

# Research on Investment Execution Evaluation and Management Method of Distribution Network Infrastructure Engineering Unit at The Overall Level

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**Abstract**—Distribution network infrastructure project has the characteristics of large number of projects, small investment scale of a single project and inconsistent management granularity. Therefore, the investment implementation evaluation of a single project is not only large, but also the evaluation standards adopted by different types of distribution network infrastructure projects are inconsistent, which brings difficulties to project batch management. This paper takes the whole process of investment management of distribution network infrastructure project as the main line, Study the investment execution evaluation and management methods from the overall level of the unit, build the investment execution evaluation index system and determine the evaluation rules based on the existing systems and data, realize the batch management and evaluation of distribution network investment execution, assist the management and investment decision-making of distribution network infrastructure projects, and improve the investment execution efficiency and benefits at the overall level of the unit.

**Keywords**- Distribution network infrastructure project; Investment execution evaluation; Project batch management; Data indicator system;

## 1 INTRODUCTION

The Fifth Plenary Session of the 19th CPC Central Committee pointed out that China has turned to a high-quality development stage. In order to promote the high-quality development of power grid enterprises, the government regulates the nuclear price, and puts forward clear requirements for the investment efficiency of power grid. The goal of "carbon peaking and carbon neutralization" forces investment efficiency, and the requirement of power grid upgrading is more urgent. Distribution network infrastructure project has the characteristics of

large number of projects and small investment scale of single project, and there are differences in management methods and requirements of different distribution network projects. Some projects are managed according to single projects and some projects are managed according to project packages. Therefore, based on the whole process of distribution network investment management, this paper studies and constructs the implementation evaluation index system of distribution network project from the unit level, build a unit level investment execution evaluation model to assist each unit in the supervision and evaluation of distribution network investment execution, and improve the efficiency and benefit of the overall investment of distribution network.

## 2 RESEARCH CONTENT

### 2.1 Construction of unit level investment execution evaluation indicators

Based on the whole process of investment management of distribution network infrastructure project, the early stage of the project, project commencement, project construction, project production and project closure are distinguished, and the investment implementation monitoring indicators only applicable to the unit level are established to monitor the investment implementation at the unit level. The calculation method, evaluation rules, data source and significance of each index are shown in the table below:

Table 1 Monitoring indicators of unit level investment implementation

Stage	Index	Professional department	Analysis content	Calculation method of unit floor	Data source system	Significance of index selection
Early stage of the project	Decomposition rate of investment plan	Development Department	Check the breakdown of unit level investment plan	Decomposed and issued investment plan / Annual investment market of power grid infrastructure projects of 10kV and below.	Planning system	Speed up the decomposition of investment plans
	Project initiation rate	Equipment Department	Check the project startup at the unit level	Annual investment plan of projects that have been built in ERP and PMS systems / Annual investment market of power grid infrastructure projects of 10kV and below.	Planning system; ERP system; PMS system;	Speed up project startup
	Deviation between ERP project construction and PMS project construction	Equipment Department	Check the construction deviation of unit level project	Number of deviation items between ERP project construction and PMS project construction / Number of decomposed items.	Planning system; ERP system; PMS system;	Reduce project construction deviation between systems
Project commencement	Project commencement rate	Development Department	Check the commencement of unit floor projects	Project commencement rate (quantity) = Number of started projects / Number of decomposed projects; Project commencement rate (amount) = Total investment plan of projects under construction this year / total investment plan of	Planning system	Improve the speed of project commencement

Stage	Index	Professional department	Analysis content	Calculation method of unit floor	Data source system	Significance of index selection
				decomposed projects this year;		
	Project commencement timeliness	Equipment Department	Check the timely commencement of unit floor	The number of projects whose deviation between the actual commencement time and the planned commencement time exceeds one month / The number of projects whose actual commencement time is not empty;	PMS system; Planning system;	Improve the timeliness of project commencement of each unit
	Accuracy of actual commencement time of 10kV project	Equipment Department	Check the accuracy of commencement time of unit floor	Number of projects with accurate actual commencement time / Number of projects with non empty actual commencement time;	PMS system; Planning system;	Improve the maintenance accuracy of the actual start-up time of the system
Engineering construction	Forecast implementation rate of agreed inventory materials	Material Department	Check the implementation of material forecast	Planned amount of material implementation / Predicted planned amount of agreed inventory; (It is calculated separately in the third batch and the first batch. The third batch of plans forecasts the demand from January to June of the current year in September of the previous year, and the first batch of plans forecasts the demand from July to December in February) ;	ERP system intelligent supply chain	Improve the implementation rate of agreed inventory contracts
	Material collection ratio	Material Department	Check the actual receiving and use of the overall materials of the unit	Cumulative net material requisition of 10kV and below / Total investment of decomposed projects of 10kV and below;	ERP system; Planning system	—
	Investment completion rate	Development Department	Check the completion of unit level investment	Cumulative investment completion of 10kV and below / Total investment of decomposed projects of 10kV and below;	Planning system	—
	Cost entry ratio	Finance Department	Check the cost entry at the unit level	Cumulative entry cost of 10kV and below / Total investment of decomposed projects of 10kV and below;	ERP system; Planning system	—
	Capital expenditure rate	Finance Department	Check the fund payment at the unit level	Accumulated capital expenditure of 10kV and below / Total investment of decomposed projects of 10kV and below;	ERP system; Planning system	—
	The construction period of the project is too long	Equipment Department	Check whether the construction period of unit level project is too long	Number of projects whose construction period is too long / Number of projects whose actual commencement time is not empty;	Planning system	Improve the speed of project construction
	Project put into operation	Project completion rate	Development Department	Check the project completion at the unit	Project completion rate (amount) = total investment plan of projects put into operation	Planning system

