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Research on Investment Scale Calculation and Accurate Management of Power Grid Projects Based on Three-Level Strategy

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ABSTRACT In order to improve the investment accuracy of power grid projects, this paper takes distribution network investment as the research object, and proposes a distribution network precision investment method based on a three-level strategy of region, power supply grid, and power supply unit. Firstly, building a precise investment index system for the investment scale of the regional distribution network, and calculate the investment situation through the precise investment calculation formula of the regional distribution network. Secondly, building a time sequence evaluation system for the overall construction of the power supply grid of the distribution network, and then study the prioritization method based on investment projects. The time sequence method for the overall construction of the power supply unit of the distribution network and the multi-objective optimization precision investment method based on the target grid framework. Finally, the effectiveness and operability of the above precision investment method are verified through empirical application.

INDEX TERMS Three-level strategy, investment scale calculation, interval multiplicative reciprocal matrix, PPM algorithm, multi-objective optimization.

I. INTRODUCTION

Investment strategy is the key to the development of power grid and the healthy development of enterprises [1]–[4]. At present, China's economic development has entered a new normal. The growth of electricity sales has slowed down, market competition has intensified, electricity prices are subject to strict supervision, and the contradiction between the development of high-intensity investment, rigid cost growth, slower electricity growth, and difficulty in benefit growth has become increasingly prominent. It is more difficult to maintain stable operation and achieve profit target, which puts forward higher requirements for power grid investment decision [5], [6]. The main grid of the power grid plays a decisive role in the stable supply of power in the region, and the research on its investment management is relatively standardized and mature. With the rapid development of society, the distribution network is no less important than the main network [7], [8]. Distribution network has become an important part of the power system, its safety and reliability will directly affect the national economic development and people's living standards [9], [10]. With the continuous increase in the construction of the distribution network, its investment benefits have also attracted the attention of power grid companies [11]–[13]. Therefore, in order to achieve the goal of precise investment in the distribution network, it is urgent to carry out research on the scale of distribution network investment and precise management.

At present, domestic and foreign experts and scholars have done a lot of research on the precise investment of distribution network, mainly for investment decision-making, project optimization and project post evaluation [14], [15]. It is demonstrated in [16] that a comprehensive investment decision-making method for medium voltage power grid based on the concept of utility planning. This method can determine the investment scale reasonably and allocate all kinds of project attribute investment in a balanced way. An investment priority evaluation method for incremental

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distribution network planning based on hyperplane projection transformation is proposed in [17]. In the established multi-index evaluation index system, multi-level indicators such as economic and technical factors are used to comprehensively evaluate the distribution network infrastructure projects. In [18], a precise investment optimization strategy analysis method based on distribution network infrastructure project library is proposed. This method takes the highest project evaluation as the goal, optimizes the project, ensures the accurate implementation of the project through the monitoring management system, and realizes the accurate investment. In [19], neural network method is used to mine the relationship between reliability index and reconfiguration strategy, so as to establish ''fast channel'' for investment decision of distribution network. Literature [20] starts from the relationship between distribution network investment and social benefits and economic benefits to build a precise investment evaluation system for distribution networks. In addition to power grid investment optimization, scholars put forward the idea of power grid investment planning and control system optimization [21].

The current distribution network planning mainly adopts the grid planning method with the characteristics of accurate planning, lean management and differentiated construction [22]. The research on the precise investment strategy of distribution network in the above literature mainly focuses on the project precise investment. There is a lack of attention to the accurate investment of power grid and power supply unit, and the connection with the grid planning of distribution network. Therefore, combined with the grid planning of distribution network, this paper puts forward the calculation method of power grid project investment scale and accurate management strategy based on three-level strategy.

II. DISTRIBUTION NETWORK PROJECT INVESTMENT SCALE CALCULATION AND PRECISE MANAGEMENT PROCESS

Based on the three-level strategy of region power grid power supply unit, this paper carries out the research of distribution network project investment scale calculation and Investment precision management. The management process is shown in Figure 1.

