Exploration of Fuzzy Cost in Power Wiring Process

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Keywords: power wiring, wiring costs, fuzzy costs.

Abstract: The most important factor in the choice of wiring lines in the traditional power wiring process is the total cost of wiring, and the cost based on the power wiring planner mainly refers to the visible cost in the wiring planning. This paper proposes a new calculation method of fuzzy cost. The fuzzy cost here mainly refers to the loss caused by urban economic development and existing economic structure in the process of power wiring. The power wiring fuzzy cost model is used to analyze the discrete analysis of variables that indirectly reflect social economic development and daily production and life, and then through fuzzy cost estimation model and discrete adjustment of results to evaluate the actual wiring reliability. This method takes the non-traditional cost into consideration during the construction of the project through the measurement of fuzzy costs, and improves the existing cost assessment system.

1. Background and Research Significance

China is the largest developing country in the world. China's economic and social development has been developing rapidly since the reform and opening. In recent years, China's infrastructure construction has been growing at a rapid rate. The growth rate of infrastructure investment is expected to increase by 10% this year. The cumulative investment scale is expected. It has reached 20 trillion yuan [1]. Economic construction requires strong power and real-time communication to provide the necessary support, and the transmission of electricity needs to cover a wider grid. The power industry is a capital-intensive industry. How to reduce the cost of the power wiring process is the primary consideration.

In the pre-design and field investigation of traditional power lines, the most important factor considered is the total cost of materials and construction during the wiring process, but the environmental damage during the layout of the power lines and the impact on normal production and life have not been considered [2]. Therefore, a selected optimal line is often not the lowest cost solution considering the socio-economic impact of the wiring process. Therefore, the fuzzy cost calculation method proposed in this paper can integrate various factors and provide an optimization solution for the selection of wiring lines, which will control the total cost of the whole process of wiring and the overall impact on society, which is beneficial to China's overall economy. Development and advancement of the power industry.

2. Fuzzy Cost

2.1 The Necessity of Fuzzy Cost Calculation

The fuzzy cost we propose in this article is a completely new concept relative to the cost often mentioned in daily life. According to economics, cost is the value of the commodity economy and an integral part of the value of the commodity. When people want to carry out production and management activities or achieve certain goals, they must spend certain resources. The monetary performance of their resources and their objectification are called costs [3]. The cost defined by traditional economics is mainly the monetization of the consumption of resources in the production process of goods, but the impact on other production processes in the production process of goods, such as the destruction of the ecological environment and the production environment. Additional costs and the like are not considered. The main reason for this is the abstraction of the additional costs in these production processes, and the cost of fuzzy virtual is difficult to express.

2.2 Fuzzy Cost Concept

This paper defines the cost of abstract existence in actual production life as a fuzzy cost. For example, for the power wiring problem studied in this paper, the fuzzy cost mainly includes the following aspects: the impact cost to the road along the line during the construction of the line, the impact on the production and life of the factories and residential areas around the construction line, and It affects the cost of the surrounding economic facilities such as hotels, shopping malls, and vegetable markets. In the actual wiring process, there are many indirect effects of the construction process. Here are just a few examples. The detailed process will be discussed in the model introduction below.

3. Power Wiring Fuzzy Cost Model

3.1 The Actual Economic Cost of Power Wiring

We mainly focus on the application of intelligent algorithm in actual wiring, and combine the actual situation to optimize the structure of PW system and CO system. The emphasis is to find the digital methods of actual nodes and problems, and verify the rationality and effectiveness of the digital weights and the final methods. The mathematical modeling method is integrated into the application of wiring, the actual model is visualized, and the optimal solution is found through programming. Firstly, we divide the wiring process into three parts: overall design, route design and structure comparison and optimization. On the whole from the shallow to the deep, the paper problems completely digital.

