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Analysis on the construction and application of comprehensive evaluation index system of construction quality of power transmission and transformation project

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Science and technology project of State Grid Fujian Electric Power Co., LTD.: Construction of work quality evaluation system of participating units in power transmission and transformation project construction; Project No:B1130T22000N.

Abstract. As the basic project of urban construction and development, power transmission and transformation project mainly provides sufficient power resources for urban residents, so the construction quality of the project determines the work efficiency and service quality of the power industry. With the continuous development of social economy and science and technology, the number of power transmission and transformation projects in our country is increasing, the scope of project construction is getting larger and larger, and the actual construction period is getting smaller and smaller, which leads to the quality of the project itself is not guaranteed. Therefore, on the basis of understanding the construction status of power transmission and transformation projects, this paper mainly explores how to construct the comprehensive evaluation index system of power transmission and transformation projects construction quality, and analyzes the corresponding management measures from the perspective of project construction.

Keywords: power transmission and transformation project; Construction quality; Comprehensive evaluation; Index system.

1. Introduction

Power construction project as the focus of China's modernization development, power transmission and transformation project belongs to the basic component of power engineering, project quality not only affects the operation of the project itself, but also determines the power supply quality of the power system operation, and has a far-reaching impact on the national economic development. The power transmission and transformation project has more special properties, the practical construction is more complex, the various processes are more numerous, and the requirements for material properties and application equipment are extremely high, so there are often a variety of quality problems during construction. At present, how to improve the construction quality of power transmission and transformation projects is the core issue that power enterprises and research scholars mainly explore. Accurate evaluation of the construction quality of power transmission and transformation project is a prerequisite for ensuring the quality management of the project construction. Nowadays, scholars at home and abroad have put forward a number of issues in the study of comprehensive evaluation, but there are few studies on the construction of the index system used in comprehensive evaluation, which leads to the structure of comprehensive evaluation is not scientific and normative, and the management measures proposed in practice also have defects.

Most power transmission and transformation projects work in the open air, and there are many potential dangers under the influence of natural conditions. If we start from the perspective of the entire construction process, it is difficult to construct and apply the quality management evaluation

index system, and the resistance to index extraction and task screening is relatively large. Therefore, some scholars classify power transmission and transformation projects according to the construction process. According to different construction requirements and construction contents, the corresponding quality evaluation system is formulated. Generally speaking, the power transmission and transformation project can be divided into two parts: on the one hand refers to the power transmission project, on the other hand refers to the power transformation project. The former is mainly the construction and planning of transmission lines, while the latter is the construction of civil engineering and electrical equipment. Both of them analyze the construction quality problems of projects according to different construction processes, select clear and accurate evaluation indicators, and establish a more perfect quality evaluation system.[1-5]

In the construction of power transmission and transformation projects, construction quality control refers to the selection of reasonable management activities and operating technologies on the basis of meeting the requirements of project quality, accurate identification and correction of various links of construction operations, selection of application methods consistent with technical requirements, to ensure that the project quality is consistent with the expected standards. Generally speaking, construction quality management should follow the following principles: First, people-oriented. The quality control of power transmission and transformation engineering should follow the principle of people-oriented, take people as the main body of quality control, give full play to the initiative of people, improve the professional quality and responsibility consciousness of staff, and reduce the probability of human error. Second, implement quality standards. In the construction management of power transmission and transformation projects, quality standards are used as the basic basis for project quality assessment. In order to improve the quality level of engineering construction, various work should be carried out in strict accordance with contract standards and quality standards, and the basic work of inspection and acceptance should be completed in an orderly manner. Third, always adhere to the prevention first in the construction management of power transmission and transformation projects, to effectively intervene in all aspects of the construction quality, accurately identify and analyze the potential factors affecting the quality of the project, and finally put forward effective preventive measures. Therefore, after understanding the status quo of quality assessment and management of power transmission and transformation projects in the new era, this paper mainly explores the quality management measures of power transmission and transformation projects in line with the requirements of the new era by constructing a comprehensive evaluation index system of power transmission and transformation engineering quality, taking power transmission and transformation engineering construction projects in a certain period as an example.

