Research on the evaluation index system of "new energy cloud" operation mode based on CRITIC weighting method and AHP method

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Abstract. Accelerating the development of new energy is an inevitable trend of the energy low-carbon transition. Information technology means and new energy and new energy business management are combined by most energy enterprises, so as to further improve the coordination of source, network and storage load in the development of new energy, solve the problem of new energy consumption, and improve the management efficiency. This study takes the "new energy cloud" platform of State Grid Corporation of China as the research object. Firstly, the basic architecture and operation mode of the cloud platform is analyzed; secondly, according to the characteristics of the operation mode, the evaluation index system of the "new energy cloud" operation mode is constructed from four dimensions of business, capital, learning and growth, and data. At the same time, the actual data of nine provinces that have deployed the "new energy cloud" platform are selected, and the weight of the evaluation index is determined by using the CRITIC—AHP method. This study can provide a model reference for related energy enterprises to build new energy business management platforms, and provide a practical reference for the evaluation of new energy business operation mode.

1. Introduction
As the world's largest emitter of greenhouse gases, China promises to reach the peak of carbon emissions by 2030 according to the Paris Agreement [1-3]. Carbon dioxide emissions from China's power sector account for nearly half of the country's energy-related carbon emissions [4]. With the increasing degree of electrification, the emission reduction of the power sector will also drive the emission reduction of transportation, industry, construction, and other economic sectors. With the rapid decline of the cost of new energy power generation technology represented by wind and photovoltaic, the emission reduction potential of the power sector is becoming more and more significant, and the economic efficiency of emission reduction through renewable energy rather than natural gas and other low-carbon fossil energy is also constantly improving [5], which promotes the rapid development of the new energy industry and can help China's power sector to reduce emissions.

New energy generation has the characteristics of randomness, volatility and intermittent, which puts forward higher requirements for the coordination of load and storage of source network and energy consumption. At present, most enterprises choose to combine all aspects of business with information technology in the process of new energy business, to realize the digital transformation of the whole
process of new energy business, build a new energy ecosystem, and realize the whole process and multi-agent connection of business. However, there are great differences in energy endowment, economic development, industrial structure, technology development and even social and cultural customs in China. There is a big gap in space between energy fuel and service flow [6-8]. The development status of new energy enterprises in different regions is relatively large. Different new energy business operation modes should be selected according to their development status and needs. China National Grid Corporation has constructed a platform of "new energy cloud" to promote the development of new energy business, to build an industrial ecosystem of new energy value creation and opportunity sharing, to serve the local economic and social development, to improve the efficiency and efficiency of new energy enterprises, and to promote the higher quality and rapid development of the whole industry through the use of big data, cloud computing and other information technologies [9-11]. Meanwhile, the new energy enterprises are managed in a unified way, which will make the new energy power more accessible and consumed, directly improve the quality of the development of China's new energy industry, and vigorously promote the transformation of energy production and consumption. As the new energy business is still in its infancy and the business model and process structure are not clear, there are few mature evaluation systems for the new energy business model in the existing literature. The analysis and evaluation of the "new energy cloud" operation mode is not only the actual demand of the State Grid Company, It is also an important problem that energy industry enterprises need to solve in the process of new energy business.

At present, the evaluation of the operation mode is mainly from the economic, environmental and social dimensions. Qin [12] and others evaluated the operation mode of regional energy Internet from four aspects (technology, economy, society and Engineering). By establishing the evaluation standard system of regional energy Internet, they evaluated the regional energy network from a comprehensive perspective; Zhou [13] selected multiple indicators for comprehensive evaluation from the dimensions of the urban landscape, operation cost and regional economic development level in the evaluation of location and operation mode of hydrogen gas station; Lu [14] evaluated the sustainability of public-private partnership mode, evaluated PPP microgrid from the perspective of sustainability, and established a sustainable evaluation standard system from the aspects of the economy, society, environment, technology and management.

When determining the weight of the evaluation index, researchers usually use subjective and objective weighting methods to ensure the rationality of weight setting. Liu[15] proposed the method of environmental damage compensation value evaluation based on fuzzy analytic hierarchy process to decompose the environmental damage caused by air pollution into multiple pollution factors, and evaluate the value loss caused by it. The advantage of this method is to evaluate the compensation value of the natural environmental damage caused by the multi standardization index; Chen [16] in the rural tourism resources evaluation system, AHP, dare and Delphi are used to calculate the index weight of the evaluation system, but the research conclusion is still subjective; In the research and analysis of China green productivity index evaluation system [17], we use fuzzy set theory and entropy weight method to deal with uncertain information, and objectively and scientifically calculate the weight of green productivity index. In the related papers of operation mode evaluation, some authors use the Decision Theater method to train stakeholders of network projects [18], and the critical weighting method is also often used in the evaluation of power grid projects [19].

