Research on the Standard Analysis Technology of Safe and Civilized Construction Cost Counting for Emergency Rescue Building Repair Project of Power Grid Projects Under Natural Disasters

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Abstract. In power transmission and transformation emergency repair projects, existing budget preparation and cost calculation standards often fail to meet real-world settlement requirements, especially under dynamic and unpredictable conditions caused by natural disasters. To address this gap, this paper proposes a calculation method for the safety and civilization construction cost of emergency response projects in power grid engineering, based on the impact of natural disasters. By combining cost composition analysis with statistical analysis methods, the paper constructs a calculation model for the emergency safety and civilization construction cost specific to power transmission and transformation projects. In the validation phase, data from emergency repair projects conducted by 14 county-level power supply companies between 2020 and 2022 was used. Regression analysis of cost sequences for different repair projects was performed using statistical software like SPSS, and the correlation between safety and civilization construction costs and labor, material, and machinery costs was measured. The results show that the proposed method effectively calculates the safety and civilization construction costs for power grid emergency response projects, providing valuable guidance for cost control in emergency rescue projects within power grid companies.

Keywords: natural disaster, power transmission and transformation project, emergency rescue project, xx cost, calculation method

1 Introduction

Existing budget preparation and cost calculation provisions for emergency repair projects in power transmission and transformation are often inadequate for meeting real-world settlement requirements, particularly under the dynamic and unpredictable conditions posed by natural disasters. Although prior studies have established frameworks for regular power grid project cost management, limited attention has been

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given to standardizing the costs associated with emergency response projects. This gap necessitates a detailed exploration and refinement of cost standards, especially focusing on the safety and civilized construction costs incurred during emergency repairs.

Literature [1] compares consulting fee models for grid projects and suggests a full-process consultation mode. Literature [2] proposes a lean control system addressing budget, risk, and closed-loop management for cost optimization. Literature [3] evaluates 110–500 kV transformer traction costs in Guizhou, aligning pricing standards with market trends. Literature [4] applies laser scanning in helicopter inspections to enhance grid project efficiency and tackle maintenance challenges. Literature [5] examines Russian practices for standardizing road maintenance costs, focusing on budget allocation differences and federal-regional alignment. Literature [6] highlights cost pressures in grid construction, advocating for a three-dimensional cost standard system to improve management. Literature [7] establishes benefit-cost criteria for local infrastructure optimization, addressing financing and intergovernmental impacts. Literature [8] in accordance with the work requirements for adjusting the accounting method of fixed asset investment in the power grid to the financial expenditure method, starts from the basic project cost values obtained by the financial expenditure method. Literature [9] analyzes the existing problems in the project costs of power grid technology and major overhauls, and puts forward relevant countermeasures for the whole process of cost management in a targeted manner, so as to strengthen the cost control of power grid technology and major overhaul projects. Literature [10] based on practical work experience, conducts an in-depth study of the key technologies for the dynamic control of power grid project costs on the basis of briefly introducing the relevant concepts of the dynamic control of power grid project costs.

2 Analysis of Safe and Civilized Construction Cost Composition of Power Grid Emergency Rescue Project

Safe and civilized construction costs and protection measures can be categorized into three major components:

Temporary Facilities Fee: Includes costs related to setting up, maintaining, and dismantling temporary structures such as on-site offices, storage facilities, and worker accommodation. For instance, erecting prefabricated shelters for a flood-affected repair site.

Safety, Environmental Protection, and Civilized Construction Measures Fee: Covers expenses for implementing safety protocols, such as providing personal protective equipment, environmental measures like waste management, and maintaining cleanliness at the site.

Emergency Protection Fee: Specific to mitigating environmental and operational risks, including costs for waterproofing, windproofing, and securing repair sites against additional damage caused by severe weather conditions.