In Figure 1, firstly, construct an indicator system for the investment scale of the regional distribution network and screen the key influencing factors. And further predict the future development trends of key influencing factors to determine the investment in the regional distribution network. Secondly, the evaluation index system of the overall construction time sequence of distribution grid is constructed. By evaluating the importance and construction requirements of power grid, the construction sequence of power grid is determined. Then, the risk index of the power supply unit of the distribution network is evaluated based on the PPM algorithm. And determine the construction sequence of the power supply unit. Furthermore, the multi-objective optimization scheme of portfolio project based on target grid is determined under the constraint of ensuring the maximum total risk and investment benefit. Finally, through actual case analysis, the accuracy and effectiveness of the above methods are verified. And get the precise management strategy of the distribution network project.

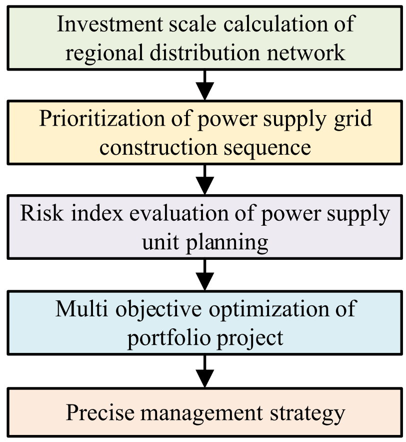


FIGURE 1. Distribution network project investment scale calculation and precise management process.

III. MEASUREMENT METHOD OF INVESTMENT SCALE OF REGIONAL DISTRIBUTION NETWORK BASED ON DATA DRIVEN

Combined with the historical data of regional distribution network, this paper proposes a data-driven method to measure the investment scale of regional distribution network. The specific steps of the method are as follows:

(1) Construction of regional distribution network investment scale measurement index system. Asset liability ratio and total assets are the measurement indicators of asset level, and the measurement of social power consumption and regional maximum load are the measurement indicators of power consumption level. Power supply population and gross regional product (GDP) are the measurement indicators of economic level, while electricity sales, return on net assets and total profit are the measurement indicators of operational efficiency. This paper analyzes the relationship between the above indicators and the infrastructure investment of power grid. The investment demand of regional distribution network is reflected from four aspects: asset level, power consumption level, economic level and operation benefit. And build the regional distribution network investment scale measurement index system as shown in Figure2.

(2) Screening of key influencing factors. Quantitative calculation of the above constructed regional distribution network investment scale measurement index system of indicators and regional distribution network investment correlation. Through the analysis of correlation, the index with high correlation is selected and determined as the key influencing factor. In general, regional GDP, total assets, electricity consumption of the whole society and the maximum load of electricity consumption of the whole society are regarded as the key influencing factors.

TABLE 1. The weight table of the evaluation index of the overall construction time sequence of the power supply grid of the distribution network.

First level indicators	Weight	Secondary indicators	Weight	Third level indicators	Weight
Importance of power supply grid in distribution network	0.40	Social influence	0.50	Load density	0.40
				Number of users per unit area	0.30
				Proportion of important users	0.30
		Economic performance	0.50	Annual power supply	0.50
				Average electricity price level	0.25
				Increasing power supply per unit investment	0.25
Demand of power supply grid construction in distribution network	0.60	Power supply capacity	0.25	Proportion of 10kV heavy overload line	0.30
				Proportion of 10kV light load line	0.15
				N-1 passing rate of 10kV lines	0.30
				Average load rate of 10kV transmission line	0.15
				Reasonable capacity ratio of 10kV line installation and distribution transformer	0.10
		Grid structure	0.25	Connection rate of 10kV lines	0.40
				Standard rate of 10kV line grid structure	0.20
				Standard rate of power supply radius of 10kV lines	0.20
				Reasonable rate of 10 kV line section	0.20
		Equipment level	0.25	Insulation rate of 10kV transmission line	0.35
				Cabling rate of 10 kV lines	0.35
				Distribution automation coverage of 10kV lines	0.30
		Power supply quality	0.25	Proportion of low voltage users	0.50
				Comprehensive voltage qualification rate of 10kV transmission line	0.50