To sum up, there is no mature business model and corresponding evaluation system in the process of promoting the new energy business of energy enterprises. Therefore, this study takes the State Grid Corporation of China as the research object, and mainly answers the following questions:
1. what kind of operation mode does the new energy cloud platform adopt?
2. How to evaluate the operation mode of the "new energy cloud"?
2. Research methods

2.1. Critic weighting method
A critical method is an objective weighting method. Its basic idea is to determine the objective weight of indicators based on two basic concepts. First, the contrast intensity, which represents the value gap of each evaluation scheme of the same index, is expressed in the form of standard deviation, that is, the size of the standardization difference indicates the value gap of each scheme within the same index, and the larger the standard deviation is, the greater the value difference of each scheme. The second is the conflict between evaluation indicators, and the conflict between indicators is based on the correlation between indicators. For example, there is a strong positive correlation between the two indicators, indicating that the conflict between the two indicators is low. It is mainly divided into five steps:

(1) Dimensionless processing
To eliminate the influence of different dimensions on the evaluation results, it is necessary to carry out dimensionless treatment for each index. If the value of the index used is larger, the forward treatment (such as formula 1) is generally used. If the value of the index used is smaller, the reverse treatment (such as formula 2) is generally used.

\[
x_j' = \frac{x_j - x_{\min}}{x_{\max} - x_{\min}} \quad (1)
\]

\[
x_j' = \frac{x_{\max} - x_j}{x_{\max} - x_{\min}} \quad (2)
\]

(2) Calculate the index contrast strength
In the form of standard deviation:

\[
\begin{align*}
\bar{x}_j &= \frac{1}{n} \sum_{i=1}^{n} x_{ij} \\
S_j &= \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_{ij} - \bar{x}_j)^2}
\end{align*} \quad (3)
\]

Such as formula 3, represents the standard deviation of the j index, in the CRITIC method, the standard deviation is used to indicate the fluctuation of the internal value of each indicator. The larger the standard deviation, the greater the numerical difference of the indicator, the more information can be displayed, and the evaluation strength of the indicator itself is also The stronger, the more weight should be assigned to the indicator.

(3) Calculate the index correlation coefficient
It is expressed by correlation coefficient:

\[
R_j = \sum_{i=1}^{n} (1 - r_{ij}) \quad (4)
\]

Such as formula 4, is the correlation coefficient between the evaluation index I and J, the stronger the correlation with other indicators, the less the conflict between the indicator and other indicators, the more the same information is reflected, the more repetitive the evaluation content can be reflected, which weakens the evaluation intensity of the indicator to a certain extent, and the weight of the indicator should be reduced.

(4) Calculation of weight influence coefficient

\[
C_j = S_j \sum_{i=1}^{n} (1 - r_{ij}) = S_j \times R_j \quad (5)
\]

Such as formula 5, The larger is, the greater the role of the j-th evaluation index in the whole evaluation index system is, and more weight should be assigned to it.

(5) Determine weight
Finally, the weight calculation of the J index is shown in formula 6

\[ W_j = \frac{C_j}{\sum_{j=1}^{p} C_j} \]  

(6)

2.2. Analytic Hierarchy Process

AHP is a simple, flexible and practical multi criteria decision-making method for quantitative analysis of qualitative problems. It is characterized by the combination of qualitative analysis and quantitative analysis to deal with various decision-making factors, and its advantage is that the system is flexible and concise. It is mainly divided into four steps:

1. Building hierarchical structure model

From the top to the bottom, the algorithm first analyzes the closeness of each index in the criterion layer (that is, the factors affecting the target) and the target layer, and obtains a one-dimensional weight vector. Then it analyzes the closeness of each index in the scheme layer and each index in the criterion layer and obtains as many weight vectors as there are.

2. Constructing pairwise comparison matrix

According to the hierarchical structure model, the judgment matrix is constructed layer by layer from top to bottom. Each element of each layer takes the elements of the adjacent upper layer as the criterion, and constructs the judgment matrix by pairwise comparison according to the "1-9 scale" (as shown in table 1).

| Scale values | The meaning                                      |
|--------------|-------------------------------------------------|
| 1            | They are equally important compared to each other|
| 3            | Comparing the two indicators, the former is slightly more important than the latter |
| 5            | Compared with the two indicators, the former is significantly more important than the latter |
| 7            | Compared with the two indicators, the former is strongly important than the latter |
| 9            | Comparing the two indicators, the former is extremely important than the latter |
| 2, 4, 6, 8   | The median value of the above adjacent judgments |

3. The weight of the judgment matrix is calculated and the consistency is tested

There are three methods to calculate weight: arithmetic average method, geometric average method and eigenvalue method. In this paper, the arithmetic average method is used to normalize the judgment matrix according to the columns, add the normalized columns, and divide each element in the vector obtained after adding by n to get the weight vector:

\[
\text{Hypothesis judgment matrix } A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix},
\]

Then the weight vector obtained by the arithmetic average method (as shown in formula 7).

\[ W_j = \frac{1}{n} \sum_{j=1}^{p} \frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}} \]  

(7)

The steps of the consistency test are as follows:
① Calculate the maximum eigenvalue and consistency index CI of the judgment matrix, where
\[ CI = \frac{\lambda_{\text{max}} - n}{n-1} \]
and \( n \) are the dimensions of the matrix.

