



Research on the Analysis of Cost of Power Transmission and Transformation Project Based on DEMATEL Method

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Abstract. With the dynamic and stable development of the national economic form, the investment scale of power transmission and transformation projects is gradually increasing. In the process of power transmission and transformation project cost calculation and evaluation and settlement, there will be some controversial costs and large costs due to different time and space. The deviation of these costs is not conducive to the realization of the lean management goal of project cost and the efficient and accurate control of project investment. Therefore, this paper to better promote the project cost of the lean management goal realization, efficient accurate control of project investment, solve the controversial and time domain difference cost billing standard of business management practical problems, put forward the DEMATEL method based on power transmission and transformation project cost influence factor analysis technology, strengthen the power transmission and transformation project cost control, improve precision investment control ability to support.

Keywords: power transmission and transformation project, cost, DEMATEL method, analysis technology.

1 Introduction

At present, in the field of engineering cost in our country, quota valuation mode and listing valuation mode still coexist, with the strong impact of social economic development of our country, the present project cost management system some management lag phenomenon, has not well applicable to the needs of social economy and market development, reform in the field of engineering cost need to be further deepened. In order to realize the high-quality development requirements of the power grid and ensure the benefits of power investment, enterprises need to enhance the cost control ability of the whole process, improve the level of accurate cost control, and comprehensively improve the quality and efficiency of cost control.

Engineering cost management: literature [1] based on the engineering cost estimation and valuation mode does not match, quantity statistics is not enough science,

engineering changes the corresponding cost management limitations, quality and cost is difficult to overall consideration, information transmission efficiency is not high, therefore, actively promote the project cost process management to reduce risk, improve efficiency and increase efficiency is of great significance. The whole process management of power transmission and transformation project cost shall be systematically divided into the stages of project approval, initial establishment, implementation and completion, to form a standard system of management, and introduce an incentive mechanism to fully reflect the scientific and systematic nature of the whole process management. Literature [2] examines both traditional and more recent developments in order to highlight their advantages and limitations. The analysis includes parametric estimating, feature based costing, artificial intelligence, and cost management techniques. Engineering cost factor analysis: literature [3] in the analysis of power transmission and transformation engineering cost on the basis of the control process, according to the reason of engineering cost deviation comparative analysis of historical cost big data, and comprehensive expert interviews, literature quality, using root theory to identify the project cost deviation of the bidding, construction process control, market environment, a total of nine key factors, using ANP-entropy weight method of quantitative analysis of key factors, and control power transmission and transformation project cost deviation, improve cost control quality effect of Suggestions. Literature [4] Identithe whole process of cost management influencing factors through principal component analysis. First, the factors affecting the cost management of power transmission and transformation projects are determined, including 5 first-level indicators, 15 second-level indicators and 39 three-level indicators. Then the component analysis was used based on the results of the questionnaire, and the key elements were summarized. Finally, based on the key elements, the cost of the whole process management of power transmission and transformation project. Project cost prediction: Literature [5] Using the entropy weight method to screen the key influencing factors of power grid project cost, effectively predict the cost of power transmission and transformation project dynamically through the BP neural network prediction model, and the prediction results confirm the effectiveness of the model. Literature [6] presents a unique perspective on applications of AI/DL/ML in these domains for the complete building lifecycle, from conceptual stage, design stage, construction stage, operational and maintenance stage until the end of life. Project cost evaluation: Literature [7] analyzes and studies the cost risk assessment of power grid production technology transformation projects through statistical analysis, and puts forward some suggestions, hoping to improve the effectiveness of the cost risk assessment of power grid enterprises' production technology transformation projects.

To sum up, at present, relevant scholars pay more attention to the aspects of power grid cost process management, cost deviation analysis, cost prediction and cost risk assessment, while the analysis of the influencing factors of engineering cost is relatively weak, so this paper has a good research necessity.

2 Analysis Method of Cost Impact Elements Based on DEMATEL Method

The DEMATEL (Decision Making Trial and Evaluation Laboratory) method is a system analysis tool for analyzing and solving decision problems in complex systems. This method helps decision makers to understand and reveal the interactions and influences among factors in the system by constructing and analyzing causal networks between factors.