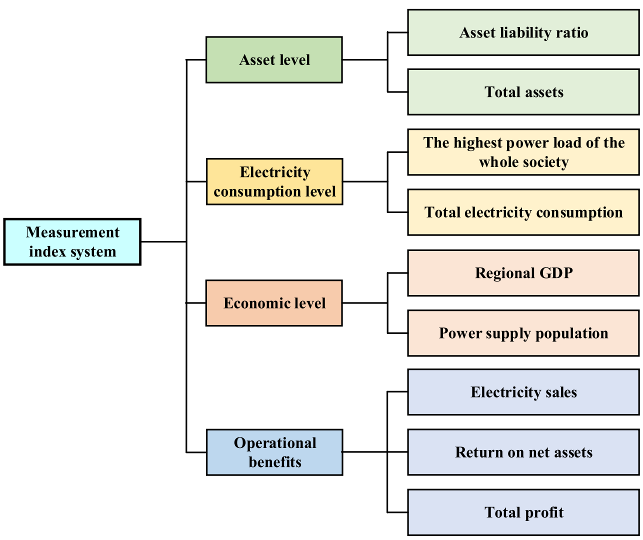


FIGURE 2. Index system for investment scale calculation of regional distribution network.

(3) Forecast of the development trend of key influencing factors. The grey prediction model needs less modeling information, convenient operation and high modeling accuracy, which is more suitable for the actual situation of the data in this paper. Therefore, this paper uses the grey prediction model (as shown in Formula 1) to predict the development trend of the key influencing factors (regional GDP, Total assets, rower consumption of the whole society, the highest load of power consumption of the whole society) in the future years (such as 2025).

$$X_y^{(0)}(k) = X_y^{(1)}(k) - X_y^{(1)}(k-1), \quad k = 2, 3, \cdots, n \quad (1)$$

where $X_y^{(1)}$ is the sequence prediction value of $X^{(1)}(k)$.

(4) Calculate the decision-making coefficient. This paper uses the Delphi survey method [23] to calculate the decision coefficients of the key influencing factors selected above (regional GDP, total assets, electricity consumption in the whole society, the highest load in electricity consumption in the whole society).

(5) Calculate the investment of regional distribution network. The accurate investment calculation formula of regional distribution network is as follows:

$$z = \sum_{i=1}^{n} u_i \times \left[\frac{y_i(j+1) - y_i(j)}{y_i(j) - y_i(j-1)}\right] \times x(j) \quad (2)$$

where z is the scale of power grid infrastructure investment in the next year, $y_i(j+1)$ is the future development trend of the <u>*i-th*</u> key factor (regional GDP or total assets or total social electricity consumption or Maximum social load), $y_i(j)$ is the current development trend of the *i-th* key factor (regional GDP or total assets or Total social electricity consumption or maximum social load), $y_i(j-1)$ is the *i-th* key factor (regional GDP or total assets or total social electricity consumption or maximum social load) is the development trend of the previous year, u_i is the decision coefficient of the *i-th* key influencing factor (regional GDP or total assets or total social electricity consumption or maximum social load),

