

Study on the Whole Process Risk Management System of Power Grid Construction Projects

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Abstract

With the rapid development of economy in China, the importance of power grid construction projects is increasingly highlighted and the environment and risks encountered by power grid construction projects also become more and more complicated. In order to ensure that perfect social and economy benefits of power grid construction projects are realized, it is necessary to practically enhance the risk management level of power grid construction projects. Based on an overall analysis of the features of objectivity, uncertainty and change of risks in power grid construction projects, this article begins with the whole process of project construction, conducts a systematic study on the whole process risk management system of power grid construction projects from the three perspectives of whole process risk identification of power grid construction projects, whole process risk evaluation of power grid construction projects and whole process risk management measures of power grid construction projects and provides reference for management personnel of power grid construction projects in enhancing their risk management level.

Keywords: power grid construction project, whole process management, risk management, risk evaluation

1. Introduction

Social and economic benefits of power grid construction projects are especially prominent. The technique of power grid construction projects is complex, the construction aspects and constraint factors are various and they involve a lot of aspects of planning, design, construction and supervision, etc. There is great unpredictability and randomness in a variety of factors that affect the construction of power grid and the economic benefits, which makes the construction and management of power grid construction projects have great risks. With enormous development of the national economy, rapid increased demand on electric power and continuous deepening of the institutional reform of electric power, risk management of power grid construction projects has received more and more attention by all participating parties involved in the construction projects and all walk of life in the society have higher demand on the risk management level of power grid construction projects. Thus, it is of great significance to study the identification of risks in power grid construction projects and corresponding management system.

2. The Concept and Features of Risks in Power Grid Construction Projects

Risks in power grid construction projects can be defined as possibility that the goal of power grid projects is unlikely to be realized or suffering from any damage caused by losses on the conditions specified by the goal of power grid projects (Wang Jufeng, 2006). Risks in power grid construction projects mainly have the following characteristics:

2.1 Objectivity of Risks in Power Grid Construction Projects

In the entire process of project activities, the factors causing risks are various, so it is unlikely to totally eliminate these risks since a lot of factors are themselves uncertain. Hence, happening of risks is objective and also necessary. And in order to reduce and avoid any damage caused by risks, it is a must to discover in due time all kinds of factors that might lead to risks and adopt scientific methods to conduct effective risk management.

2.2 Uncertainty of Risks in Power Grid Construction Projects

Uncertainty of risks aggrandizes difficulty of identification and control of risks. However, a systematic analysis

of factors causing risks based on the scientific theory of risk management and appropriate employing of corresponding technical methods and means may effectively control risks in power grid construction projects.

2.3 Changes of Risks in Power Grid Construction Projects

The amount of risks may change. With reinforced consciousness of project management personnel in risks and improvement of risk management methods, some risks may be taken under control to a certain extent and the frequency of occurrence of risks and amount of losses may be reduced. However, with proceeding of the projects and development of other new activities, new risks will continue to emerge.

Therefore, considering the characteristics of power grid construction projects and the periodicity of the risks of the projects, this article employs the dimensionality of whole process to make an analysis of risk management in power grid construction projects.

3. Identification of Whole Process Risks of Power Grid Construction Projects

The construction process of power grid construction project is one imbued with risks and the main reason is that it is unlikely to have an overall mastery of a lot of information in the process of power grid construction project. For instance, it is unlikely to completely predict the developmental process of power grid construction projects, which makes the power grid construction projects dynamic and uncertain. Hence, identification of risks in power grid construction projects is the basis to take control over the whole process risks in the power grid construction projects.