2. Method

2.1 Gray rough set

Establishing a perfect index system is the basic condition to obtain the evaluation effect. Generally speaking, the objectivity and accuracy of the final evaluation results can be guaranteed only when the evaluation index system is scientific and reasonable. Nowadays, there are a lot of researches on evaluation index system. At present, various evaluation index systems have been formed with the help of various literatures. However, due to the lack of scientific theories as guidance, various problems have been caused. This paper studies the use of grey rough set to screen

indicators, which means the combination of grey correlation aggregation in grey theory and knowledge in rough set, the use of comprehensive theory to establish an index optimization model, quickly screen the selected indicators.[6-9]

Index minimalism refers to the classification of the selected index, the use of grey clustering analysis, select and define different defined values to obtain different classification results. In order to ensure that the selected critical value meets the requirements, the optimal critical value should be determined according to the F statistic. The numerator of the F statistic represents the distance between classes and the denominator represents the distance between samples within the class. In other words, the larger the F value, the better the classification results obtained. After obtaining the best classification by using grey cluster analysis, the knowledge reduction index of rough set can be selected, and the index system as shown in Table 1 below can be obtained:

Table 1 Comprehensive evaluation index system of construction quality

Category system	Specific indicators
Construction quality of transmission line engineering	Construction quality of foundation engineering
	Construction quality of tower engineering
	Construction quality of stringing project
	Accuracy of pile position retest
	Grounding engineering quality
	Frequency of short circuit occurrence
	Construction quality of optical cable
	Engineering related information
Civil construction quality of substation engineering	Construction quality of main structure
	Construction quality of structure, support foundation and equipment foundation
	Construction quality of cable trench
	Construction quality of indoor ground and roof of substation
	Construction quality of retaining wall
	Backfill quality
	Road construction quality
	Preventive effect of structural corrosion
Electrical construction quality of substation engineering	Construction quality of electrical equipment
	Construction quality of secondary wiring
	Matching degree between installation materials and installation site
	Construction of transformer and reactor system
	Construction quality of cable laying
	Construction quality of grounding device
	Quality of electrical equipment itself
	Construction quality of bus device
	Construction quality of transformer
	Construction quality of series compensation device
	Construction quality of reactive power compensation device
	Construction quality of lightning arrester
	Construction quality of screen cabinet and terminal box

2.2 Index System

According to the analysis in Table 1 above, it can be seen that the construction quality management of power transmission and transformation projects contains many indicators, and there may be overlapping among various symbols. In order to effectively solve problems such as the solubility of indicators, an index optimization model with gray rough set as the core can be used. Eight indicators are selected in the process of establishing indicators, and six relevant research experts are invited to score the possibility of reduction by using these eight indicators. The actual scoring results are shown in Table 2 below, which are expressed in terms of the percentage that can be reduced between the two indicators, and will be recorded in the form of decimal less than or equal to 1:

Table 2 Scoring results of index reduction

Fractional index						
	1.00	0.62	0.74	0.83	0.47	0.96
	0.97	0.86	1.00	0.89	0.84	0.95
	1.00	0.57	0.89	0.93	0.63	0.91
	0.96	0.67	1.00	0.92	0.89	0.90
	0.82	0.70	1.00	0.81	0.79	0.88
	1.00	0.57	0.79	0.87	0.69	0.87
	1.00	0.72	0.83	0.80	0.51	0.97
	0.79	0.41	0.58	0.30	0.13	1.00

Finally, the original eight indicators are screened into four indicators, and the actual construction results are shown in Table 3 below:

Table 3 is a summary of construction quality indicators

Subcategory	Specific indicators
Construction quality of transmission line engineering	Construction quality of foundation engineering
	Construction quality of tower engineering
	Quality of stringing project
	Grounding engineering quality

Comprehensive evaluation indicators and optimization methods of other construction parts can be obtained successively according to the above steps, and finally the index system as shown in Table 4 below can be obtained:[10-13]

Table 4 Final construction quality index evaluation results

Category system	Specific indicators
Construction quality of transmission line engineering	Construction quality of foundation engineering
	Construction quality of tower engineering
	Quality of stringing project
	Grounding engineering quality
	Construction quality of main structure
	Construction quality of structure, support foundation and equipment foundation
Civil construction quality of substation engineering	Construction quality of cable trench
	Construction quality of indoor ground and roof of substation

	Backfill quality
	Preventive effect of structural corrosion
	Construction quality of electrical equipment
	Construction quality of secondary wiring
	Construction quality of transformer and reactor system
	Construction quality of cable laying
Electrical construction quality of substation engineering	Construction quality of grounding device
	Construction quality of bus device
	Construction quality of transformer
	Construction quality of series compensation device
	Construction quality of reactive power compensation device
	Construction quality of lightning arrester

According to the analysis of the construction characteristics of power transmission and transformation project, the construction quality management is an important problem that is generally concerned at present. In order to further improve the level of construction quality and reduce the probability of safety accidents in power transmission and transformation projects, this paper focuses on analyzing the main problems affecting quality management during construction from the perspective of comprehensive evaluation index of construction quality, and systematically analyzes the construction process of comprehensive evaluation index system of construction quality of power transmission and transformation projects by using relevant theories of gray rough sets reasonably. Each provides an effective basis for subsequent quality management.