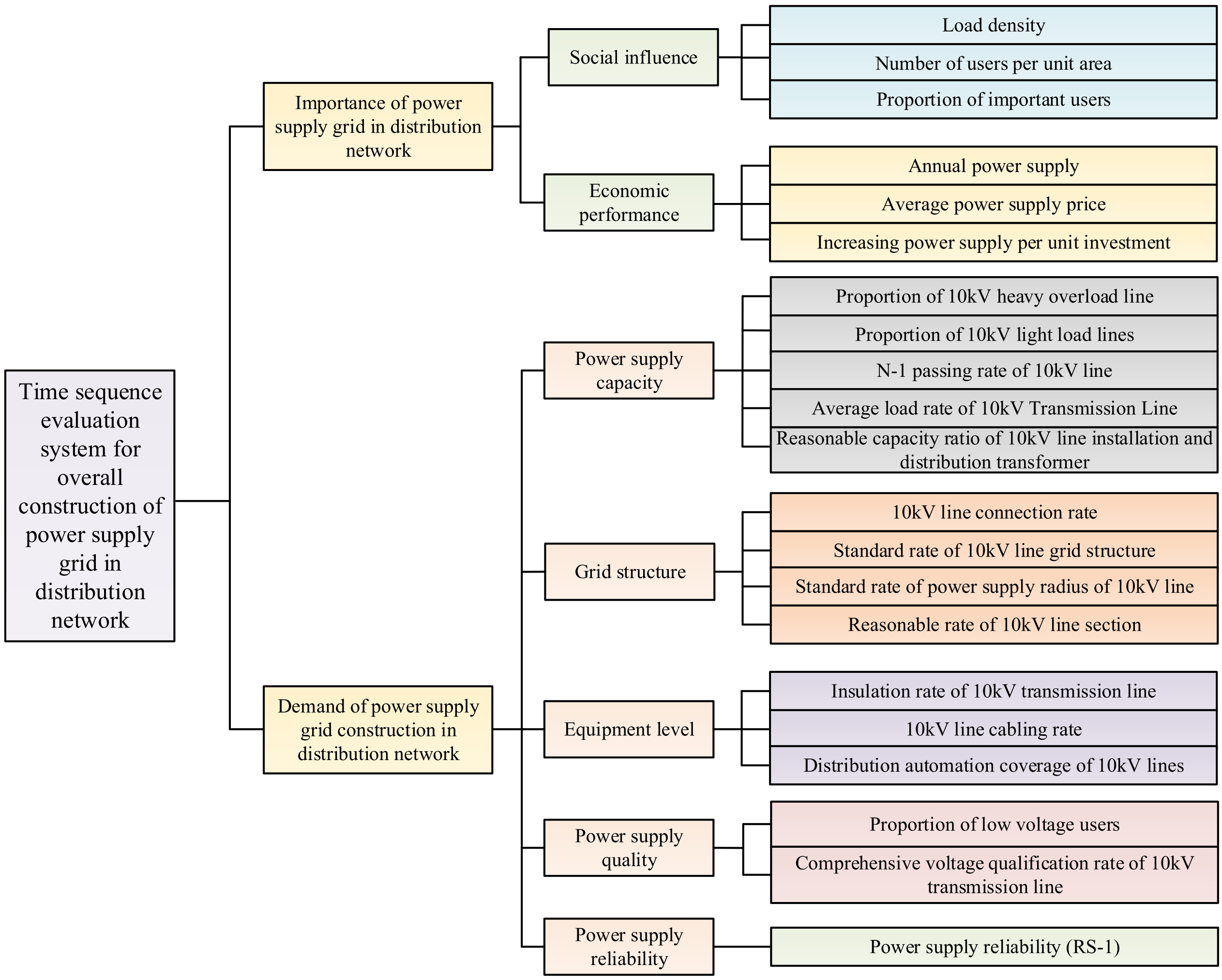


FIGURE 3. Time sequence evaluation system for overall construction of power supply grid in distribution network.

$x(j)$ is the total investment scale of power grid infrastructure in this year.

IV. TIME SEQUENCE PRIORITY RANKING METHOD FOR POWER SUPPLY GRID CONSTRUCTION OF DISTRIBUTION NETWORK BASED ON IMPORTANT COFFICIENTS

Power grid is the target grid planning and management unit. It is formed on the basis of the division of power supply area of distribution network, by connecting the functional divisions in urban and rural regulatory detailed planning, and considering the distribution network construction, operation and maintenance, emergency repair service and management authority boundary. In this paper, through the construction of the overall construction time sequence evaluation system of power supply network (as shown in Figure 3), the importance and construction demand of power supply network are quantitatively evaluated. So as to realize the accurate management of power supply network level investment.

In the quantitative evaluation of the importance of the power supply grid of the distribution network, it can be considered from two aspects: economic benefit and social impact. The economic benefits include annual power supply, average power price level, and increase in power supply per unit of investment. The social impact includes load density, number of users per unit area, and proportion of important users.

In the quantitative evaluation of the power supply grid construction needs of the distribution network, it can be considered from five aspects: power supply capacity, grid structure, equipment level, power supply quality, and power supply reliability. Among them, the power supply capacity includes the proportion of 10kV heavy overload (pre heavy load) lines, the proportion of 10kV light load lines, the N-1 passing rate of 10kV lines, the Average load rate of 10kV lines, and the reasonable rate of 10kV line installation and distribution transformer capacity. The grid structure includes 10kV line connection rate, standard rate of 10kV line grid structure, standard rate of 10kV line power supply radius, reasonable rate of 10kV line segmentation. Equipment level includes 10kV line insulation rate, 10kV line cable rate and 10kV line distribution automation coverage rate. The quality of power supply includes the proportion of low-voltage users and the comprehensive voltage qualification rate of 10kV lines. Power supply reliability includes power supply reliability rate (RS-1).