② According to the size of \( N \), find the average random consistency index RI according to the following table (as shown in Table 2-2).

| \( N \) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------|---|---|---|---|---|---|---|---|---|
| \( \text{RI} \) | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.46 |

③ Calculate consistency ratio \( CR \) (as shown in formula 8).

\[
CR = \frac{CI}{RI}
\]  \( \text{(8)} \)

If \( CR < 0.1 \), the consistency of the judgment matrix is acceptable; Otherwise, the judgment matrix needs to be modified.

(4) Weight determination

According to the weight analysis of hierarchical structure, the eigenvector and eigenvalue are multiplied, and the result is the weight.

To sum up, AHP is a subjective weighting method. According to the experience and judgment of relevant experts, the specific evaluation index is assigned, which reflects the subjective judgment of the evaluator, but makes the result subjective and random, and the weight value is unstable; CRITIC weighting method is an objective weighting method, which has a strong logical basis and avoids the influence of subjective factors, but it may cause the weight value to be inconsistent with the reality. Single selection of a method to evaluate the index system is easy to make the evaluation results subjective or objective. Therefore, this paper uses AHP and the critical weighting method to comprehensively analyze the evaluation index system and get the final weight value of specific indicators.

3. Analysis and evaluation of "new energy cloud" operation mode

3.1. Analysis on the operation mode of "new energy cloud" platform

3.1.1. Basic architecture of "new energy cloud" platform

State Grid new energy cloud data platform is the first platform to connect the company's main business core process, which helps to break the internal and external data barriers, provide one-stop online services for all parties in the new energy industry chain, optimize and improve the business process of new energy management, break the "chimney" of relevant professional departments, and realize "one data source, one power grid map, one power grid management" internally "One business line" and "one network connected, transparent in the whole process", widely connect internal and external, upstream and downstream resources and demands, help the construction of ubiquitous power Internet of things data center and business center, and lay a solid foundation for the development of national energy digital economy and the construction of ubiquitous power Internet of things of the company.

It has 15 sub platforms:

- Environmental carrying platform: dynamically monitor the information of resource carrying capacity and air quality nationwide, provide environmental carrying capacity assessment for the development of new energy, and assist the layout optimization of new energy development in China.

- Resource distribution platform: it can dynamically monitor the information of wind energy resources and solar energy resources across the country, and has the function of short-term weather forecast of new energy, providing analysis suggestions for the planning, site selection, operation and consumption of new energy power stations.

- Planning and planning platform: provide new energy planning, annual development plan, reserve and approval project filling management services, analyze national and local planning objectives,
coordination of new energy project construction and supporting power grid project construction, and provide support for the government to issue new energy development plan.

Manufacturer user platform: provide online and offline integrated services such as design and construction, equipment procurement, monitoring and operation, product traceability, financial transaction and industry analysis for users of new energy equipment manufacturers, system integrators, industry associations and financial institutions, so as to realize the interconnection between operation equipment and various manufacturers.

Power enterprise platform: provide power users with one-stop service of new energy point selection design, investment and construction, grid connection and installation, operation and maintenance, data analysis, and assist all kinds of power users to realize intelligent and lean management.

Power grid service platform: standardize the business process of new energy management, provide one-stop online services in the whole process of planning, early stage, grid connection, operation, transaction, subsidy, post evaluation and other projects, improve the quality and efficiency of management, and optimize the business environment.

Electricity price subsidy platform: it provides online filling, auditing and publishing functions of subsidy projects, and provides online one-stop subsidy project list declaration and auditing services for power users and energy authorities. Dynamic monitoring and analysis of renewable energy generation cost, on grid electricity price and subsidies to assist government decision-making and industry supervision.

Energy storage service platform: dynamically monitor the operation status of various types of energy storage at power supply side, power grid side and user side, provide development analysis, operation monitoring, procurement and transaction services for power grid enterprises, energy storage owners and operation and maintenance manufacturers, and guide energy storage planning.

Technology consulting platform: establish a platform for knowledge sharing and interactive discussion of new energy cutting-edge technology, show the R & D and application of advanced technology at home and abroad, and the latest technology progress, track new business forms and new models, and evaluate technology application potential.