3.1 Risk Factors at the Stage of Decision Making and Feasibility Research of the Projects

At the stage of decision making and feasibility research of power grid construction projects, the major risk factors include the following two, namely, technical risk factors and project management risk factors. The technical risk factors include information risks and technical parameter selection risks. Information risks include local economic development planning information, power load forecasting information and related policies, laws, rules and regulations, etc., which is the basis for decision making of power grid construction projects. In technical parameter selection risks, it is necessary to refer to similar projects that have been constructed according to the actual requirements of power grid construction projects and reasonably determine major technical parameters for electric transmission and transformation equipment (Song Wei, 2009), which will directly decide the scale of investment in the projects and the production and operation security in the future. Project management risk factors include feasibility research report and project approval procedures. The former is the primary evidence for decision making of the projects and its depth and width will bring important influences on decision making of the projects. Thus, it is the key to success or failure of the entire project and determines the level of risks the entire project will encounter.

3.2 Initial Design and Bidding Stage

At the stage of design and bidding of power grid construction projects, the major risk factors encountered include technical risk factors, economic risk factors and bidding risks and contract management risks. Technical risk factors include information risks and design alteration risks. Information risks include a large amount of related information used for bidding of design, bidding of equipment and bidding of construction and submitting data and information by equipment manufacturers and design units (Deng Tiejun, 2008). Design alteration mainly refers to timely alteration made to any design issue discovered after a joint hearing of the working drawing and the significant adjustments made to the design plan in the process of the design, which will affect the design progress and investment of the entire project. Economic risk factors include financial and financing risk which mainly refers to the risk caused by finance and financing of the equipment manufacturers and construction contractors to the entire project, interest risk, the change of which has certain effects on increase of investment costs of the project and may bring about certain interest risk and risk of rise in price of raw materials. Bidding risks and contract management risks include bidding risks of design, supervision, equipment and construction. Bidding risks include risk of bidding flow management and risk of aptitude of the design unit and the participants of the supervision unit. In the power grid construction projects, investment in equipment material occupies a large proportion of the total investment, so insufficient preparation of equipment material bidding, deficiency of bidding document, defect of contract document, a wrong bidding winner, inappropriate classification of bidding and inappropriate handling of a dispute in the process of carrying out a contract will lead to great risks to the entire project.

3.3 Construction Stage

The major risk factors encountered at this stage include technical risk factors, social, political and economic risk factors and project management risk factors. Technical risk factors include whether a design takes into

consideration of feasibility and safety of the construction and design alteration risks. Conditions of a construction site are complicated and a lot of theoretically feasible technical programs may be unlikely to be fulfilled on the construction spot due to a variety of factors. As a result of complexity of the power grid construction project itself, occurrence of alteration of a design is unavoidable and the alteration of a design itself belongs to control after the event. Therefore, its occurrence may lead to increase in the amount of the project and the expenses and laggard progress of the project. Social, political and economic risk factors include public interference and obstruction risk, public security risk which here refers to the public security risks of prevention of burglary and prevention of robbery, and risk of rise in price of raw materials which includes changes in price of raw materials used for manufacturing power transformation equipment, materials of power transmission line and materials used for construction. Power grid construction projects contain the following management goals: management of investment, quality, progress, security, contract and equipment. Since the technique of power grid transmission and transformation projects is complicated, there exists a lot of specialization of work and all participants involved in the projects have different purposes, a lot of information adhesion often happens in the actual project management (Guo Bo, Gong Shiyu & Tan, Yuntao, 2008). Thus, there are a lot of management interfaces in power grid construction projects, leading to risk of interface management.

3.4 Completion Acceptance and Summary and Assessment Stage

This stage is one at which the contractor reviews implementation of a project in a comprehensive way and sorts out data about construction. At this stage, final audit of returns of a completed project, settlement and supervision of the project, price auditing of the project and confirmation and auditing of the amount of the project all have certain effects upon the quality of the completion work of the entire power grid construction project and upon the final cost of construction. If the work responsibilities of different departments are ambiguous or coordination of different departments is insufficient, it might affect correspondence of specification, type and quantity of the fixed assets subsidiary ledger and the physical assets, cause the fixed assets that have been put into operation to be unable to be brought into fixed asset management and add to risks of losses of the assets of the companies.