Considering the randomness of decision-makers' pairwise comparison, this paper uses interval reciprocal judgment matrix method to determine the index weight, which can obtain reasonable weight vector from interval reciprocal judgment matrix [24]. The weight of the above index system is shown in Table 1.

V. PROJECT OPTIMIZATION METHOD OF POWER SUPPLY UNIT PLANNING IN DISTRIBUTION NETWORK BASED ON PPM

The power supply unit refers to a number of relatively independent units that are divided based on the power supply grid, combined with the functional positioning of urban land, and comprehensively considered land attributes, load density, power supply characteristics and other factors. power supply unit is the basic unit of grid analysis and project planning.

A. RISK INDEX EVALUATION OF POWER SUPPLY UNIT INDISTRIBUTION NETWORK

The concept of PPM is based on the frequency characteristics of risk (failure). Generally speaking, the more serious the fault is, the lower the probability of its occurrence. The severity of the fault is approximately linear with the probability (frequency). Moreover, the actual fault is generally in a valid range (as shown in Figure 4).

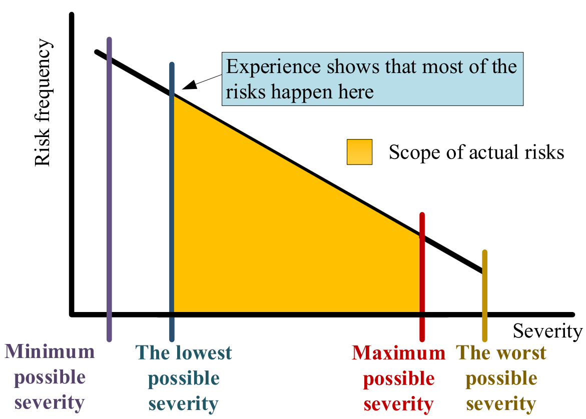


FIGURE 4. Risk consequence probability matrix.

In this paper, PPM algorithm is combined with grid planning of distribution network, and the power supply unit project in grid planning of distribution network is taken as a whole. Research on the timing method of overall construction of power supply unit in distribution network based on PPM algorithm. The higher the risk index of power supply unit, the higher the priority of construction.

The calculation method of "risk composite index" E is as follows:

1) BASIC CALCULATION FORMULA

The specific calculation of "risk composite index" E corresponding to power supply unit project and the value standard of each parameter are as follows:

$$E = (A + B + C) \times D \tag{3}$$

A is the maximum possible minor severity. For all cases with the greatest possibility of occurrence, an array is constructed to record the accident severity score corresponding to each case. A is the maximum value of the array. The severity of the accident was evaluated by Financial impact, operational risk, personal safety and environmental protection, human investment, supervision and compliance. The more serious and harmful the accident is, the higher the score is. Taking the financial impact as an example, the value coefficient of a is shown in Table 2.

B is the evaluation index of the probability (frequency) of the event corresponding to the value A, and the value coefficient of B is shown in Table 3.

C is the dynamic index after the accident (measuring the subsequent changes of event A). According to the follow-up dynamic development degree of risk corresponding to A, evaluate and score, as shown in Figure 5.

D is the current control status, reflecting the control effect of existing measures, and its value coefficient is shown in Table 4.

2) QUADRATIC SORTING FORMULA

Considering the secondary ranking, the calculation formula of project risk index e is revised as follows:

$$E = (A + B + C) \times D + F + G \tag{4}$$

F is the lowest possible severity. F parameter is the fault severity value corresponding to the worst possible result. In order to highlight the severity of the problem risk corresponding to the project, this auxiliary index can be used to highlight the weight of Risk control on project arrangement.

The value standard of F parameter is the same as that of A parameter. The difference between the two is that the A parameter considers the slightest consequence of the greatest possibility, and the F parameter focuses on the most serious consequence of the least possibility.

G is the sensitivity index. Evaluate the fit between the project and regulatory requirements, industrial standards, and company investment strategies. The higher the score, the better the fit. The coefficient of G is shown in Table 5.