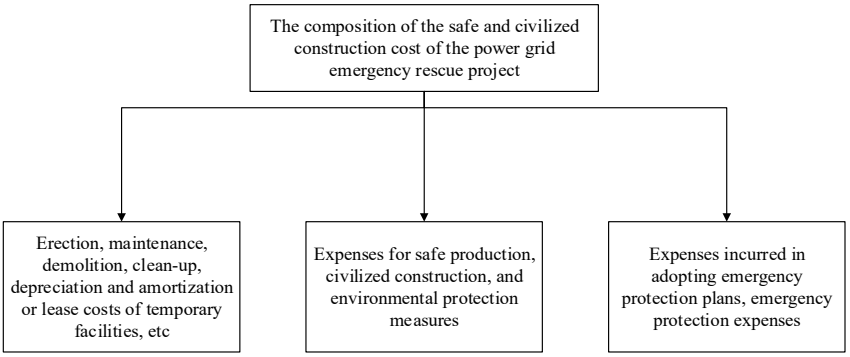


Fig. 1. Composition of the safe and civilized construction cost of the power grid emergency rescue project.

As can be seen from Figure 1, the safety and civilized construction cost of the power grid emergency rescue project mainly consists of the following three parts:

(1) In the construction of the main process of emergency repair, in order to meet the management and construction needs of the construction site, the erection, maintenance, demolition, cleaning, depreciation and amortization of the temporary facilities;

(2) In order to meet the needs of the project site management and construction operation, the corresponding cost of safety production, civilized construction and environmental protection measures have occurred;

(3) Emergency repair in the main construction process in order to meet the needs of the project site management and construction operations, take rain, moisture, shelter, collapse, fall, flood control, antifreeze, skid, wind, epidemic prevention, lighting and other measures must increase costs, including materials, protective measures and mechanical equipment, equipment procurement, leasing, use, etc, and take the emergency protection scheme of the cost of emergency protection.

3 Empirical Analysis

3.1 Raw Data Collection and Collation

In this paper, the production emergency repair projects from 2020 to 2022 of 14 county-level power supply companies under a provincial power grid company are tically analyzed. The statistics of the number and cost of emergency repair projects of the county-level companies are shown in the Table 1.

Table 1. Statistical table of the raw data.

Project type	Construction repair project	Substation maintenance project	Overhead line maintenance project	Cable line maintenance works (onshore)	Communication line maintenance project	Tote
The number of projects	656	80	1795	298	45	2874
The proportion of project number	22.83%	2.78%	62.46%	10.37%	1.57%	100%
Cost (ten thousand yuan)	400.16	1030.83	4150.80	791.03	100.80	6473.62
Cost ratio	6.18%	15.92%	64.12%	12.22%	1.56%	100.00%

As can be seen from Table 1 above, among all the emergency repair projects, the number of overhead line maintenance projects ranks first, followed by construction repair projects and cable line maintenance projects (on land). The top three expenses are: overhead line maintenance engineering, substation maintenance engineering and cable line maintenance engineering (land).

3.2 Standard Measurement Analysis of Safe and Civilized Construction and Protective Measures

(1) The corresponding sequence of the main cost of sample engineering

Through the comparison of the main cost of multiple sequence of the sample project, the scatter plot of the comparison between the safe and civilized construction and protective measures in the emergency repair project and the direct engineering cost, labor cost, material cost, labor cost and machinery cost + machinery cost is shown as Figure 2.