Auxiliary decision-making platform: analyze new energy development strategy, business management optimization, domestic and foreign new energy development effect comparison and other information, realize customized query of new energy data and full scene information display, and support production and operation decision-making of relevant government departments, new energy related enterprises and equipment manufacturers.

Power customer platform: with the user as the center and the power grid as the service platform, real-time tracking of the completion of various types of users’ participation in green power trading and consumption responsibility weight can promote the transformation and upgrading of the national energy consumption side.

Supply and demand forecasting platform: relying on the power supply and demand Laboratory of the State Grid, it carries out forecasting and Analysis on the monthly, quarterly, annual and medium and long-term power supply and demand, power economic relationship and power supply and demand balance of the whole country, provinces, cities and counties, so as to provide data for the calculation of consumption capacity.

Consumption calculation platform: provide new energy consumption status assessment, consumption capacity calculation and dynamic early warning services, calculate new energy consumption capacity by province, prefecture, city and county, forecast monthly, quarterly, annual and medium and long-term abandoned electricity, utilization rate, acceptable new installed capacity and other indicators, guide the scientific development and layout of new energy.

Regulation and policy platform: publicize, study and implement the renewable energy law, establish a database of new energy laws, regulations and policies, and an analysis, interpretation and interactive discussion platform, so as to realize intelligent interpretation and analysis of policies. Work with relevant government departments and think tanks to jointly carry out research on relevant regulations and policies
in the field of new energy, so as to provide support for scientific decision-making and policy formulation of government departments.

Big data service platform: relying on the massive data of new energy, applying advanced information technology, mining the value of data assets, providing new energy big data mining analysis and display services for the government, enterprises, industry associations, power users and other groups.

3.1.2. operation mode of "new energy cloud" platform
"New energy cloud appliance" platform provides the whole process, whole link, whole scene data and professional services for new energy planning, construction, grid connection, production and manufacturing, which will effectively promote the scientific planning, rational development, efficient construction, safe operation and full consumption of new energy. The new energy cloud has designed 15 sub platforms including environmental bearing, resource distribution and power grid service, covering all links of source network load storage, and established a new energy open service system with "all links, all penetration, all coverage, all ecology and all scenes". Realize "one data source, one business line, one new energy map", and significantly improve service efficiency.

![Figure 1 "new energy cloud" operation mode - "PDCA" cycle](image)

At present, "new energy cloud" focuses on providing information analysis and consultation, panoramic planning layout and site selection, one-stop network connection in the whole process, calculation and release of global consumption capacity, and application and management of subsidies in the whole process. During the operation of the platform, "PDCA" cycle is followed for quality management (as shown in Figure 1). The sub platforms of environment bearing, resource distribution, planning plan, manufacturers and users, and power supply enterprises are responsible for planning, namely P (plan); Each voltage level grid and grid service platform is responsible for the implementation of the plan, namely D (do); Sub platforms such as supply and demand forecast, energy storage service, consumption calculation and technical consultation are responsible for real-time monitoring of the whole platform operation, namely C (check); Finally, the big data service platform is responsible for the overall operation summary evaluation, namely A (action).
3.2. construction of "new energy cloud" operation mode evaluation system

3.2.1. establishment of evaluation index system of "new energy cloud" operation mode

State Grid "new energy cloud" is a typical practice of State Grid Corporation of China in the field of new energy. It is a new energy industry internet platform formed by the deep integration of new generation information technology and new energy business. Based on the existing literature review and actual management needs, this paper refines the performance indicators from four dimensions of business, capital, data, learning and growth to establish a multi-dimensional evaluation index system of new energy cloud system operation mode (as shown in table 2).

| Comprehensive evaluation index $A$ of new energy cloud operation mode | First level indicators | Second level indicators | reference |
|---|---|---|---|
| Business dimension $B_1$ | Business processing time $C_1$ | [12,41] |
| | Customer complaint rate $C_2$ | [12,41] |
| | Business completion rate $C_3$ | [12,41] |
| | Cost rate $C_4$ | [12,41,42] |
| | Profit margin $C_5$ | [12,41,42] |
| | Labor cost saving rate $C_6$ | [12,41,42] |
| | Training fee input $C_7$ | [42] |
| | Staff turnover rate $C_8$ | [42] |
| | Career development channel $C_9$ | [42] |
| Capital dimension $B_2$ | Data platform construction level $C_{10}$ | [13,14,41] |
| Learning and growth dimension $B_3$ | Data visualization level $C_{11}$ | [13,14,41] |
| Data dimension $B_4$ | Data application level $C_{12}$ | [13,14,41] |

3.2.1.1. Business dimension ($B_1$)

New energy cloud is a new energy open management system with "all links, all penetration, all coverage, all ecology and all scenes". Internally, it can optimize the company's new energy management related standards and business processes, and provide new energy full business online sharing platform for all majors. Therefore, the business dimension index system should reflect the operation and management ability of new energy cloud. It includes three indicators: business processing time, customer complaint rate and business completion rate.