B. MUTI OBJECTIVE OPTIMIZATION METHOD OF COMBINATION PROJECT BASED ON TARGET GRID

Under the constraint of certain investment ability, the project portfolio with the largest total risk value in the next year or several years is selected.

The total risk function formula (5) is as follows:

$$MaxM = \sum_{i=1}^{n} M_i \tag{5}$$

TABLE 2. Correspondence table of *A* value coefficent.

score	Description of consequences	Financial impact	Operational risk
		Corresponding to the risk caused by improper or ineffective Financial management or the loss caused by changes in the Financial market.	It is used to measure the quality problems, cost loss and time investment in operation caused by improper and wrong internal processes, personnel, systems or external events.
5 Catastrophic impact	1.It will threaten the survival of enterprises. 2. It has a disastrous impact on the strategy and operation of the enterprise.	If the financial loss exceeds 100 million yuan, the problem of capital turnover will happen soon.	1.Power grid level: two or more regional substations cannot supply power for more than 24 hours or 3000-20000 households have power failure for more than 24 hours. 2.Enterprise operation: online business interruption for more than 30 days.
4 Significant impact	It has a significant impact on the strategy and operation of the enterprise.	The financial loss is in the range of 35 million yuan to 100 million yuan, and there may be problems with capital turnover.	1.Power grid level: 1400-3000 households have power failure time of more than 2 hours. 2.Enterprise operation: the interruption time of online business or office business is within 7-14 days.
3 Serious influence	It has a certain impact on the strategy and operation of the enterprise.	The financial loss is in the range of 20 million yuan to 35 million yuan, and there is a risk of capital turnover.	1.Power grid level: 700-1400 households were cut off for more than 2 hours. 2.Enterprise operation: the interruption time of online business or office business is within 1-7 days.
2 More serious impact	There is no significant impact on the enterprise, and the problem can be solved internally.	The financial loss is in the range of 10 million yuan to 20 million yuan, and the impact on capital turnover can be digested in normal operation.	1.Power grid level: 200-700 households power off for more than 2 hours. 2.Enterprise operation: online business or office business interruption time more than 1 day.
1 Slight impact	The impact on the enterprise can be ignored, and the problems can be handled by routine operation.	The financial loss is less than 10 million yuan, and the impact on capital turnover is negligible.	1.Power grid level: the power outage time of 0-200 households reaches 2 hours. 2.Enterprise operation: Office business interruption for several hours.

TABLE 3. Correspondence table of *B* value coefficent.

Possibility description		Guidance
5 Almost sure	The event is expected to happen in most cases	●It is expected to happen once a year (or more). ●The probability of occurrence is more than 75%. ●Recent and possible recurrence.
4 Great possibility	Events are likely to happen in most cases	●It will happen at some time in the next 2-3 years. ●The probability of occurrence is 51% - 75%. ●Have a history of occurrence or may be difficult to control due to some external influences.
3 More likely	Events should happen at certain moments	●It may happen at some time in the next 4-5 years. ●The probability of occurrence is 26% - 50%.
2 Unlikely	Events may happen at certain moments	●It may happen in the next 6 years or more. ●The probability of occurrence is 5% - 25%.
1 Almost impossible	Events may only occur under special circumstances	●Only under special circumstances (i.e. more than 10 years). ●The probability is less than 5%.

The total risk is calculated as follows:

$$\sum_{i=1}^{n}\left(w_a A_i + w_b B_i + w_c C_i + w_d D_i + w_f F_i\right) * x_i \tag{6}$$

The total cost function is as follows:

$$I = \sum_{i}^{n} I_i x_i \leq I_0 \tag{7}$$

TABLE 4. Correspondence table of *D* value coefficent.

