Application Research of Full Process Engineering Consulting in Power Grid Engineering Cost Management

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Abstract. The safe and reliable supply of electric energy is an important foundation for ensuring the rapid development of my country's social economy. In recent years, with the continuous increase in the power demand of the whole society in our country, the scale of investment and construction of power grid projects has continued to expand, strengthening project cost management and improving project investment efficiency has become one of the important goals of investment management of power grid enterprises. The whole process engineering consulting service covers the complete life cycle of the power grid project, from the feasibility study analysis report and feasibility estimation preparation, project preliminary design and preliminary budget preparation, to project decision-making plan, project bidding plan, project whole-process cost management. Completion settlement and final accounts have made important contributions to the investment and construction of power transmission and transformation projects in China.

1. Introduction
The safe and reliable supply of electric energy is an important foundation for ensuring the rapid development of my country's social economy. With the continuous expansion of the investment and construction scale of my country's power grid engineering projects, objectively, it has also promoted the vigorous development of engineering consulting service companies, especially in cost management, engineering consulting companies have played a great role[1]. In the past, due to some management problems in the early decision-making stage, preliminary design stage, engineering construction stage of the power transmission and transformation project, the actual investment of the project in the cost management of the power transmission and transformation project often exceeded the estimated investment, which was not conducive to The investment management and control of power grid enterprises also caused a waste of resources to a certain extent. The engineering consulting company participates in the entire process cost management and serves the construction unit as a third party, so as to better control the cost of the power grid project, reduce the black box operations and violations of rules and regulations in the power grid project construction, and ensure the transparency of the power grid project cost. The source, use and effect of comprehensive supervision and audit to control the construction cost of the project to the greatest extent, improve the investment efficiency of the power grid project, and standardize the power industry[2].

The target of full-process engineering consulting is the complete life cycle of power transmission and transformation engineering. The services provided include consulting services and management services for the early, middle, and late stages of the project, operation, and investment. The specific connotation of the whole process engineering consulting covers all aspects, from feasibility study
analysis report, project design analysis report, to project decision plan, project bidding plan, project management plan, operation acceptance plan, etc. Construction has made important contributions [3].

2. Disadvantages of traditional power grid project cost management

Compared with the entire process cost consultation, the traditional power transmission and transformation project cost control has many drawbacks, which to a certain extent restricts the further improvement of the project cost control level.

![Figure 1. Disadvantages of traditional power grid project cost management.](image)

2.1. Lack of engineering management professionals

The power grid engineering investment project requires all parties to allocate professionals and resources to carry out the work according to the work requirements to ensure that the project goes smoothly. However, at this stage, there is no cost management position in the organization structure of the power grid enterprise. The lack of effective control over the cost of the project makes it difficult to coordinate project costs, schedules, benefits, and quality, which is not conducive to the lean management of power grid projects.

2.2. The cost management of each stage of the power grid project is not in place

Due to the large investment scale, long construction period, many cost control links, and many influencing factors, the power grid project has caused inadequate cost management in all aspects of the project. Mainly manifested in three aspects: First, the investment and construction of power grid projects at this stage are more from a safety perspective, but the economic analysis of the project is obviously insufficient. The second is that the technical and economic management personnel, especially the cost management personnel, are not sufficiently involved in the project construction process and cannot provide effective support for the project cost management. Third, the cost control of power grid projects relies more on the experience of grassroots personnel, lacking the corresponding cost management expertise and methods.
2.3. Project cost management is greatly affected by the outside world
With the development of society and economy, the external environment of power grid construction is becoming more and more complex, and the difficulty of external coordination is increasing. For example, land acquisition and coordination of transmission and distribution line corridors are becoming more difficult. Construction schedule and cost control have serious impacts. In addition, due to regional differences, the cost calculation standards and listing contents are different in different regions, resulting in a large difference in the cost of the same technical transformation project in different regions. Very large, after investigation and analysis, it is found that the difference in the cost of young crop compensation among other costs is the main reason for the difference in cost level.

3. Application of full-process engineering consulting in cost management of power transmission and transformation projects

3.1. Support the project's early decision
The power grid project investment decision-making stage serves as the source and basis of the entire process cost management. Therefore, during the decision-making period, the cost management personnel need to conduct a comprehensive investigation, analysis and comparison, conduct a feasibility study, propose a project proposal, and optimize the existing power grid design plan. Formulate project investment estimates that meet the needs of the owners, and provide basic information for subsequent power grid project cost control. The preliminary work helps to avoid the "three super" problems, and the approved investment estimate is used as the maximum limit for the construction of power grid projects, thereby controlling the cost of design, construction, and completion. Cost management personnel must ensure the accuracy of project investment estimates, especially in terms of investment decision-making, as the main body of cost control, the owner should plan the construction and purpose, engineering functions, and project construction cycle influencing factors. To manage goals and make decisions, cost management personnel are required to make more accurate investment estimates.