4. Whole Process Risk Evaluation of Power Grid Construction Projects

4.1 Statistics of Data about Whole Process Risks of Power Grid Construction Projects and Risk Estimation

Statistics of data is the basis of risk evaluation. It is necessary to collect all data and materials related with the risk events to be analyzed. These data and materials may be either acquired from summary of experiences or historical records in the previous similar engineering projects, or empirical and subjective evaluation materials with professional knowledge can be obtained with the method of survey by experts and all data and materials collected have to be objective, authentic and statistical.

Risk evaluation is to give a priority ordering and evaluation in accordance with the degree of potential dangers from the perspective of all stages in the whole process of risks in power grid construction projects (Gong Jian, 2008). Risk evaluation of power grid construction projects mainly employs statistical method, analysis method and inferencing method, which is enough to prove statistics of data about features and conditions of the objects evaluated as the guarantee. According to risks at all the stages of the whole process of power grid construction projects and the connotation of risk evaluation of power grid construction projects, the major content of risk evaluation includes possibility of occurrence of risk events at all stages in the whole process, the result scope and extent of dangers of possibility of occurrence of the risk events, the time anticipated of the occurrence of the risk events, frequency of occurrence of the risk events, and so on.

4.2 Construction of a Risk Evaluation Model

Evaluation of risks in the whole process of power grid construction projects makes evaluation on risks in power grid construction projects from two dimensionalities. On one hand, it makes evaluation on a single risk event at all stages in the whole process. On the other hand, it makes evaluation on all the stages of the whole process and on the total risks of the projects. Evaluation of risks in the whole process of power grid construction projects usually employs the following several common methods.

4.2.1 Subjective Scoring Method

In this method, management personnel of a project judge the risk of certain risk factor among all risk factors at each stage of operation process of a power grid construction project based on experiences of experts and give a subjective score to the risk, and then analyze whether the project is feasible or not.

4.2.2 Fault Tree Analysis

We make an analysis of all factors that might lead to failure of the projects in the process of qualitative analysis of risks in power grid construction projects, draw a logic diagram and determine a tree structure chart with all possible ways of combination of reasons leading to failure of the projects. Fault tree analysis has a fixed analysis flow, can be constructed and analyzed with the assistance of computer and may, to a great extent, increase the efficiency of the whole process risk management of power grid construction projects.

4.2.3 Analytic Hierarchy Process

Through combination of qualitative analysis and quantitative analysis, this method has the features of flexible application and easy intelligibility in analysis and evaluation of power grid construction projects and have certain degree of precision.

4.2.4 Monte Carlo Simulation Approach

Monte Carlo Simulation is able to effectively deal with multiple uncertain factors encountered in power grid construction projects and effectively identify the sensitive factors that cause changes in all risks by means of taking into an overall consideration of the probability distribution of all risk variables, which is helpful for quantification and materialization of risk management.

5. Whole Process Risk Management System of Power Grid Construction Projects

Whole process risk management of power grid construction projects is a complete system that includes multiple aspects, is omnibearing, multi-level and systematic. On the basis of the current advanced management regulations, flow and method of the State Grid Corporation of China and on the basis of taking into consideration of the whole process risk identification and risk evaluation of power grid construction projects, we can classify the whole process risk management system of power grid construction projects into four levels.

