawn.

5.2 Model Building Methods

There are many methods to conduct evaluation research in the comprehensive evaluation, including: expert consultation method, background investigation method, mathematical model method, field monitoring, mathematical model method, analog analysis method and so on. However, there are many qualitative indicators that are difficult to be quantified, and subjective judgment problems exist in many places in the process of comprehensive evaluation of risk projects, such as the selection of indicators in the index system, the determination of the weight of indicators in the index system and the acquisition of qualitative index values. However, individual cognition cannot reach the level of insight into all aspects of objective things. Due to this limitation, it is impossible to fully and accurately express the final feedback results of objective things in the human brain, and finally, it can only be fuzzy judgment. The process of judgment is the most susceptible to subjective factors, including

psychological factors or the influence of the surrounding environment, and various uncertain factors become the random factors that affect subjective judgment. On the other hand, the system factors that affect the judgment process include the knowledge structure, talent, experience and the level of obtaining the information of the judge.

Since the evaluation index system constructed in this paper are all qualitative indicators, it is necessary to adopt expert scores to construct relevant evaluation matrix when applying analytic hierarchy process to model. However, experts have different views and differentiated data due to the environment they are in, the accumulated practical experience and the fields they are good at, etc. This information is subjective, inaccurate and gray. However, if the experts' scoring results are simply averaged, the differences in cognition among the experts will be ignored, resulting in the deviation of the evaluation results. In order to reduce the pure subjectivity of the data obtained according to the scores of different experts, the entropy weight method, an objective weighting method, is used to calculate the weights of indicators. At the same time, in order to avoid the simple average handling of experts with different opinions, the concept and theory of Grey system are introduced, the analytic hierarchy model of judgment matrix is improved, the analytic hierarchy model is constructed, the subjective and objective weights are calculated, the Grey system theory is introduced, and the comprehensive score is obtained by univalued. Then, according to the range of the comprehensive score, the comprehensive evaluation conclusion is drawn, and the corresponding countermeasures are put forward.

6. Conclusion and Prospect

The main research results of this paper are as follows:

(1) The risk theory of power grid construction projects is analyzed. This paper expounds the implementation process of power grid construction project, as well as the risk factors and risk characteristics faced in the implementation process, and introduces the relevant theories of risk management from the aspects of process, link, assessment and prevention.

(2) The risk evaluation index system of power grid construction projects has been established. This paper analyzes the relevant theories of risk identification, explores risk assessment indicators from six aspects of policy, economy, environment, management, technology and society through brainstorming method and risk tree method, and constructs an evaluation index system including 6 first-level indicators and 20 second-level indicators.

(3) Research on risk assessment model of power grid construction projects. Construct a risk assessment model. In view of the complexity and uncertainty of power grid construction projects, the judgment matrix of AHP is improved based on the grey system theory, and the weight of AHP is calculated based on the entropy weight method, and the AHP is optimized, and a risk assessment model based on grey hierarchy analysis is established.

By identifying and evaluating the risks of power grid construction projects, risk managers have a certain understanding of the various risks and potential losses existing in power grid construction projects. It is hoped that on this basis, power grid projects can seek to avoid, transfer, mitigate and utilize risks, which is not only realistic, but also can turn risks into opportunities or minimize the negative effects of risks.

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