3.2. Perfect engineering design
In the design stage, it is necessary to decompose the project budget goals, combined with life-wide cost management theory, engineering value management theory, etc., to ensure the economic rationality of the project design, reduce the cost of power grid construction stage, reduce project construction, the cost of the operation phase. Engineering consulting units and cost consulting personnel should conduct a comparative analysis of multiple design schemes, comprehensively consider many factors such as graphic design, process design, architectural design, design unit, individual level, etc., and comprehensively strengthen the cost control at the design stage. In the actual cost control, it is necessary to take preventive control as the main body, and to ensure the quality and function requirements of the power grid project, do not exceed the planned expectations and save resources as much as possible. The initial design should include all project investment goals, so that the initial design will not exceed the overall project cost goal. The construction drawing design should also be within the scope of the revised estimate, and follow-up construction work should be carried out based on this standard. In design, a design tracking mechanism should be adopted to timely evaluate the design drawings and engineering content, and compare design project investment with planned investment. If the actual design investment exceeds the planned investment, the design shall be revised to ensure that the limit is not exceeded. Quota design is an important means of cost control in the design stage. The preliminary design should be carried out according to the feasibility report and cost estimate, combined with the preliminary design budget control technology design and construction drawing design. Unreasonable limit control changes to ensure that the total investment amount remains unchanged.
3.3. Strengthen construction cost management

The construction phase is the main implementation phase, and it is important to consider the construction quality, cycle time, cost, personnel factors, and social factors. One is the trade-off between quality, construction period and cost. The investigation and analysis show that the construction cost, project quality, and project cost itself affect project cost. These three factors can be transformed into each other. For example, the delay of construction period and the failure of quality standards will increase the cost of the project, and the cost will directly affect the quality and construction cycle. The three must balance. The implementation goals of the whole process cost management are good quality, low price and reasonable construction period. Second, in the construction of power grid projects, construction must be carried out in strict accordance with the construction drawings, and at the same time, the acceptance work should be done in accordance with the norms and standards. The actual construction of the power grid project must meet the mandatory standards to ensure the quality of the project and avoid a lot of waste of resources due to the failure to meet the standards. The cost is exceeded. The third is that the construction period is directly related to the cost. Since the value of resource consumption will become a project investment over time, all resources in the project construction have a certain time value. That is, the value of time will directly affect the project cost, such as changes in the construction period will lead to changes in capital and burden of interests. However, the construction period cannot be shortened blindly, which will affect the quality and increase the investment cost. It can be seen that cost control during the construction phase is a dynamic control process. The management of a certain element alone cannot achieve the ultimate goal of cost control. The tripartite relationship between duration, quality, and cost must be fully considered, so that costs can be controlled more effectively.

4. Statistical analysis of the whole process cost consultation participation in project construction

At present, the whole process cost consultation service has become more and more active in the construction of power transmission and transformation projects, which has beneficially improved the quality of project construction and raised the level of control of project cost. The whole process cost consulting service and the main service content and participation level in the construction process of power transmission and transformation project are shown in Table 1:

Table 1. Statistics on the participation level of the whole process cost consultation in the construction of power transmission and transformation projects.

| Serial number | Project implementation phase | Service Content                                                                 | Participation ratio |
|---------------|------------------------------|----------------------------------------------------------------------------------|---------------------|
| 1             | design phase                 | Engineering quantity list and maximum bid limit price review                      | 100%                |
| 2             |                              | Drafting construction tender documents                                           | 10%                 |
| 3             |                              | Contract drafting and presentation                                               | 30%                 |
| 4             | construction stage           | Construction cost settlement review                                               | 100%                |
| 5             |                              | Project progress payment review                                                   | 70%                 |
| 6             |                              | A supply materials and equipment audit                                           | 70%                 |
| 7             |                              | Review of other expenses related to construction                                 | 80%                 |
| 8             |                              | Work on concealed works, field leveling, site surveys, forensics, signing of engineering quantity confirmation sheets, etc. | 80%                 |
5. Conclusion
In summary, the participation of engineering consulting units in power grid project cost management is conducive to solving the problem of lack of cost control personnel and management methods for power grid companies, and is conducive to further improving the level of lean management of power grid project investment.

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