Control effectiveness level	Describe	Degree of concern
1 Powerful	●A comprehensive and effective risk management and internal control system, with almost all risk factors noted. There is a comprehensive control system that can prevent the loss of Transactions, Operations/IT risks, and ensure accurate Financial reporting and compliance with Regulatory requirements. ●The degree of compliance with the established degree of customization, control and procedures is very high, and the staff are fully aware of their responsibilities in terms of control.	Under this rating, there are no obvious management problems
2 Enough	●The overall risk management and internal control system is considered appropriate, but some areas are deficient or not satisfactorily solved. Some control problems may be noticed, but the management is aware of these problems and has taken measures to solve them, or take compensation measures to reduce the risk level to an acceptable level. ●The entity is able to deal with existing and foreseeable Risk exposures and Risk/Control related deficiencies, and any such deficiencies will not have a significant impact on the organization.	Under this rating, only management's daily attention is required
3 Acceptable	●Risk management and Internal control system have major defects, generally unable to determine and control major Risk exposure or solve major Control problems in many aspects. ●The management may be aware of the weak links in control, but it has no effect in solving these problems. Some major problems and control deficiencies have been pointed out, which may lead to significant risks if they are not adequately addressed in a timely manner.	Critical rating, calling on management to pay attention to it in time
4 Bad	●A Risk management and Internal control system that is ineffective in almost all aspects. The management did not understand the possible impact of the risk and control deficiencies, and did not take any action to solve these problems. ●The lack of internal control system to the extent that the operation is seriously threatened, and major losses caused by fraud or other operational problems may lead to defects that cannot be remedied immediately.	Unfavorable rating and require immediate attention from management

TABLE 5. Correspondence table of *G* value coefficent.

Supervise	Supervise	Industry standard	Industry standard	Good asset management	No
Immediate action is required as required by the regulation	Regulatory requirements	Industry standard requirements will affect the changes of health and safety environment	Industry standard requirements, conducive to asset management	To improve asset management	--
5	4	3	2	1	0

where, M_i is the risk of the *i-th* project, A_i, B_i, C_i, D_i and F_i are the scores of A, B, C, D and F of the *i-th* project, w_{ai}, w_{bi}, w_{ci}, w_{di} and w_{fi} are the weights of the scores of A, B, C, D and F of the *i-th* project, I_i is the investment amount of the *i-th* project in the current year, x_i represents the investment or not, I_0 is the constraint of the total investment scale of the current year.

For the above functions, linear programming is used to solve the effective portfolio under the constraint of investment scale. Generally, enumeration method is used to solve 0-1 planning, but the calculation amount of this method is large, and it needs the planning solution function of Excel to get the investment scheme that can maximize the benefit.

VI. EMPIRICAL APPLICATION

According to the accurate investment method of regional distribution network, the investment of 10kV distribution network in the planning area is calculated. The investment of 10kV distribution network can be calculated according to the load proportion. According to the data-driven regional distribution network investment scale calculation method, the total investment of empirical regional 10 kV distribution network project in 2021 is about 70 million yuan.

According to the indicator data of the 10kV distribution network of each power supply grid in the demonstration area, calculate the time sequence score of each power supply grid construction. The overall construction sequence of the power supply grid of the distribution network is shown in Table 6 and Figure 6.

It can be seen from Figure 6 that the construction sequence of power supply grid of distribution network is: 5# Grid, 1# Grid, 4# Grid, 3 # Grid and 2# Grid.

Taking the empirical regional 5# Grid in 2021 as an example, the risk index of each power supply unit is evaluated

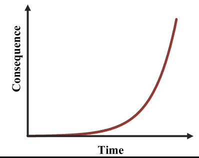
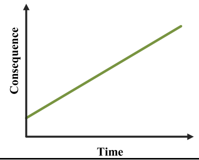
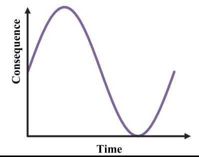
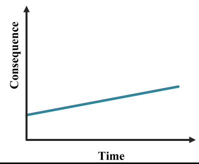
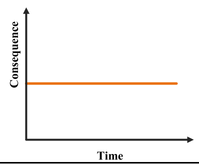
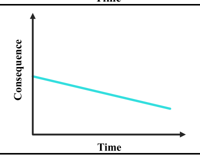
Dynamic	Description of the dynamics of the consequence factor	Rank Score for PPM
Exponential		5
Linear Fast Increase		4
Cyclical		3
Linear Slow Increase		2
Static		0
Decrease		-2