2.3 Hierarchical comprehensive analysis method

Based on the environmental impact characteristics of power transmission and transformation projects, the stage of environmental impact assessment is discussed in depth, a comprehensive analysis is made of the environmental impact assessment of power transmission and transformation projects, and a criterion layer is formed from three aspects: design period, construction period and operation period, looking at the basic objectives. On this basis, the main factors affecting the environment in each stage are selected, as shown in Table 5 below:[14-15]

Table 5 Evaluation index system of impact on environment

Target layer	Criterion layer	Index layer	
Comprehensive analysis of environmental impact assessment of power transmission and transformation project a	Design period B1	Substation site selection	C1
		Route direction	C2
		Tower base position	C3
		Environmental protection measures and facilities	C4
		vegetation deterioration	C5
		Land occupation	C6
		Environment in ecologically sensitive areas	C7
	Construction period B2	water environment	C8
		Atmospheric environment	C9
		acoustic environment	C10
		Solidity	C11

		Demolition and resettlement	C12
		electromagnetic environment	C13
	Operation period B3	acoustic environment	C14
		water environment	C15
		Landscape aesthetics	C16
		environmental risk	C17

From the perspective of power transmission and transformation project construction management, its impact on the surrounding natural environment, ecological stability and even social development is mainly concentrated in the construction and operation stage. During the construction period, the common manifestations are machine noise, expansion of land area, destruction of vegetation, etc. During the operation period, the environmental impact includes domestic sewage, environmental risks, electromagnetic environment, etc. The environmental protection means of China's power grid technology projects are divided into two aspects, on the one hand refers to the construction of power transmission and transformation environmental impact assessment system, and on the other hand, fully implement the completion of environmental acceptance system. At present, scholars from various countries have put forward a large number of analyses based on power transmission and transformation, but because the construction environment is characterized by uncertainty, complexity and long-term nature, it is impossible to make accurate judgments in practice. Studies on environmental impact assessment of power transmission and transformation projects are in the initial stage, and relevant theoretical analysis is relatively backward. Therefore, positive influencing factors should also be considered in future construction quality assessment. Only in this way can we provide reference for the construction of environment-friendly power transmission and transformation projects.

3. Result analysis

Due to the high technical requirements of power transmission and transformation projects, high-quality construction projects are the main factors to ensure the quality of power grid operation. Although the quality of most power transmission and transformation projects in our country has been very stable, there are still many problems in the basic engineering and construction process, which directly affect the comprehensive level of project quality. Therefore, after constructing the comprehensive evaluation index system for the construction quality of power transmission and transformation projects, scholars put forward the following construction quality management measures: First, establish a sound construction responsibility system. During the construction management period, the construction unit should put forward a perfect construction responsibility system, scientifically allocate all aspects of the staff, assign each work to a special person, and clearly divide the basic work responsibilities. Second, scientific acceptance of construction materials. The quality of building materials and equipment is the basic condition to ensure the quality of construction management. If the construction quality is unqualified, it will directly affect the quality of the project. Therefore, in the selection of materials and equipment, it is necessary to prioritize the proper way to purchase, to ensure the quality of materials, but also to control the cost of materials, and always in accordance with the standards of project construction management requirements for inspection management. Third, control the quality during construction. The quality management of construction process is the basic factor to guarantee the quality of engineering

project. During the construction management of power transmission and transformation project, if the lack of perfect quality management countermeasures, it will affect the quality of the whole project. In essence, quality management during construction not only includes personnel management and material management, but also involves various elements related to project quality. Therefore, in the selection of construction units, it is necessary to give priority to the selection of enterprises with high qualification level and good reputation and quality, pay attention to the design of construction projects, carefully review the construction plan and drawing design, in order to ensure the scientific construction management. After the completion of the construction project, it is necessary to provide technical data, completed drawings and settlement data and other information to the site supervision personnel for acceptance, and to the director or the construction unit for independent inspection after passing the inspection, so as to timely discover the hidden safety problems during the construction period and correct them in time, and ultimately ensure the quality and safety of the project construction.

Conclusion

To sum up, the intelligence of the index system studied in this paper has grey rough set screening indicators, and the weight confirmation and comprehensive evaluation methods have not been thoroughly studied. Therefore, future researchers can jointly study from fuzzy sets, extension theory, rough set method and other aspects, so as to integrate support vector machine and neural network theory together. Construct a more scientific and perfect comprehensive evaluation system for the construction quality of power transmission and transformation projects, and put forward more valuable construction management measures.

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