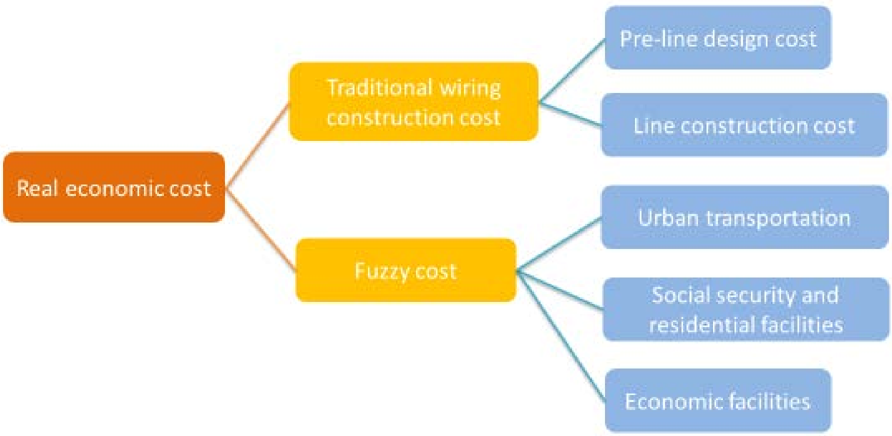

Figure 1. The actual economic cost of power wiring

3.2 Fuzzy Cost Estimation Model

3.2.1 Selection of Indicators

Based on the main components of the actual economic cost of power wiring introduced in the previous section, and the three aspects of the fuzzy cost proposed above. We have studied and analyzed the main factors of social and economic development and the main indicators for measuring economic development, and finally determined the influencing factors of nine fuzzy costs. Secondly, based on the data of the 2019 Social Development Yearbook of LianChi District, Baoding City, Hebei Province, we conducted a correlation analysis of the above factors through the correlation coefficient method within one kilometer of the North Campus of the North China Electric Power University:

S_{xy} sample covariance calculation formula:

$$S_{xy} = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$$

S_x, S_y sample standard deviation calculation formula:

$$s_x = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}, s_y = \sqrt{\frac{\sum(y_i - \bar{y})^2}{n-1}}$$

Correlation coefficient:

$$r_{xy} = \frac{s_{xy}}{s_x s_y}$$

Through the above formula, we obtain the correlation coefficient of the nine fuzzy cost influencing factors. The correlation coefficient reflects the relationship between the influencing factors and economic development. The closer the correlation coefficient is to 1, the difference between the influencing factor and economic development. The stronger the relevance.

Table 1. Correlation coefficient

Influencing Factor	Correlation Coefficient
Road Width	0.9321
Number of Restaurants	0.7952
Number of Schools with More Than 2,000 Students	0.8569
Number of large shopping malls and large markets	0.9296
Number of Residential Areas with More Than 2,200 Households	0.9136
Number of Third-class Hospitals and Fire Stations	0.5648
Railway	0.6265
Number of Courts	0.6538
Number of Gas Stations	0.7259

According to the data in the TABLE 1, the three most important factors affecting the fuzzy cost were finally determined, namely the road width, the number of third-class hospitals and the fire station. The road width correlation coefficient is the highest, which is the most important factor affecting the economic development of the city. The main factor of the correlation coefficient between the third-class hospitals and the fire station is that it is the main factor for calculating the fuzzy cost. Although this factor has the lowest correlation with social and economic development, it is an important factor for the stable development of society, and its social function limits the surrounding. Economic development, therefore, the destruction of the orderly production of the two will inevitably lead to greater social impact, so it is regarded as the main influencing factor of fuzzy costs.

3.2.2 Road Width Specific Fuzzy Cost Estimates

Road construction plays an important role in the economic development of the areas along the line. Part of it is mainly reflected in the increase of road construction to regional GDP, which drives economic growth. The other part is the adjustment of regional industrial structure after the road is opened to traffic [4][5]. Here we mainly consider the impact of the second part, that is, the impact of the wiring activities after road opening on the road capacity and thus the burden on the regional economic development.

