Research on Risk Assessment Technology of Investment Plan Implementation of Electricity Grid Construction Projects Based on Automatically Generated Fixed Asset Investment

Ming Zhou¹*, Shengwei Lu¹, Qiang Wu¹, Sha Jin¹, Jiong Yan², Zixia Sang², Rengcu Fang²
1 State Grid Hubei Electric Power Co., Ltd., Wuhan, Hubei, 430077, China
2 State Grid Hubei Economic Research Institute, Wuhan, Hubei, 430077, China
*Corresponding author’s e-mail: Zhoum50@hb.sgcc.com.cn

Abstract. In order to achieve accurate verification of the implementation of power grid infrastructure investment plan, support the dynamic monitoring and risk assessment of annual investment plan implementation. Based on the "three rates in one" Investment completion collection value of 110 kV and above grid infrastructure projects, this paper constructs a risk assessment model for the implementation of the investment plan of grid infrastructure projects. Evaluate the rationality of the current reported investment progress, predict the risk of the implementation of the investment plan and quantify the risk amount of the implementation of the plan, timely discover the risk of the implementation of the investment plan, promote the timely resolution of problems, and improve the investment lean management level of power grid enterprises.

1. Research Background
With the deepening of transmission and distribution price reform, how to ensure the stability of transmission and distribution price has become the key to the realization of benefit objectives of power grid companies. As one of the key factors to determine the transmission and distribution price, the accuracy of the process implementation has a significant impact on the level of transmission and distribution price. At present, in the actual management process of investment specialty, there is a situation of "inconsistent manual submission standard" in the investment completion amount, which makes it difficult to accurately measure the actual implementation of investment, the investment implementation process lacks closed-loop control, and there are risks in the implementation of investment plan. Therefore, it is necessary to explore a scientific and effective technical scheme and quantitative management tool for investment plan implementation risk assessment, build a set of risk assessment and quantitative model for investment plan implementation process to adapt to the reform of transmission and distribution electricity price, and assist the dynamic monitoring and plan adjustment of the whole process of annual investment plan implementation Make decisions and improve the lean management level of investment plan.

2. Research Train of Thought
According to the idea of "analyzing the current situation and predicting the future", this paper constructs a risk assessment model for the implementation of the investment plan of Electricity Grid Construction Projects based on the Investment completion collection value, and
evaluates the rationality of the current reported investment progress. At the same time, based on the theoretical investment completion progress curve model, the possible investment in the remaining years is predicted, the annual investment plan implementation risk of Electricity Grid Construction Projects is evaluated and the risk amount of plan completion is quantified. The calculation period of investment plan risk amount of Electricity Grid Construction Projects refers to the period from the commencement of Electricity Grid Construction Projects to December 31 of the evaluation year, which is divided into historical period and prediction period. The historical period refers to the period from the commencement date of the project to the current time, the forecast period refers to the period from the current time to the end of the evaluation year. The specific research thought are as follows:

Figure 1. The general idea of risk assessment for investment plan execution of Electricity Grid Construction Projects.

3. Construction of Risk Assessment Model for investment plan implementation of Electricity Grid Construction Projects.

3.1 Related Concepts

3.1.1 Project construction progress. Project construction progress is the core management index of the construction department, which reflects the actual construction progress of the project, and is the completion of each sub part project quantity expressed by the actual completion percentage.

3.1.2 Project cost. Project cost is the core index of project management in financial department, which reflects the actual financial expenditure of construction cost. Cost entry progress is equal to the ratio of project cost to the approved budget.

3.1.3 Investment completion. Investment completion is the amount of fixed asset investment in the form of currency, in which the amount of fixed asset investment is the amount of work in the form of currency. Investment completion refers to the submitted value of fixed asset investment amount completed according to the project, that is, investment completion report value. Investment progress is equal to the ratio of fixed asset investment to the approved budget.

3.1.4 Investment completion collection value. In order to accurately measure the real investment completion of power grid infrastructure projects, the system automatically calculates the investment completion amount based on the objective data of relevant infrastructure and financial source system. The Investment completion collection value is the automatically generated value of investment completion, which is the fixed asset investment completion amount automatically generated in the planning and planning system of the Ministry of development based on the construction progress data and project budget data of the infrastructure management and control system(IMCS) of the Ministry of infrastructure.
Generally, the Investment completion collection value is divided into construction engineering cost, installation engineering cost, equipment purchase cost and other costs according to the cost.