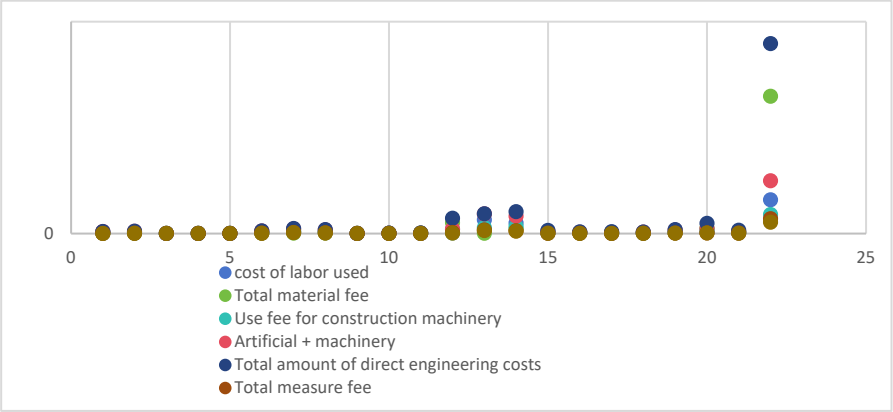
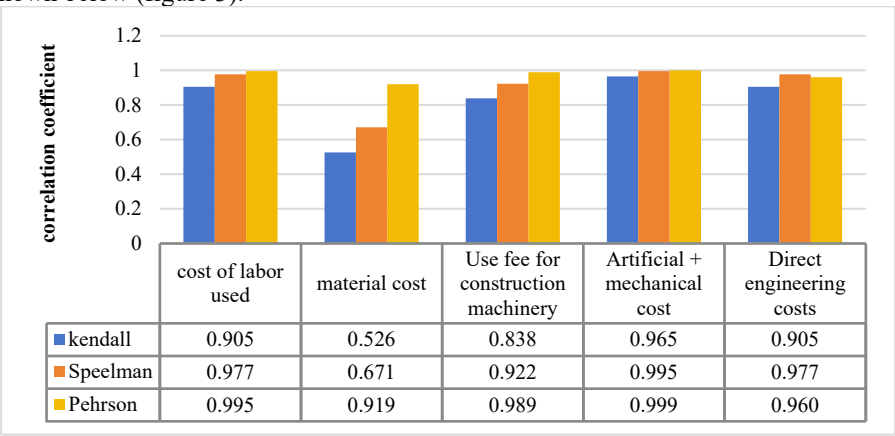


Fig. 2. Corresponding sequence of the main cost of the building repair sample project.

(2) Cost sequence correlation analysis

Pearson, Kendall, and Spearman correlation coefficients were used to measure the relationship between the costs of "safe and civilized construction measures" and key cost components, including labor costs, material costs, and machinery costs. Pearson's coefficient assesses linear relationships, Kendall's coefficient captures ordinal relationships, and Spearman's coefficient examines monotonic relationships. Results indicated a strong positive correlation (Pearson's $r > 0.85$) between labor costs and safe and civilized construction measures, suggesting labor-intensive projects contribute significantly to this cost component. The SPSS software output the correlation coefficient of the labor cost, material cost, construction machinery cost, construction machinery cost and direct engineering cost and the cost sequence of safe and civilized construction and protective measures cost, and obtained the comparison diagram as shown below (figure 3).



	cost of labor used	material cost	Use fee for construction machinery	Artificial + mechanical cost	Direct engineering costs
kendall	0.905	0.526	0.838	0.965	0.905
Speelman	0.977	0.671	0.922	0.995	0.977
Pehrson	0.995	0.919	0.989	0.999	0.960

Fig. 3. Comparison of the correlation coefficient of the building repair sample project cost sequence.

(3) Regression fit degree analysis

In order to further quantify the fitting degree of the sequence of "safe and civilized construction and protective measures cost" and other cost sequence, the sequence of "safe and civilized construction and protective measures cost" and other cost sequence were analyzed respectively. Through SPSS software, the regression analysis of the five cost sequences of labor cost, material cost, construction machinery use cost, labor cost + machinery cost and direct engineering cost of emergency repair projects and the cost sequence of safe and civilized construction and protective measures is fit R2, To obtain the case shown in the following below (figure 4).