Considering that the road transport capacity or traffic capacity depends mainly on the width of the road itself, here we mainly study the relative relationship between road width and road traffic capacity and calculate the additional burden caused by the wiring activity per kilometer to the original economy of the road.

After discussion and analysis, we found that the width of the road has different rules in the city and the suburbs. For some areas with poor economic development such as the suburbs, although the roads have been built, the economic development has not kept up, so it is difficult for the roads to exert their full transport capacity, which leads to a large deviation of results. Moreover, considering the complicated road conditions of urban power wiring, the method of deep burial is often adopted, and most of the power wiring in rural areas in suburbs adopts the measures of erecting electric poles, which has a faster construction speed and less impact on normal economic production. Therefore, we mainly Discuss the scope of the city.

In order to obtain the general relationship between road width and traffic flow, we selected ten roads around the second campus of North China Electric Power University in Baoding City, Hebei Province, and conducted actual investigations. The results are shown in the following table.

Table 2. Measuring Point Measurement Information

Road number	**Road width (m)**	**Traffic flow (vehicle)**		
		10 pm—6 am the next day	**6 am—2 pm**	**2 pm—10 pm**
1	6.2	223	2302	3323
2	6.6	198	3606	5420
3	10.5	320	4202	5328
4	10.5	356	3542	4566
5	12.3	360	5220	7451
6	20.1	865	8203	10262
7	18.3	885	7459	9200
8	20.0	989	10659	12629
9	10.0	560	6520	6525
10	11.2	526	4520	5620

According to the data in the table, it can be known that at 22 o'clock - the traffic volume of all roads in this time period is small at 6 o'clock the next day, so the construction during this time period can be considered to have less impact on the normal economic life of the society, and the actual municipal pavement construction pays attention to safety principles. The traffic volume during this time period is small, which can effectively guarantee the personal safety of the construction personnel [6]. However, for power wiring, the construction period is long and cannot be completed in the short time at night. Considering that the traffic volume at night is small, it is stipulated here that the road traffic is blurred from 6 am to 10 pm. In order to obtain accurate data of fuzzy traffic flow, we also made the same observations on the other two selected points in Baoding City, and based on the observation data and the annual production of the region, the general calculation formula for road fuzzy traffic flow was obtained:

$$N = (1 + \ln G)e^{\frac{D}{\beta}} \quad (\beta = 1.254)$$

β: adjustment factor

G: year GDP of the area where the wiring is located

D: road width

N: Traffic flow (vehicle)

According to the relevant data, the economic growth mode of transportation infrastructure to consumption was obtained [7]. This model is mainly carried out from two aspects, namely the impact of road on production and consumption. But this model focuses on several economic factors, such as sales of private cars and sales of consumer goods. Therefore, the comprehensive calculation method of fuzzy traffic flow finally obtains the fuzzy cost calculation formula for each kilometer of road construction (P) along the power wiring:

$$P = N^{1+K}e^{1+\tau}$$

τ: infrastructure depreciation rate

H: Government budget constraints

K: the rate of GDP growth set by the government in the past

3.2.3 Third-class Hospitals and Fire Stations Fuzzy Cost Estimates

At the same time, economic construction is inseparable from the follow-up of social security. Perfecting a sound social security system is the prerequisite for promoting economic development. The third-class hospitals and fire stations are an important part of formal social stability and security [8][9]. From the analysis of the economic development correlation coefficient of the selected part of the base table, it can be seen that although the factors affecting the number of third-class hospitals and fire stations are very low in correlation with economic development, the data obtained reflect the economics of the third-class hospitals and the fire department. Construction activities must also be based on their own social functions. In practice, it is difficult to actualize the impact of the organization of social service organizations. Hospitals and fire stations are non-profit organizations. Therefore, research on the impact of power wiring construction will be transferred to its own functions. For hospitals, the most important indicators to measure are the number of patients admitted and the number of ambulances in a day. For the fire station, the research indicator is the number of fire trucks. Through a hierarchical analysis of hospitals and fire stations, we obtained a fuzzy cost formula for the impact of power wiring construction on hospitals and fire stations (Q):

$$Q = \left(1 + \ln \frac{G}{10000}\right) e^{\frac{N}{1050} + \frac{L}{35}} + (\frac{10}{3})^{A+B}$$