![Figure 2. Investment completion collection value algorithm](image)

3.2 Construction of Investment Plan Execution Risk Assessment Model for projects under construction.

For the grid infrastructure projects under construction and not put into operation, firstly, the deviation of the investment completion report value and the investment completion collection value is calculated, and the items with larger screening deviation are included in the list of the risk item. And then the risk amount of the investment plan implementation of the risk project is calculated. Finally, the project investment plan execution risk exceeds the evaluation annual investment plan or the project total budget estimate the project to carry on the adjustment, calculates the final investment plan execution risk amount.

3.2.1 Screening risk items.

(1) Judge the abnormal project of investment completion progress

The investment completion progress abnormal project refers to the fact that the investment completion is not matched with the capital construction and finance, that is, the investment completion progress is not matched with the construction progress and the cost entry progress. The specific indicators and judgment rules are as follows:

| Indicators | Judgment Rules |
|------------|----------------|
| Deviation rate of Investment Completion and Capital Construction = \[\text{Investment Completion Progress} - \text{Construction Progress}\] | When the construction progress is less than or equal to 30%, the Deviation rate of Investment Completion and Capital Construction is more than 10%, then it is the project that the investment completion and capital construction are not matched. When the construction progress is more than 30%, the Deviation rate of Investment Completion and Capital |
Construction is more than 50%, then it is the project that the investment completion and capital construction are not matched.

When the construction progress is less than or equal to 30%, the Deviation rate of Investment Completion and Finance is more than 10%, then it is the project that investment completion and finance are not matched.

When the construction progress is more than 30%, the Deviation rate of Investment Completion and Finance is more than 50%, then it is the project that investment completion and finance are not matched.

When the investment progress is not matched with the capital construction and finance, it is the abnormal project of investment completion progress. The risk score of such project is 1 point, otherwise it is 0 point.

(2) According to the deviation degree between the investment completion collection value and the investment completion report value, the risk score is made.

The deviation amount of investment completion (Deviation amount of investment completion = investment completion collection value - investment completion report value) reflects the deviation degree between the investment completion collection value and the investment completion report value. The risk score is divided according to the absolute value of the calculation index, and the specific risk scoring rules are shown in the table below:

| Indicator                              | Absolute value of the Indicator(Unit:¥10,000) | Risk Score |
|----------------------------------------|-----------------------------------------------|------------|
|                                        | Lower limit of interval                        | Upper limit of interval (including boundary)  |            |
| Deviation amount of investment completion | 0                                             | 100        | 0          |
|                                        | 100                                           | 500        | 1          |
|                                        | 500                                           | 3000       | 2          |
|                                        | 3000                                          | 5000       | 3          |
|                                        | 5000                                          | --         | 4          |

(3) According to the above judgment results, determine the project risk score and risk rating evaluation results.

- The total risk score of a single project is calculated according to the risk scores calculated in the above (1) and (2). According to the total risk score, the project risk level is divided into project risk grade: score 0 to 2 is low risk, score 3 is intermediate risk, score 4 to 5 is high risk.
- Select projects with intermediate and advanced risk levels as risk projects of investment plan implementation and include them in the list of risk projects.

3.2.2 Calculate the execution risk of investment plan of risk project.

The risk amount of investment plan execution (R_e) is the sum of the risk amount of investment plan execution (R_h) during the project history period and the risk amount of investment plan execution (R_f) during the forecast period. The detailed calculation method is as follows:

Historical period risk amount (R_h): the historical period risk amount is the investment collection value minus the investment completion report value.
Risk amount in forecast period (Rf): risk amount in forecast period=investment completed amount in forecast period-investment plan not completed=Investment completion amount in the forecast period - (cumulative investment plan issued-investment completion report value).

The calculation steps and methods of investment completion amount during the project prediction are as follows:

(1) Determine forecast period
First determine

Table 3. Algorithm for determining the forecast period

| Preliminary calculation method of forecast period | Prediction interval judgment | Determine forecast period |
|--------------------------------------------------|-----------------------------|--------------------------|
| Calculate the remaining construction progress of each project divided by the monthly average construction progress, and get the time required for the project construction \( (A) \) | Compare \( A \) and \( B \), and take the larger value as the preliminary prediction period \( (C_1) \) | \( C_1-C_2\geq2 \) | \( C_1 \) |
| The remaining months of the year are determined as the maximum forecast period \( (B) \) | \( C_1-C_2\leq2 \) | \( C_2 \) |

(2) Calculation of investment completed during the forecast period
According to the above determined forecast period and the average monthly growth rate of investment completion, calculate the predicted investment progress, and then calculate the investment completion amount in the forecast period.