Business processing cycle ($C_1$) refers to the process of business processing. The whole cycle includes five steps: data input, business processing, file and database processing, file and report generation, and query processing results. The timeliness of business processing reflects the efficiency of new energy cloud management system in providing external services. Only efficient services can win more customers. The main measurement standards are the integrity and standardization of the processing cycle, the length of the cycle and so on. According to the actual situation of "new energy cloud" platform management, the business processing timeliness is scored. The business processing cycle is complete and standardized, and the cycle time is short, with a score of 8-10 points (including 8 points); The business processing cycle is complete and standard, but the processing cycle is long, with a score of 5-7 (including 5 points); The business processing cycle is not complete and standard, and the processing cycle is long, with a score of 0-5 (including 0).

Customer complaint refers to the written or oral objection, protest, claim, problem solving, and other behaviors that customers are not satisfied with the product quality or service of the enterprise. Customer
complaint rate (C2) refers to the ratio of the number of customer complaint businesses to the total number of businesses completed, as shown in formula 9.

\[
C_e = \frac{C_p}{C_t} \times 100\% 
\]  

(9)

Among them, \(C_e\) refers to the customer complaint rate, \(C_p\) refers to the number of customer complaint businesses, and \(C_t\) refers to the total number of businesses handled by the platform. Customer complaint rate is the main indicator reflecting the service quality of the new energy cloud system. Only by providing high-quality customer service and customer demand-oriented, can customer complaints be reduced or even eliminated.

Business completion rate (C3) is an indicator to measure the business completion degree of the "new energy cloud" management platform, and also reflects its business efficiency from another side. Business completion rate refers to the ratio of business completion to total business, as shown in formula 10.

\[
B_e = \frac{B_p}{B_t} \times 100\% 
\]  

(10)

Among them, \(B_e\) refers to the business completion rate, \(B_p\) refers to the number of businesses completed by the platform, and \(B_t\) refers to the total number of businesses planned to be completed by the platform.

The application of "new energy cloud" information technology provides a wider range of possibilities for the implementation of process standardization. The higher the degree of standardization, the higher the business completion rate and business processing efficiency, and the lower the customer complaint rate. The three indicators are an organic whole of mutual influence and promotion.

3.2.1.2. Capital dimension (B2)

Based on cost reduction, the "new energy cloud" service center considers and pays attention to the characteristics of value creation in the big data center. Therefore, when selecting this dimension index, we should consider not only the profit margin and other financial indicators to measure performance, but also the performance appraisal of the cost budget. Therefore, the evaluation index focuses on cost and profit, including cost expense rate, profit rate, and planned capital utilization rate.

Cost expense ratio (C4) reflects the ability of enterprises to bring benefits from all costs incurred in the current period, and is a measure of the cost saving degree of enterprises after using the "new energy cloud". Cost expense ratio is the ratio of cost expense to main business cost (as shown in formula 11).

\[
C_e = \frac{C_i}{C_t} \times 100\% 
\]  

(11)

Among them, \(C_e\) refers to the cost rate, \(C_i\) refers to the total cost (including operating costs and period expenses), and \(C_t\) refers to the operating revenue. The cost rate index can evaluate the control ability and management level of the enterprise to the cost, urge the enterprise to strengthen the internal management, save expenditure and improve the quality of operation.

Profit margin (C5) is a relative index reflecting the profit level of an enterprise in a certain period. The profit rate index can not only assess the completion of the enterprise profit plan but also compare the operation and management level between enterprises and in different periods, to improve the economic efficiency. In this paper, the profit rate refers to the cost profit rate, which is the ratio of profit and cost, as shown in the formula 12.

\[
P_m = \frac{P_n}{B_e} \times 100\% 
\]  

(12)

Among them, \(P_m\) refers to profit margin, \(P_n\) refers to operating profit, \(B_e\) refers to costs (costs only include costs and expenses related to operating activities, namely all kinds of costs and expenses incurred before operating profit).
Profit margin refers to the ratio of profit to cost, which is the main indicator to measure the value creation of new energy cloud, and also reflects the specific performance of the new revenue brought by the use of big data.

Human cost saving rate (C6), which is the ratio of human cost saving amount to total human cost (as shown in formula 13), is a measure of the degree of human capital saving after the implementation of the "new energy cloud" platform and is the main indicator to achieve the goal of cost reduction and efficiency increase.

\[ L_r = \frac{L_t - L_i}{L_i} \times 100\% \] (13)

Among them, refers to the labor cost saving rate, refers to the labor cost saving, refers to the total labor cost.

