Analysis on the Impact Factors of Mechanized Construction of Transmission Line Project

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Abstract—Transmission line engineering is an important part of electric power construction. With the continuous improvement of transmission line engineering safety technology and other management requirements, the traditional "manpower first, machinery as auxiliary" construction mode of transmission line engineering will not be sustainable. In this context, in this context, the traditional transmission line construction mode urgently needs to change the development direction, improve the development quality, and reduce the construction safety risk. Therefore, the use of mechanized construction, the use of advanced construction equipment, with high efficiency, high construction technology standards instead of human construction needs came into being. Based on the systematic analysis of the influencing factors of transmission line engineering mechanization construction, this paper puts forward the engineering mechanization construction cost control measures to provide reference for improving the cost management level of transmission line engineering.

Keywords: transmission line engineering, mechanized construction, analysis of influencing factors, cost control method

1. Introduction

With the development of my country's social economy and the increase of human resource costs, by promoting the application of mechanized construction in each sub-process, the overlap time between each process can be effectively shortened, the work efficiency can be greatly improved, and the overall construction cycle can be significantly improved. shortening, and the proportion of labor costs has been effectively reduced.

Document [1] combines the actual application of new electric construction drilling rigs, analyzes the impact of mechanized construction on cost management, and proposes countermeasures. Document [2] analyzes the significance of the whole process of mechanized construction of transmission line engineering, and proposes typical construction methods. Document [3] proposes a mechanized construction scheme for the whole process of transmission line engineering, which provides a reference for improving engineering construction efficiency and reducing engineering construction costs. Document [4] compares and analyzes the advantages and disadvantages of human construction and mechanized

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construction in engineering quality management, safety management, cost control, etc. Document [5] compares the economics of mechanized construction and traditional construction methods based on engineering examples, and provides a reference for the choice of construction measures for enterprises.

To sum up, the current scholars pay more attention to the analysis of the advantages of transmission line engineering mechanization construction and conventional construction of human resources, while the research on the influencing factors and cost control methods of the influence of transmission line engineering mechanization construction is relatively weak.

2. Analysis of the influence factors of mechanized construction of transmission line engineering based on system dynamics

2.1. The Basic Theory of System Dynamics

System dynamics (SD) was founded by Professor Jay W. Forrester of MIT in 1956. It is an interdisciplinary and comprehensive subject specializing in understanding systems and solving system problems.

The basic tool of systems dynamics is the causal graph, connecting multiple factors with arrows marked with causality to form causal chains. Causality has positive causality and negative causality, as indicated by "+" and "- -" on the arrows, respectively, meaning that the increased cause promotes or suppresses the results. More than two causal chains are connected from end to end to constitute a causal loop. When an element in the loop strengthens, it can make the causal relationship of the whole loop strengthened. Therefore, it is called a positive causal loop, otherwise it is called a negative causal loop. When the nature of the variables and the inflow and outflow direction of the system energy are relatively clear, the flow direction of the system energy can be identified in the graph to clarify the feedback form and control law of the system. This graph is called the flow diagram.

2.2. Analysis of the influencing factors of mechanized construction of transmission line engineering

At present, the mechanized construction of transmission line construction project is mainly used in foundation construction, pole and tower group erection, guide ground line erection, grounding laying, temporary road construction and material transportation. The main influencing factors of each process are shown in Figure 1 below:

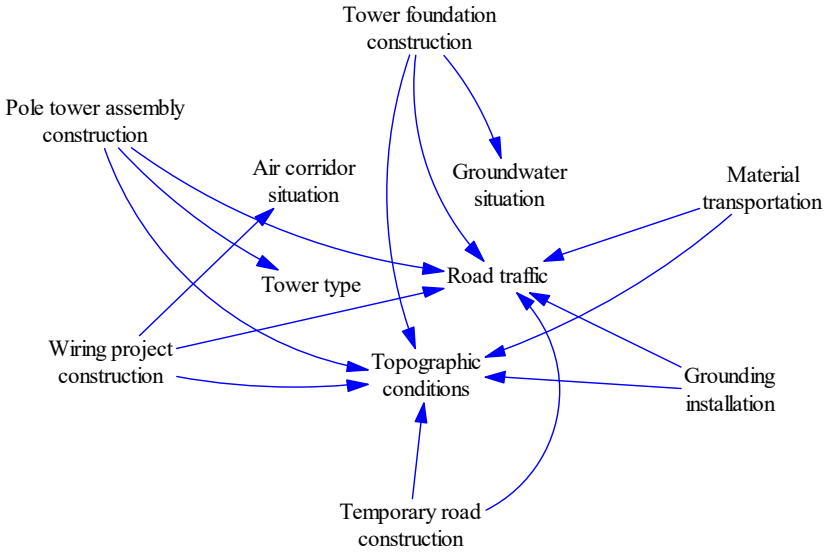

Figure 1. Analysis diagram of the influencing factors of mechanized construction of transmission line engineering.

As can be seen from Figure 1, the construction of the transmission line project consists of the construction of the foundation of the tower, the construction of the tower assembly, the construction of the wiring, the construction of the temporary road, the construction of the material transportation, the construction of the grounding, etc. The factors affecting the construction mainly include: groundwater conditions, Types of towers, air corridor conditions, topographical conditions, road traffic conditions, etc.

3. Empirical analysis

This paper collects the data of a 500kV transmission line upgrading project implemented by HB Provincial UHV Company, taking the basic part of the mechanized construction as an example, to analyze the cost level of the basic mechanized construction under different conditions.

The main landform units along the 500kV line are hilly land and plain, with 40% flat terrain, 20% mountainous land and 40%; the overall terrain is relatively flat, mainly dry land and paddy fields. The base geology of the line tower is mainly composed of quaternary overburden and bedrock. According to the terrain and geological conditions along the line, the foundation of the new pole and tower adopts excavation foundation, plate foundation and cast-in-place pile foundation.

Select representative tower foundation, according to the construction site survey and construction machinery transportation requirements, temporary construction road 200 m long, 205 m wide, 500 ㎡, 400 m long, 3 m wide, 200mm thick gravel, totaling 1200 ㎡. For laying temporary construction roads, the attachment damages and replanting fees in plain

areas are calculated as 7,000 yuan / mu; the forest compensation fees in hilly areas are 10,000 yuan.

Based on the "Power Construction Engineering Quota and Cost Calculation Provisions (2018 edition)" issued by the National Energy Administration as the valuation basis, the calculated cost of the single base tower plate foundation using mechanized construction of the project is 191,600 yuan, and the specific cost composition details are shown in the following table:

Table 1. Analysis table of slab foundation cost.

Order number	Item or expense name	Amount (YUAN)				Total amount accounted for (%)
		Amount to	Among them: direct engineering costs	Among them: labor costs	Mechanical fee	
1	bed-plate foundation	179458	119557	32283	21857	93.64%
2	temporary road	6936	3130	2815	315	3.62%
3	Compensation for attachments and farmland fees	5248	0	0	0	2.74%
amount to		191641	122687	35098	22172	100%

The cost of single tower cast-in-place pile is 426,600 yuan, and the specific cost composition details are shown in the following table:

Table 2. Cost Analysis Table of cast-in-place pile foundation.

order number	Item or expense name	Amount (YUAN)				Total amount accounted for (%)
		amount to	Among them: direct engineering costs	Among them: labor costs	Among them: mechanical cost	
1	Packed pile foundation	362535	229056	78487	39785	84.97%
2	Temporary construction road	57250	40738	7968	1884	13.42%
3	Compensation for attachments and farmland fees	6864	0	0	0	1.61%
amount to		426649	269794	86455	41667	100.00%

The cost of digging the foundation of a single base tower is 212,600 yuan, and the specific cost composition details are shown in the following table:

Table 3. Cost Analysis Table of Dig Up Foundation.