- If the difference between the current time and the actual start time is less than 6 months (the construction period in the general civil construction phase), and the accounting progress is less than 40% (equipment accounted for equipment cost accounting experience), the investment progress during the forecast period will be 5% per month (investment completed (Average monthly growth rate) plus 20% (equity investment in equipment account, monthly investment growth rate) forecast;
- If the interval is greater than or equal to 6 months, and the account progress is greater than 40%, the investment progress during the forecast period is forecasted at 5% monthly.
- For new projects with "planned production time" field (planned production time is in the remaining months of this year), calculate the difference between the given planned production time and the current time as the preliminary forecast time \( (C_2) \).

3.2.3 Adjust the risk amount and determine the risk amount of investment plan implementation.
Through the above calculation, the preliminary risk amount of investment plan implementation can be obtained, and the items exceeding the annual investment plan or the approved budget can be adjusted to obtain the final risk amount of investment plan implementation.

- When the risk amount of the implementation of the investment plan is less than 0, the absolute value of the risk amount cannot exceed the investment plan of this year. If it exceeds the annual investment plan of the evaluation, the negative value of the annual investment plan is taken as the risk amount of the implementation of the project investment plan;
- When the investment plan execution risk amount is > 0, the sum of the risk amount and the investment collection value (if the investment collection value is 0, the accounting cost / 0.8) cannot exceed the budget estimate. If it exceeds the budget estimate, the budget reduction is used to subtract the risk
amount during the historical period. The difference is taken as the amount of project investment plan execution risk.

The specific logic of adjusting the risk amount of investment plan implementation is shown in the following figure:

![Logic chart of plan implementation risk correction.](image)

**Figure 3.** Logic chart of plan implementation risk correction.

### 3.3 Building a risk assessment model of investment plan implementation for new projects.

Since the new project of power grid infrastructure construction plan has not started at the time of risk assessment, the calculation of annual plan implementation risk amount of such project is mainly to determine the risk amount during the forecast period. The main steps and methods are as follows:

#### 3.3.1 Determine forecast period. For the planned new projects, the forecast period is directly determined according to the interval from the planned commencement time to December at the end of the year.

#### 3.3.2 Calculate the investment completion amount in the forecast period. According to the forecast period, the approved budget of the project and the average monthly investment completion growth rate (5%), calculate the investment completion amount in the forecast period. The calculation formula is:

\[
\text{Investment completion amount in forecast period} = \text{predicted investment progress} \times \text{approved budget}
\]

\[
= \text{forecast period} \times 5\% \times \text{approved budget}
\]

#### 3.3.3 Determine the risk amount of investment plan implementation. The investment plan execution risk amount R2 of the newly-opened grid infrastructure construction project is the difference between the investment completion amount and the cumulatively issued plan during the forecast period. For projects with a risk amount exceeding 5 million yuan, it is included in the investment plan execution risk project list.

### 4. Conclusion

In this paper, 110kV and above voltage level electricity grid construction projects as the research object, focusing on the exploration of electricity grid construction project investment plan implementation risk assessment technology program. By constructing the risk assessment model for the implementation of the investment plan of the electricity grid construction projects, the risk assessment of the implementation of the investment plan for the construction of infrastructure projects and the planned new projects can be realized, and the adjustment and decision-making in the auxiliary grid investment
can be effectively reduced, and the implementation risk of the investment in the grid infrastructure projects can be effectively reduced, and the lean management level of the investment plan implementation can be improved.

References
[1] Ji, X.J., Wang, Y.Q. (2018) Investment Risk Assessment and Coping Strategies of Grid Corporations under the Background of Electric Reform. Smart Grid., 34(5):6-12.
[2] Huang, M.L., Qin, X. (2016) Standardizing Investment Plan Management and Promoting Coordinated Development of Power Grid. Modern Economic Information., 81.
[3] Zhang, Y. (2018) Discussion on Investment Plan Management of Power Grid Infrastructure Project Based on Improving Quality and Efficiency. Enterprise Reform and Management., 43-44.
[4] Long, Y., Hu, W., Ma, Q. (2019) Dynamic Investment and Development Mechanism of Power Grid Enterprises under Transmission and Distribution Price. Journal of Power System and Automation., 31(8):143-150.
[5] Li, Y. (2018) Requirements of Fixed Assets Investment Plan Management in Power Grid Enterprises. Power and Electronics., 63-164.