3.2.1.3. Learning and Growth Dimensions (B3)
Learning growth dimension is an important aspect to measure the sustainable development of "new energy cloud," and it reflects the platform's attention to staff's learning ability and future development. Any organization should consider its future development and growth. For the sustainable development of the "new energy cloud" management platform, it should combine the characteristics of the big data era and give full consideration to the employee growth and career development channel, including career development channel, training fee input, and employee turnover rate.

A good career development channel (C7) for employees is very important for the establishment of a stable staff team. It is also an important aspect to measure the system construction of "new energy cloud" platform, and is the basic premise for the development and implementation of big data management; The measurement standard of employee career development channel is whether the career development channel mode is reasonable or not, and whether the employee evaluation process is perfect or not. The career development channel mode is reasonable, the employee evaluation process is complete, and the score is 8-10 points (including 8 points); The career development channel mode is reasonable, and the employee evaluation process is reasonable, with a score of 5-7 (including 5 points); The career development channel mode is unreasonable, and there are big mistakes in the employee evaluation process, so the score is 0-5 (including 0).

C8 reflects the importance of staff's knowledge update and ability improvement, and it is also the main indicator to measure staff's mastery of "new energy cloud" information technology, reflecting the sustainable development ability of the new energy cloud management platform.

Staff turnover rate (C9) is the ratio of resigned employees to in-service employees (such as formula 14). It is an important indicator to measure the stability of the talented team of the new energy cloud management platform. Only organizations with good development prospects, care for employees, and providing a good growth channel can get the support and support of employees, and the organization will continue to grow.

\[ S_r = \frac{S_o - S_r}{S_o} \times 100\% \] (14)

Among them, refers to the staff turnover rate, refers to the number of departing employees, refers to the number of in-service employees.

3.2.1.4. Data dimension (B4)
"New energy cloud" platform is a digital platform of the platform economy and sharing economy for the new energy industry, which constructs a new energy value industry ecosystem, serves local economic and social development, and improves the efficiency and benefit of new energy enterprises. Therefore, three indicators are set up in the data dimension: the level of data platform construction, the level of data visualization, and the level of data application.

Data platform construction level (C10) refers to the construction level of enterprise business data platform and data warehouse. It mainly measures whether the data records of each business link are
complete and standardized and whether the business data record caliber is unified. According to the actual situation of enterprise data platform construction, the construction level of the data platform is scored. The enterprise business data record is complete and standardized, the record caliber among business modules is unified, and the data can flow freely among platforms, with a score of 8-10 (including 8 points); Enterprise business data records are complete and standardized, but due to the different caliber of data platforms of various departments, data docking needs to be completed through the data interface, with a score of 5-7 (including 5 points); The enterprise business data record is not complete and standardized, and the caliber of data record among business modules is not uniform, with a score of 3-5 (including 3 points); The enterprise business data record is not complete and standardized, the data analysis platform is not established, and the score is less than 3 (excluding 3 points).

Data visualization level (C11) refers to the level of standardized configurable data report design and intuitive visual chart output when the data platform displays the data analysis results of business links. According to the enterprise data construction platform, the data visualization level is scored. Enterprise business data report design standard, visual data output normal, score 8-10 points (including 8 points); The design of enterprise business data report is relatively standard, and it can output visual data, with a score of 5-7 (including 5 points); The design of enterprise business data report is not standard, and it is unable to output visual data. The score is 0-5 (including 0).

Data application level (C12) refers to the degree to which the data analysis results from the enterprise data platform are applied to the management and decision-making activities. It mainly measures the degree of application of data analysis results by managers, that is, whether managers can reasonably use the data analysis results when making major decision changes, conduct an in-depth analysis of business data from multiple perspectives according to decision-making needs, and make decisions and strategic judgments based on personal experience. Enterprise managers often use platform data in the decision-making process, and conduct multi angle analysis on platform data, with a score of 8-10 points (including 8 points); Platform data is rarely used by enterprise managers in the decision-making process. Platform data is analyzed from multiple perspectives, with a score of 5-7 (including 5 points); Enterprise managers do not use platform data in the decision-making process, and the platform data is not analyzed from multiple perspectives. The score is 0-5 (including 0).

3.2.2. Weight determination of evaluation index of "new energy cloud" operation mode
This paper mainly evaluates the actual situation of the "new energy cloud" platform. To clarify the key points of the operation mode evaluation, the weight is set by the combination of AHP in the subjective weighting method and CRITIC in the objective weighting method (as shown in Figure 2).
Figure 2  evaluation framework of "new energy cloud" operation mode

Step1: Determination of index weight by AHP
First of all, this study selects 10 experts from universities and State Grid Corporation (the basic information of experts is shown in table 3) and constructs the judgment matrix.