order number	Item or expense name	Amount (YUAN)				Total amount accounted for (%)
		amount to	Among them: direct engineering costs	Among them: labor costs	Among them: mechanical cost	
1	Dig the foundation project	79063	51656	15189	10109	37.19%
2	temporary road	115522	82344	15936	3768	54.34%
3	Forest compensation	17991	0	0	0	8.46%
amount to		212576	134000	31125	13877	100.00%

In the above cases, the foundation construction cost is calculated according to the current relevant valuation standard of the power code, in which the labor cost accounts for about 20% of the installation engineering cost; the machinery cost accounts for about 12% of the installation engineering cost, and the proportion of the machinery cost is lower than that of the labor cost. In addition to the foundation body construction cost, there are also temporary road construction costs and compensation costs, which account for 6.36%; swamp area accounts for 15.03%; hilly area accounts for 62.8%. It can be seen that the mechanized construction cost of transmission lines has the following characteristics:

(1) Increase the cost of road construction and compensation. The construction of the temporary construction road will produce additional construction road construction costs and land occupation compensation costs, and the more complex the terrain conditions, the higher the proportion of the total cost of the related cost.

(2) The calculation of construction site transportation costs has its particularity. After the use of mechanized construction, the human transportation cost is no longer calculated in principle, but due to the complex terrain conditions of transmission lines, the construction road is often a large slope, can only meet the entry of some construction machinery, some materials still need to rely on human transportation, so the human transportation cost is still listed in the cost.

(3) A high proportion of labor costs. Limited by the construction conditions, construction technology level, mechanized equipment and other factors, even in the use of mechanized construction, still need to use a large number of labor to cooperate with the construction, the cost can not be effectively reduced.

(4) Unreasonable machinery costs. The current valuation basis is based on the social average productive forces, in the case of standard work efficiency to calculate the labor, materials, equipment consumption of equipment and other resources. However, due to the complexity of

transmission line construction, the production efficiency of mechanical equipment is low, and its cost is higher than the quota valuation standard in the actual use situation.

Therefore, after the use of mechanized construction at this stage, due to the substantial increase in its auxiliary engineering costs, the relevant mechanized construction valuation standards are not perfect, the construction unit unreasonable mechanized construction scheme, resulting in the increase of the cost cost, which puts forward higher requirements for the mechanized construction cost control and management.

4. Mechanization construction cost control measures of transmission line engineering

(1) Move forward the cost management threshold and deepen the route design scheme

Deepen the design depth of the preliminary stage, carry out the design work strictly in accordance with the principle of "one foundation and one plan", and optimize the project according to the objective conditions such as the geology of the project site, topography and landform conditions, mechanized construction conditions, suitable construction equipment and construction technology, and traffic along the line. Design scheme, so that the design scheme more meet the requirements of the mechanized construction of transmission lines.

(2) Actively introduce advanced equipment and improve the level of mechanical construction

According to the actual needs of the project, all kinds of advanced machinery and equipment are adopted according to local conditions. Increase the cost of machinery and equipment, develop and promote advanced machinery construction technology to meet construction needs under various conditions, expand the scope of machinery use, and reduce human resource investment.

(3) Optimizing the mechanized construction plan and establishing the awareness of cost management

Establish a standardized construction plan. On the basis of the existing construction equipment, according to different geological and topographic conditions and construction purposes, according to the classification of line construction procedures, formulate a popularized standardized construction plan for each construction link.

(4) Standardize project settlement management and formulate settlement workflow

Carry out unified and standardized management of project settlement, and adhere to the principle of "strict control and fact-based verification" for expenses that are prone to disputes in mechanized construction; unify settlement requirements and standards, comprehensively improve project settlement level, and ensure settlement work in accordance with the law. regulation.

5. Conclusion

This paper systematically analyzes the transmission line engineering foundation construction, tower construction, line construction, temporary road construction, material transportation construction, grounding laying construction and other mechanization application of the main factors, and combined with the transmission line engineering mechanization construction practice demand, puts forward the corresponding cost control measures, to provide a reference for further improve the scientific nature of the transmission line engineering cost management.

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