Stage	Index	Professional department	Analysis content	Calculation method of unit floor	Data source system	Significance of index selection
			level	this year / total investment of decomposed projects this year;		
	Timeliness of commissioning	Equipment Department	Check the timeliness of each project put into operation	Number of projects that are not put into operation in time / Number of projects whose actual production time is not empty;	Planning system; PMS system;	Improve the timeliness of project commissioning
	Authenticity of production	Equipment Department	Check the authenticity of each project put into operation	Number of unreal projects put into operation / Number of projects whose actual production time is not empty;	Planning system; PMS system;	Improve the authenticity of project production time data
	Accuracy of actual completion time of the project	Equipment Department	Check the accuracy of the actual completion time of each project of the unit	The number of projects whose actual completion time is accurate / The number of projects whose actual production time is not empty;	Planning system; PMS system;	Improve the maintenance accuracy of the actual production time of the system
Project settlement	Timely rate of project settlement	Equipment Department	Check the timely settlement of unit level	Number of items that are not settled in time / Number of items whose actual settlement time is not empty;	PMS system;	Improve the timeliness of project settlement
Project capital transfer	Conversion rate	Finance Department	Check the capital transfer at the unit level	Capital conversion amount / Annual investment plan for power grid infrastructure projects of 10kV and below	ERP system; Planning system	Improve the formation speed of effective assets
Project closure	Project closure rate	Finance Department	Check unit level project closure	Project closure rate (amount) = Total investment plan of the project closed this year / Total investment plan of the decomposed project this year	ERP system; Planning system	Speed up project closure

## 2.2 construction of unit level investment implementation monitoring model

1) *Determine indicator monitoring rules.* Unit level indicators are continuous, and the scores are calculated by multiplying the index scores by 100. Continuous indicators distinguish between positive indicators and reverse indicators. For positive indicators, the greater the index value, the higher the score, and the greater the reverse index value, the lower the score. Total score = index 1 score \* index 1 weight + index 2 score \* index 2 weight +..., the total score is a number between 0 and 100. The closer the score is to 0, the worse the project implementation and the higher the risk.

2) *Determine index weight.* The unit level indicators are continuous indicators. In principle, the entropy method shall be used to determine the index weight. The entropy weight and entropy value of the indicators shall be calculated according to the principle of entropy method, and then the index weight shall be determined. Due to the lack of sample data, the entropy weight method cannot be used to calculate the index weight temporarily, and the index weight shall be determined according to the principle of equal importance temporarily.

## 2.3 Model application

1) *Example of index calculation.* Take the "predicted implementation rate of agreed inventory materials" as an example to calculate the implementation of agreed inventory in the first half of 2021. Generally, in September 2020, forecast the demand for agreed inventory materials from January to June 2021. From the smart supply chain system function menu "Visualization-full-process tracking report" collects a company's "2020 third batch of distribution network agreement inventory bid section deployment list", "Pannong network agreement deposit execution (visual purchase and storage batch)" data table, calculate 2021 1 Month-June agreement inventory material forecast implementation rate, based on the calculated agreement inventory material forecast implementation rate, you can dynamically monitor and compare the unit-level monthly agreement inventory implementation status. The specific calculations are as follows:

Table 2 Calculation example of predicted implementation rate of agreed inventory materials

Month	Agreed inventory forecast plan amount (10000 yuan)	Amount of material implementation plan (10000 yuan)				Forecast implementation rate of agreed inventory materials
		Visual shopping	Distribution network deposit batch	Total	Cumulative	
January	78336	2365.07	1743.91	4108.98	4108.98	5%
February	78336	0.00	0.00	0.00	4108.98	5%
March	78336	6391.56	4031.88	10423.44	14532.42	19%
April	78336	4946.45	678.55	5625.00	20157.42	26%
May	78336	4964.84	120.22	5085.06	25242.48	32%
June	78336	7358.53	11.22	7369.75	32612.23	42%

2) *Model validation.* Taking a unit as an example, the overall score and the portrait of each professional department are shown in the figure below. It can be seen that the investment implementation of the development department and equipment department of the unit is poor, ranking 13th and 9th respectively.