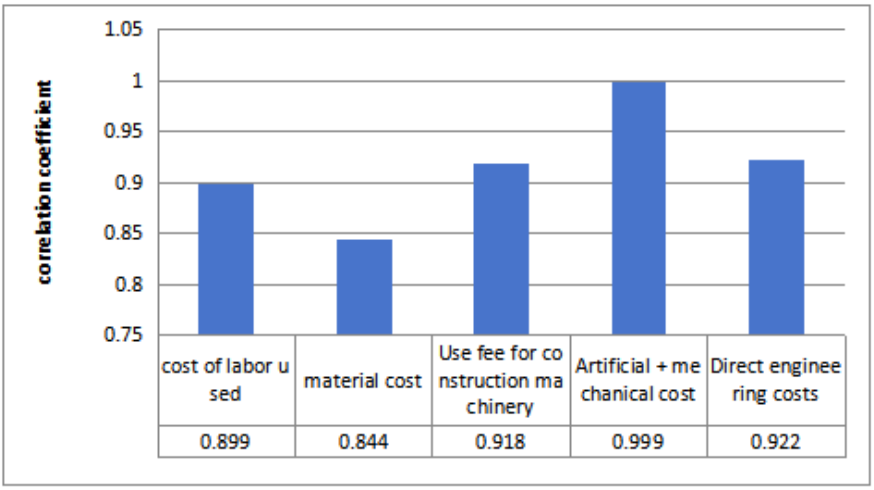


Fig. 4. Comparison of fitting degree of building repair sample engineering cost sequence.

(4) Analysis and determination of the fee rate

For construction repair works, based on the cost distribution map, the rate is 25.5% -27.5%. According to the automatic statistical analysis of SPSS, the distribution μ value is 27.08%, so the rate of safe and civilized construction and protective measures for construction repair works is 27.08%.

Table 2. Table of emergency rescue and building repair projects, safe and civilized construction costs.

Engineering type	Building repair project (%)
rate	27.08
Take fee base	Labor cost + machinery cost

According to Table 2, "labor cost + machinery cost" is selected from the safe and civilized construction cost of emergency rescue construction repair project, and the fee rate is the corresponding rate in the table above.

4 Conclusion

This paper takes the transmission and transformation emergency rescue project as the research object, on the basis of the analysis of natural disasters on emergency rescue project, combined with the historical engineering data statistical analysis, made clear the emergency rescue building repair project safety civilization construction should take cost base selection "labor + machinery" mode, and calculate the corresponding rate, to guide the power grid enterprises to carry out the emergency rescue project cost, enhance the level of enterprise cost control.

References

1. Zhu Xiaohu, Yin Min, Liu Cuiliu. Suggestions for calculation of whole process engineering consulting service fee of power grid project [J]. China Electric Power Enterprise Management, 2021, No.633(12):74-75.
2. Zhi-liang wang. Research on lean control of other costs of power grid infrastructure projects [J]. Accountants, 2020, No.344(17):41-42.
3. Xu Xiaojun, Zhang Fangyin, Zhou Yang, et al. Research on On-Site Traction Cost Standards for Main Transformers [J]. China Electric Power Enterprise Management, 2022, (21): 64-65.
4. Zhang Yanqiu, Shang Sang, Zhang Mengying, et al. Research on Cost Standards for Helicopter Aerial Laser Scanning Technology [J]. China Electric Power Enterprise Management, 2023, (09): 52-53.
5. Dmitry F, Elena G. Federal and regional standards for highways maintenance and repair costs [J]. SHS Web of Conferences,2021,112.
6. Sun A, Anli S, Chun X, et al. Research on the Framework Construction of Three-dimensional Cost Standard System of Power Grid Engineering based on the Computer Technology[J]. Journal of Physics: Conference Series,2020,1578(1):012003-.
7. Woodbury D T. The provision of infrastructure: benefit–cost criteria for optimizing local governments [J]. International Tax and Public Finance, 2020, 27(3): 552-574.
8. Zhang Yongwen, Zhao Mengzhu, Li Mei. On-site Investment Cost Management of Power Grid Projects under the New Accounting Method[J]. China Power Enterprise Management, 2024, (33): 54-55.
9. Liu Yang, Yao Yujun, Zhao Bowen. Research on the Whole-process Management of Project Costs for Power Grid Technology and Major Overhauls[J]. China Plant Engineering, 2024, (18): 215-216.
10. Shao Mengyu, Xiao Ying. Research on Key Technologies of Dynamic Control of Power Grid Project Cost[J]. Electrical Technology and Economy, 2023, (10): 244-246.