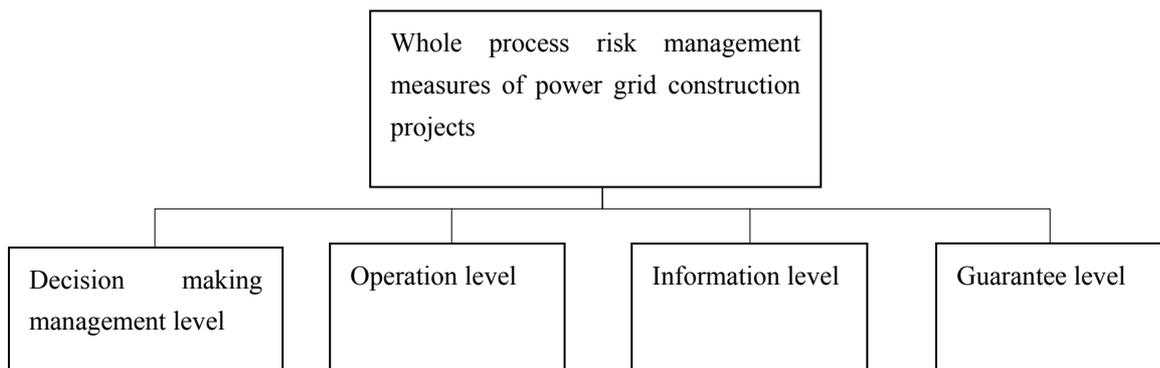


Figure 1. Whole process risk management system of power grid construction projects

5.1 Decision Making Management Level

The primary task of decision making management level is to form a whole process risk management and organization institution of power grid construction projects (Sun Lili, 2010). Under the current management model, personnel in all departments are transferred to constitute a team or department of whole process risk management of power grid construction projects who begin to take full responsibility of corresponding risk management job at the very beginning of the launching of the projects. The major function of decision making management level is to set up and improve all kinds of basic risk management coordination mechanism, risk early warning mechanism, risk prevention mechanism and risk transfer mechanism, etc., and offers a high level decision making and coordination mechanism to serve for decision making of the running of the organization and the coordination of interests. Meanwhile, this level takes a dynamic risk control over the progress, quality, safety and contract of power grid construction projects and make corresponding adjustment and optimization in accordance with feedback of information.

5.2 Operational Level

The primary task of operational level is to subdivide, including related first line personnel involved in feasibility research, design, construction, material delivery and acceptance check in the process of implementing the power grid construction projects. This level mainly places particular emphasis on implementation of specific risk management work and takes charge of project decision making in the process of implementing the power grid construction projects and risk identification, early warning, control and management of such operational business as feasibility research, design, bidding and purchase stages, construction, completion acceptance and summary

and evaluation, etc. This includes materialization of risk responsibilities at all stages, preferential selection and design, construction and supervision and debugging unit, strengthening risk responsibilities of operation in design, supervision and debugging and dispersing risks by means of contract terms.

5.3 Information Level

The primary task of information level is to optimize, including risk management information platform, risk early warning system, risk management expert system, risk evaluation and typical engineering database and auxiliary decision making and calculation system. Information level is a necessary condition to support implementation of whole process risk management of power grid construction projects. Information level is the basis for fulfilling all other levels, offers a variety of data and information support for whole process risk management activities of power grid construction projects, finishes integration, analysis, optimization, sharing, information transmission and interaction of all related information and resources so as to help carry out and implement all kinds of coordination and management mechanisms, and, in the meantime, provide repeated feedback on the effects generated by all other levels and provide evidence for decision making and control.

5.4 Guarantee Level

The primary task of guarantee level is to guarantee effective operation of the whole process risk management system of power grid construction projects, including the basic support of cooperation and trust, incentive and constraint, exchange and communication (Hu Cuijuan, Ju Meiting & Shao Chaofeng, 2010), organization and learning and so on. The guarantee mechanism of whole process risk management of power grid construction projects is the fundamental guarantee to coordinate effective proceeding of risk management implementation activities, has an important influence on the entire level of risk management of power grid construction projects, helps to strengthen sufficiency of decision making of risk management and offers support and guarantee for design and running of risk management mechanism of power grid construction projects.

6. Conclusion

A complete whole process risk management system of power grid construction projects can not only ensure that the construction, coordination and management of power grid construction projects are more standardized and institutionalized, but can also enhance the working efficiency of risk management of power grid construction projects, help to successfully prevent, transfer and disperse multiple risks in power grid construction projects and finally realize effective management on the whole process risks of power grid construction projects.

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