A: Number of third-class hospitals

B: Number of fire stations

N: Number of patients admitted to the third-class hospitals per month

L: The number of fire alarms issued by the fire station

G: year GDP of the area where the wiring is located

3.3 Fuzzy Cost Weight Analysis

In this paper, the fuzzy cost estimation model mainly includes two aspects discussed in the previous section, but when solving the sum of fuzzy costs, considering the importance of the two factors that constitute the fuzzy cost, it cannot be simply added. Two calculated fuzzy costs need to be corrected. In the division of power system load levels, hospitals and fire stations are classified as the first type of load. As the top priority of the normal operation of the society, its importance can be seen. Therefore, we analyze and calculate the weights of these two influencing factors through AHP.

Table 3. Estimation Standard of Relative Signification of AHP

Scale value	Meaning
1	Expressing the same importance compared to two elements
3	One element is slightly more important than the other compared to the other
5	One element is slightly more important than the other compared to the other
7	One element is slightly more important than the other compared to the other
9	One element is slightly more important than the other compared to the other
2, 4, 6, 8	The median value of the above adjacent judgment

$$A_n = (a_{ij})_{m \times n} \ (a_{ij} > 0, a_{ij} = 1/a_{ij})$$

3.3.1 Find Eigenvalues and Test Consistency

Let $A_n - \lambda E = 0$ and find the maximum eigenvalue λ_{max} of the comparison matrix A_n.

By calculating the eigenvalues and performing consistency check on the comparison matrix according to the AHP method, if the consistency test index $C \cdot R \leq 0.1$, the comparison matrix is consistent and acceptable.

$$CR = \frac{CI}{RI}$$

In the middle

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

The IR value can be found according to the average random consistency indicator table:

Table 4. IR value table

n	1	2	3	4	5	6	7	8	9	10
IR	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

3.3.2 Calculate Relative Weights

Using the public $A_n W = \lambda_{max} W$, the relative weight vector $W = \{w_1, w_2, \cdots, w_n\}$ of each index is obtained, and the component value of the vector is the relative weight value of each index factor (w_i). The calculated weight value is based on $(w_1) = 1$ and (w_2) =1.324.

4. Model Analysis

The fuzzy cost estimation model can effectively calculate the fuzzy cost in the power wiring process. However, due to the problem of approximation processing and model equivalence, the model and the actual situation will have large errors. Therefore, the model is mainly used for the general estimation of cost. Determine the optimal power routing path.

The selection of the optimal power routing path considers the actual wiring cost and the virtual wiring cost, but the optimal power wiring path selected by the integrated fuzzy cost may not be the lowest actual wiring cost. This also involves the fact that this extra part of the expenses may be borne by the power companies. It is obviously not practical for the power companies. Therefore, whether the community can bear this part of the increased investment has become a new problem.

5. Conclusion

The intensive capitalization of the power industry determines that cost reduction should always be the priority in power construction and production. The research in this paper shows that the real cost of power wiring is quite different from the cost considered by traditional wiring. Although these costs cannot be accurately estimated, the fuzzy cost estimation model proposed in this paper can supplement the power wiring path selection process as power. An important basis for routing path selection. In order to reduce resource consumption and promote social and economic development, the fuzzy economy will become an important trend in cost estimation in the future.

Acknowledgments

In the process of writing the thesis, first, I would like to thank the instructor who gave me the revised opinion. As an undergraduate student with insufficient writing experience, the teacher gave me many revision opinions, which greatly improved my paper. s help. Secondly, I would like to thank the authors of the references, who gave me a great help in thesis writing and helped me a lot in the completion of this paper. Finally, I would also like to thank the students of North China Electric Power University who have helped me to communicate with me during the writing of the paper.

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