Table 3  List of respondents, professional title names, and subordinate units

| Order number | Title          | Owned unit | Working life |
|--------------|----------------|------------|--------------|
| 1            | Professor      | NCEPU      | 28           |
| 2            | Professor      | NCEPU      | 25           |
| 3            | Professor      | NCEPU      | 18           |
| 4            | Professor      | NCEPU      | 14           |
| 5            | Professor      | NCEPU      | 16           |
| 6            | Senior engineer| State Grid | 24           |
| 7            | Senior Accountant| State Grid | 26           |
| 8            | Lectuer        | NCEPU      | 3            |
| 9            | Lectuer        | NCEPU      | 4            |

Secondly, the judgment matrix is calculated and the consistency test is carried out. All the judgment matrices obtained are tested for consistency. From the calculation results, the judgment matrix passes the consistency test, which meets the requirements of the analytic hierarchy process. Finally, the specific index weights of each index are obtained, and the results are shown in Table 4.
Table 4  AHP Calculation Weight Distribution Table of New Energy Cloud Operation Mode

| Aggregative indicator A | Hierarchy indicators Bi | Weight Wi | Specific indicators Ci | Weight Wj | Comprehensive weight Wij |
|-------------------------|-------------------------|-----------|------------------------|-----------|---------------------------|
| Business dimension B1   |                         | 0.5192    | Business processing time C1 | 0.6479   | 0.3364                    |
|                         |                         |           | Customer complaint rate C2 | 0.2299   | 0.1194                    |
|                         |                         |           | Business completion rate C3 | 0.1222   | 0.0634                    |
| Capital dimension B2    |                         | 0.2596    | Cost rate C4           | 0.2299   | 0.0597                    |
|                         |                         |           | Profit margin C5       | 0.6479   | 0.1682                    |
|                         |                         |           | Labor cost saving rate C6 | 0.1222   | 0.0317                    |
| Learning and growth dimension B3 |         | 0.0810    | Training fee input C7  | 0.2973   | 0.0241                    |
|                         |                         |           | Staff turnover rate C8 | 0.5390   | 0.0437                    |
|                         |                         |           | Career development channel C9 | 0.1638   | 0.0133                    |
| Data dimension B4       |                         | 0.1402    | Data platform construction level C10 | 0.1429   | 0.0200                    |
|                         |                         |           | Data visualization level C11 | 0.5714   | 0.0801                    |
|                         |                         |           | Data application level C12 | 0.2857   | 0.0401                    |

Step2: Determination of Index Weight by CRITIC Weight Method
At present, the "New energy Cloud" platform has been officially launched. Considering the availability of data, this research selects the pilot application data of the "New energy Cloud" platform in 9 provinces for calculation. All types of new energy power generation in 9 provinces are as shown in the figure 3; The results of the assignment of the evaluation index weight of the operation mode are shown in Table 5 below.

![Figure 3](image_url)
Step 3: Final weight determination

After using two methods to assign the evaluation index weight, the two calculated results obtained the final weight of new energy network, as shown in Table 6.

Table 5 CRITIC Calculation Weight Distribution Table of New Energy Cloud Operation Mode

| Aggregative indicator A | Hierarchy indicators Bi | Specific indicator Ci | Weight Wj |
|-------------------------|-------------------------|-----------------------|-----------|
| Comprehensive Evaluation of the Energy Cloud Operation Mode (A) | Business dimension B1 | Business processing time C1 | 0.0569 |
|                        |                         | Customer complaint rate C2 | 0.0805 |
|                        |                         | Business completion rate C3 | 0.1077 |
|                        | Capital dimension B2     | Cost rate C4             | 0.0800 |
|                        |                         | Profit margin C5          | 0.0597 |
|                        |                         | Labor cost saving rate C6 | 0.1136 |
|                        | Learning and growth dimension B3 | Training fee input C7 | 0.0301 |
|                        |                         | Staff turnover rate C8 | 0.1974 |
|                        |                         | Career development channel C9 | 0.0772 |
|                        | Data dimension B4       | Data platform construction level C10 | 0.0820 |
|                        |                         | Data visualization level C11 | 0.0611 |
|                        |                         | Data application level C12 | 0.0538 |