First, it is necessary to identify key factors in the system and, through expert opinion or data analysis, build a direct influence matrix that represents the reciprocal relationship and strength of influence between factors. Second, the direct effect matrix was normalized to calculate the relative strength of each factor on the other factors. By using the normalized direct influence matrix and other mathematical operations, a comprehensive influence matrix is obtained, which reflects the overall influence of and the affected situation of the factors in the system. Then, the degree of influence (the total effect of the other factors) and the degree of influence (the total effect of the other factors) are calculated by using the comprehensive influence matrix. Finally, the degree of cause and centrality, which represent the net effect of a factor (minus the degree of influence) and the sum of influence and affected degree, are used to assess the centrality and importance of the factor in the system.

DEMATEL Methods are widely used in a number of fields, including but not limited to enterprise management, project management, supply chain management, environmental assessment, policy analysis, etc. It is especially suitable for multi-attribute decision problems, in which there is a complex interactive relationship between each indicator, and the relative importance and action direction of each indicator need to be clarified. For example, when formulating the cost standard of government procurement projects, experts can analyze the interaction between the factors through the DEMATEL method, determine the weight of each attribute, and then develop a scientific cost standard.

3 Empirical Analysis

Based on the analysis of the impact of cost level by DEMATEL (laboratory method), this method is the method to determine the causality between elements and the strength of mutual influence. Finally calculates the causality between factors, and the key degree of the index is measured by the centrality. In this section, it takes the typical scenario of the influence of market factors on the cost of substation project as an example, the DEMATEL method is used to analyze the influence degree, and the mutual influence between market factors and the influence of the power transmission and transformation project cost on the market factors are not considered in the model.

3.1 Selection of Elements.

Labor unit price, mechanical unit price, material unit price, CPI, PPI, PMI, GDP are selected as the market elements, and construction engineering cost, installation engineering cost, equipment purchase cost and other costs are selected as the cost elements of substation project.

3.2 Construction Directly Affects the Matrix O.

Set the mutual relationship between the influencing factors of the change of the market factors on the cost of the substation project expert evaluation table, through the Delphi consulting 20 experts in related fields, the change of the influence of the cost of the substation project, and the strength of the relationship between the influencing factors, the construction directly affects the matrix O (Table 1, Table 2).

Table 1. Expert evaluation table of the strength relationship of influencing factors.

Semantic variables	make no difference	Smaller impact	General influence	Strong impact	Strong influence
Level 5 scaling	0	1	2	3	4

Table 2. Impact factor table.

Manual unit price	Elements 1	CPI	Elements 4	Construction project fee	Elements 8
Mechanical unit price	Elements 2	PPI	Elements 5	Installation cost	Elements 9
Material unit price	Elements 3	PMI	Elements 6	original equipment cost	Elements 10
		GDP	Elements 7	miscellaneous expenses	Elements 11

The Delphi method consulted 20 experts in related fields to evaluate the strength of the relationship between the influencing factors of the market factors with the influence on the cost of the substation project, and to construct the direct influence matrix O (Table 3).

Table 3. Direct influence of the relationship matrix O.

	Manual unit price	Mechanical unit price	Material unit price	CPI	PPI	PMI	GDP	Construction project fee	Installation cost	original equipment cost	miscellaneous expenses
Manual unit price	0	0	0	0	0	0	0	2	3	2	2
Mechanical unit price	0	0	2	0	0	0	0	2	3	3	1

original equip- ment cost	0	0	0	0	0	0	0	0	0	0	0
miscel- laneous expenses	0	0	0	0	0	0	0	0	0	0	0

Calculate the comprehensive impact matrix T (Table 5):

Table 5. The comprehensive influence matrix T.

	Manu- al unit price	Mechan- ical unit price	Mate- rial unit price	CPI	PPI	PMI	GDP	Con- struction project fee	Instal- lation cost	origi- nal equip- ment cost	miscel- laneous ex- penses
Manual unit price	0	0	0	0	0	0	0	0.111	0.167	0.111	0.111
Mechanical unit price	0	0.012	0.112	0	0	0	0	0.125	0.175	0.194	0.069
Material unit price	0	0.112	0.012	0	0	0	0	0.125	0.075	0.244	0.119
CPI	0.18	0.105	0.152	0.005	0.12	0.067	0.087	0.179	0.134	0.224	0.176
PPI	0.019	0.21	0.207	0.01	0.015	0.067	0.181	0.124	0.177	0.285	0.165
PMI	0.124	0.145	0.095	0.01	0.068	0.014	0.181	0.168	0.125	0.261	0.107
GDP	0.074	0.088	0.088	0.057	0.067	0.064	0.025	0.102	0.103	0.184	0.097
Construction project fee	0	0	0	0	0	0	0	0	0	0	0
Installation cost	0	0	0	0	0	0	0	0	0	0	0
original equipment cost	0	0	0	0	0	0	0	0	0	0	0
miscellane- ous expenses	0	0	0	0	0	0	0	0	0	0	0

The comprehensive influence matrix is used to calculate the index values, including D of influence, affected C, centrality D + C, and cause D-C. The results are as follows (Table 6):

Table 6. DEMATEL Calculate the index values.