FIGURE 5. *C* **value coefficient map.**

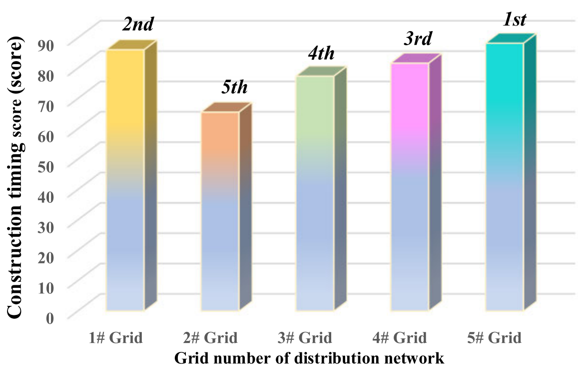


FIGURE 6. **Time sequence diagram of overall construction of power supply grid of distribution network.**

by PPM algorithm, and the calculation results are shown in Table 7.

According to the calculation results in Table 7, the overall construction sequence of each power supply unit of the 1# Grid in 2021 is: 2# Unit, 3# Unit, and 1# Unit.

TABLE 6. **Scheduling table for overall construction of power supply grid in distribution network.**

Grid number of distribution network	Construction time sequence score (points)	Sort
1# Grid	86.10	2
2# Grid	65.55	5
3# Grid	77.40	4
4# Grid	81.68	3
5# Grid	88.25	1

TABLE 7. **Risk index table of 1# grid power supply unit in 2021 (unit: points).**

Serial number	Project name	Power supply unit	A	B	C	D	F	G	E
1	1# Project	1# Unit	1	2	-2	2	1	4	7
2	2# Project	2# Unit	1	4	-2	2	2	4	12
3	3# Project								
3	4# Project	3# Unit	1	3	-2	2	1	4	9

TABLE 8. **Multi objective optimization table of empirical regional portfolio projects in 2021.**

Serial number	Project name	Investment (ten thousand yuan)	Score (points)	Item sorting	Preferred
1	1# Project	690	29.9	1	1
5	5# Project	920	29.9	1	1
4	4# Project	920	25.7	3	1
9	9# Project	390	23.9	4	1
6	6# Project	1320	20.3	5	1
3	3# Project	1485	19.7	6	0
7	7# Project	1118	19.4	7	1
2	2# Project	944	16.1	8	0
10	10# Project	758	15.2	9	1
8	8# Project	870	12.2	10	1

Under the constraint of the maximum total risk, according to the multi-objective optimization method of portfolio projects based on the target grid, the portfolio with the largest Total risk is selected, as shown in Table 8.

It can be seen from Table 8 that according to the multi-objective optimization method of combined projects based on the target grid, a total of 8 projects are selected. The total investment amount of the optimized project is 69.86 million yuan, and the total benefit score is 176.5 points, which is the portfolio of investment projects with the largest investment benefit of the project.

VII. ACCURATE MANAGEMENT STRAGETY OF DISTRIBUTION NETWORK INVESTMENT

Based on the above three-level strategy level by level subdivision method to determine the optimal portfolio of distribution network empirical analysis. The accurate management strategies of distribution grid investment are summarized as follows:

Adhere to the market demand-oriented. In depth study of economic development trend, changes in industrial structure and development of key industries, accurately predict power load and demand, and calculate investment demand and new scale of power grid. The load rate and other indicators should be controlled in a reasonable range to prevent blind advance reserve.

Implement the concept of asset life cycle. Adhere to unified planning, unified management and unified standards. Based on the principle of optimal life-cycle investment benefit and efficiency of the project, the power grid transformation scheme is optimized to improve the construction standard of distribution network and the level of equipment automation.

VIII. CONCLUSION

In this paper, the accurate investment method of distribution network based on three-level strategy of region, power grid and power supply unit is studied. Firstly, the paper studies the calculation method of regional distribution network investment scale. Secondly, the overall construction time sequence of distribution grid is studied. Then, the overall construction time sequence of power supply units in distribution network and the multi-objective optimization method of composite project based on target grid are studied. Finally, the effectiveness and operability of the above methods are verified by using empirical region. The investment method of distribution network proposed in this paper realizes the accurate investment of region, power grid and power supply unit on the macro level. At the micro level, the multi-objective optimization of portfolio projects is realized, which is from top to bottom and progressive, and ensures the comprehensiveness and coordination of distribution network investment. This method has certain inspiration for the accurate investment management of distribution network projects, and has guiding significance for the realization of accurate investment of distribution network.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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