Table 6 Weight Allocation of Evaluation Index of New Energy Cloud Operation Mode

| Aggregative indicator A | Hierarchy indicators Bi | Specific indicator Ci | Weight Wj |
|-------------------------|-------------------------|-----------------------|-----------|
| Comprehensive Evaluation of the Energy Cloud Operation Mode (A) | Business dimension B1 | Business processing time C1 | 0.197 |
|                        |                         | Customer complaint rate C2 | 0.100 |
|                        |                         | Business completion rate C3 | 0.086 |
|                        | Capital dimension B2     | Cost rate C4             | 0.070 |
|                        |                         | Profit margin C5          | 0.114 |
|                        |                         | Labor cost saving rate C6 | 0.073 |
|                        | Learning and growth dimension B3 | Training fee input C7 | 0.027 |
|                        |                         | Staff turnover rate C8 | 0.121 |
|                        |                         | Career development channel C9 | 0.045 |
|                        | Data dimension B4       | Data platform construction level C10 | 0.051 |
|                        |                         | Data visualization level C11 | 0.071 |
|                        |                         | Data application level C12 | 0.047 |
4. Results analysis
The operation of the new energy cloud platform realizes the calculation and evaluation of the new energy consumption capacity online, and can calculate the new energy consumption capacity by Region rolling, and forecast the quarterly, annual, and medium-term new energy generation, utilization rate, new consumption space and other indicators. As the Internet, carbon neutralization support service and new power system technology innovation platform, the new energy cloud platform has comprehensively improved the digital and cloud management level of the new energy business and provided strong support for the large-scale development and utilization of new energy.

From the index weight distribution table, it can be seen that the most important dimension for the evaluation of the operation mode of the new energy cloud platform is a business dimension, second is fund dimension, the data dimension, and finally the learning and development dimension. The index of dimension is an organic whole that is complementary and promotes each other. The efficiency of the business process brings higher business processing time and business completion rate, thus improving customer service satisfaction and better completion of service level agreements. The improvement of service satisfaction will bring a larger market customer group (internal and external customers) to the "new energy cloud" platform to realize value creation.

From the specific key indicators, the weight of the four indicators in the business dimension is the largest, which is 0.197, because, in the digital era, the timeliness of business processing is the direct embodiment of enterprise capability, which is consistent with the original intention of establishing the "new energy cloud" platform, that is to accelerate the approval and approval of related businesses of the new energy industry; The proportion of customer complaint rate and the business completion rate is 0.100 and 0.086 respectively. Accurate and efficient business completion is an important guarantee for the rapid development of the new energy industry and an important guarantee for new energy power to connect to large power grid. Among the three indicators of capital dimension, the enterprise takes profit as the most important purpose of establishment, so the profit ratio accounts for the highest proportion of 0.114, the cost rate and the human cost resolution rate are 0.070 and 0.073 respectively. As a new energy industry management platform, the new energy cloud platform also occupies a great advantage in cost-saving and strengthens the power grid dispatching capacity, Clear process can improve the efficiency of system operation and create more benefits. In the data dimension, the weight proportion of data visualization level indicators is 0.071, which is the most important of the three indicators. The proportion of data platform construction level and data application-level index is 0.051 and 0.047 respectively. The new energy cloud management platform is the product of the era of "big data", This dimension index can directly show the application level of high-tech of the new energy cloud platform. Finally, the dimension of learning and growth is slower than the other three categories. The most important of the three indicators is the staff turnover rate index, with the weight ratio of 0.121, the proportion of 0.021 and 0.047 respectively being training fee input and career development channel.

5. Conclusion
Based on the analysis of the characteristics of the "new energy cloud" management platform, this paper selects the evaluation index system of the "new energy cloud" operation mode in line with the background of the intelligent era, and constructs the index weight distribution through expert interviews, combined with analytic hierarchy process and critical weighting method, to make up for the lack of research on the evaluation index weight, The impact of each index on the operation of the new energy cloud platform is analyzed. This paper makes a quantitative study on different operation modes, which provides a basis for enterprise managers to make decisions in the future.

Although this paper considers the weight of the evaluation index, the internal relationship between the indicators has not been involved and needs further research. At the same time, due to the consideration of the common characteristics of the "new energy cloud" management platform in the selection of indicators, there may be defects in the actual application of evaluation indicators of an individual "new energy cloud" platform. But this paper fully considers the era characteristics of "new energy cloud", which has significant practical significance for the evaluation of different operation modes.
modes of "new energy cloud". From the perspective of index selection, considering the development trend of "new energy cloud" management platforms to big data centers and cloud service centers, this paper selects some common evaluation indexes and improves them individually according to their characteristics. From the perspective of the index weight allocation method, it provides ideas and methods for the evaluation system of the new energy cloud platform operation mode. Combined with the characteristics of the platform, it uses an expert scoring method, analytic hierarchy process, and critical weighting method to allocate the weight of performance indicators, and establishes an evaluation index system in line with its characteristics.

This paper fully considers the era characteristics of the "new energy cloud" management platform and provides a practical reference for the future data industry to establish its related evaluation system.

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