	Impact degree D value	The impact degree C value	Centrality de- gree DC value	Cause degree D-C value (R)
Manual unit price	0.5	0.397	0.897	0.103
Mechanical	0.687	0.673	1.361	0.014

unit price				
Material unit price	0.688	0.667	1.354	0.021
CPI	1.429	0.082	1.511	1.347
PPI	1.459	0.269	1.729	1.19
PMI	1.298	0.213	1.511	1.086
GDP	0.948	0.474	1.422	0.474
Construction project fee	0	0.934	0.934	-0.934
Installation cost	0	0.955	0.955	-0.955
original equipment cost	0	1.502	1.502	-1.502
miscellaneous expenses	0	0.844	0.844	-0.844

(4) Draw the centrality-cause degree diagram to analyze the relationship between centrality and cause degree (Fig 1).

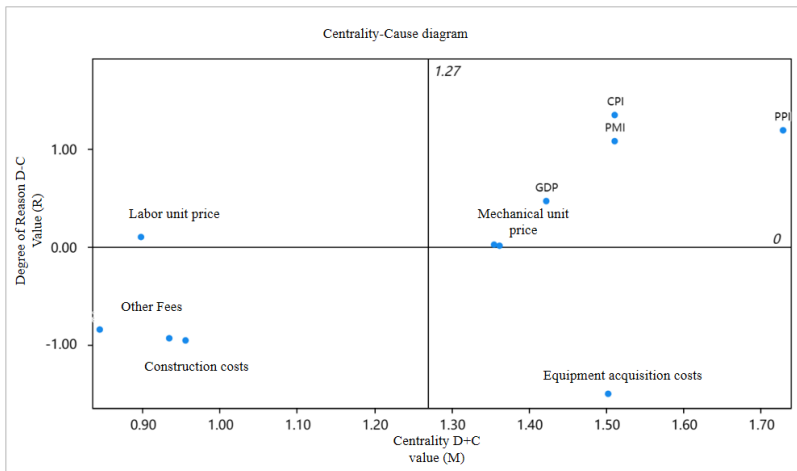


Fig. 1. centrality-Reason degree plot.

3.4 Draw the Influence and Affected Relationship of the Influence and Affected Factors (Fig 2).

Numbers on the arrows represent the magnitude of the effect, with larger numbers increasing the effect. Compared with the transmission project, the equipment purchase cost accounts for a larger proportion, so the material unit price, mechanical unit price, PPI and other market factors have a greater impact on the equipment purchase cost, resulting in a greater impact on the cost of the substation project.

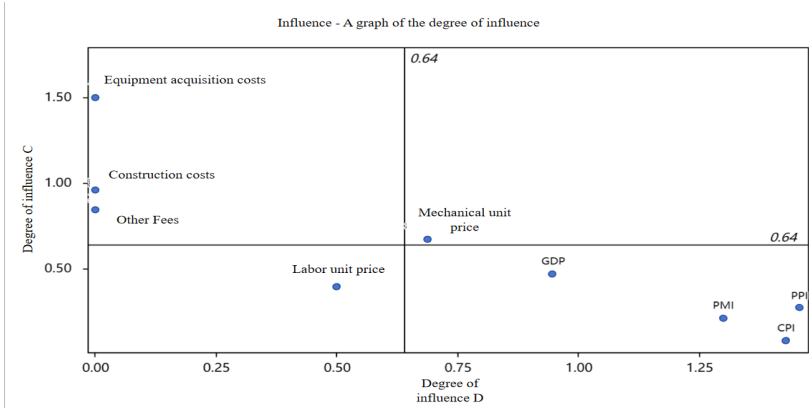


Fig. 2. influence degree-affected degree plot.

4 Conclusion

This paper proposes the analysis method based on the influence of DEMATEL (laboratory method) on the cost level, which is the method to determine the causality between elements and the strength of mutual influence. Through the final calculation, the causality between the factors is divided, and the key degree of the index is measured by the centrality. In this section, it takes the typical scenario of the influence of market factors change on the cost of the substation project as an example, the DEMATEL method is used to analyze the influence degree, and the mutual influence between the market factors and the influence of the power transmission and transformation project cost on the market factors are not considered in the model.

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