Overall portrait	Overall score	Development Department portrait	Professional score of Development Department	Development sector ranking	Equipment department portrait	Equipment department score	Ranking of equipment departments	Portrait of material department	Score of material department	Ranking of material departments	Portrait of financial department	Financial department score	Ranking of financial department
Medium level	69.75	Poor investment execution	57.77	13	Poor investment execution	74.91	9	Investment execution is normal	87.83	1	Investment execution is normal	54.95	2

Figure 1. Portrait of a unit

Further through the query on the ranking of various indicators of the development department, it can be seen that the ranking of indicators of the development department such as "investment plan decomposition rate", "project commencement rate", "investment completion rate" and "deviation between investment completion and investment collection value" is poor. The specific index ranking is as follows:

Development Department portrait	Professional score of Development Department	Development sector ranking	Decomposition rate of investment plan	Project commencement rate	Investment completion rate	Project completion rate
Poor investment execution	57.77	13	10	12	12	1

Figure 2. Example of index ranking of Development Department of a unit

Further query the index value with lower ranking, locate the problem projects with lower index value, formulate solutions and improve the investment implementation progress. For example, for the indicators with low scores of the following development departments, for the case of low "plan decomposition rate", it is necessary to accelerate the decomposition of investment plans; For the low rate of "Kwai", it is necessary to accelerate the formalities for the projects which have not started to achieve the project as soon as possible. In the case of low "investment completion rate", it is necessary to speed up the picking of materials for the started projects and improve the project construction progress.

Decomposition rate of investment plan	Project commencement rate	Investment completion rate
29%	27%	27%

Figure 3. Example of low implementation index value of professional development investment of a unit

Further through the query on the ranking of various indicators of the equipment department, it can be seen that the equipment department has poor ranking of indicators such as "project startup rate", "accuracy of actual commencement time of 10kV project" and "accuracy of actual completion time of project". The specific index ranking is as follows:

Equipment department portrait	Equipment department	Ranking of equipment departments	Project initiation rate	Deviation between ERP project construction and PMS project construction	Project commencement timeliness	Accuracy of actual commencement time of 10kV project	The construction period of the project is too long	Timeliness of commissioning	Authenticity of production	Accuracy of actual completion time of the project	Timely rate of project settlement
Poor investment execution	74.91	9	11	5	1	9	4	1	1	11	1

Figure 4. Example of low investment execution index value of equipment department of a unit

Further query the index value with lower ranking, locate the problem projects with lower index value, formulate solutions and improve the investment implementation progress. For example, for the indicators with low scores in the following equipment disciplines, in case of low "project start rate", it is necessary to accelerate the project construction to ensure the timely start of the project; In case of low accuracy of "actual commencement time of the project", data collaboration among disciplines shall be strengthened to reduce the difference of commencement time among systems; In case of low "actual accuracy of project completion", data collaboration among disciplines shall also be strengthened to reduce the difference in completion time among systems.

Table 3 Calculation example of predicted implementation rate of agreed inventory materials

Project initiation rate	Accuracy of actual commencement time of 10kV project	Accuracy of actual completion time of the project
25%	63%	8%

### 3 CONCLUSION

Combined with business practice and comprehensively considering the characteristics of distribution network construction, Jiangsu company establishes the unit level investment execution evaluation method, generates the overall portrait of different professional dimensions of each unit, intuitively understands the supervision and early warning of unit investment execution, and facilitates the comparative analysis among units. Each unit can determine the investment execution improvement scheme and strategy based on the index value ranking lower due to ranking penetration query. After verification, the model has strong practicability, and provides reference standards and quantitative analysis means for unit layer distribution network evaluation and supervision and management.

### REFERENCES

- [1] Lv, Q.Y. (2019) Research and Prospect of low voltage distribution network visualization. *Comprehensive research.*, (33)173-174.
- [2] Li, Y.K. (2016) Research on statistical methods and practice of user portrait under the background of big data. *Capital University of economics and trade.*
- [3] Shi, D.S. (2018) Management strategy for improving the quality of distribution network project. *Power construction.*, 227-228.
- [4] Wang, D.A., Zhou, S.Q., Liao, J.H. (2018) Research and Practice on the matching between material management and project schedule of rural distribution network project. *Guangxi electric power industry.*, (1) 62-66.
- [5] Gu, W.Q. (2017) Research on investment and evaluation standard system of multistage power grid construction. *North China Electric Power University.*
- [6] Chen, Q., Huang, H.G. (2015) Visual development of intelligent distribution network centered on target user groups. *Smart Grid.*, (3) 652-657.
- [7] Xu, X.Q. (2017) Research on multi dimensional management and evaluation of distribution network construction project. *North China Electric Power University.*
- [8] Liu, S.L. (2017) Research and application of distribution grid investment effectiveness evaluation and decision-making model. *North China Electric Power University.*