Construction of Effectiveness Evaluation System for Innovative Application of Multi-source Power data

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Abstract. At present, the evaluation criteria and structure for the effectiveness of innovative application of electric power data are generally set in an independent form, covering a small evaluation range, resulting in an increase in unit evaluation differences. This paper proposes the construction and verification analysis of the effectiveness evaluation system for the innovative application of multi-source power data. According to the changes in the current assessment requirements and standards, first define the assessment indicators for the application of basic multi-source power data, expand the coverage of the assessment by multi-level means, and build multi-level assessment standards and structures. Based on this, design the effectiveness assessment model of power data, and use dynamic correction to achieve effectiveness assessment. The final test results show that the final unit evaluation difference value is well controlled below 1.3 for the six test objectives currently set, which indicates that the effectiveness evaluation system currently designed is more flexible and changeable with the help of the innovative application of multi-source power data. It has strong pertinence, better evaluation effect and practical value.

Keywords: Multi-source power data; Innovative application; Effectiveness; Evaluation system; System construction; Data processing

1 Introduction

At present, the innovative application of multi-source power data is promoting the development of related industries and technologies, and the integration with various regions and the effect of innovation are gradually recognized by the society [1]. The current multi-source power data are not from the same information source, but from different sources under different environmental backgrounds, and are collected in a data set. This type of data set can be called multi-source data [2]. However, multi-source power data is mostly used in energy management, smart grid, power market transactions, etc., with a high degree of conversion [3]. However, the effectiveness of multi-source power data is uncontrollable in the process of practical application, such as uncontrollable data execution effect, uncontrollable correlation technology, uncon-

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trollable transition form, etc. [4]. To some extent, these problems will lead to the application effect can not reach the expected standard. In order to solve this problem, relevant personnel designed a data validity evaluation system [5]. The traditional evaluation structure is mostly set as one-way. Although it can achieve the expected evaluation tasks and objectives, it lacks pertinence and integrity. Under the complex background environment, it is difficult to strengthen the application ability of multi-source power data, expand the evaluation scope, and form a more specific and detailed evaluation system [6]. Moreover, the effectiveness evaluation systems designed at this stage are mostly one-way, with relatively low efficiency in data processing and evaluation and lack of cohesion, which is also one of the important reasons for the errors in the final evaluation results [7]. For this reason, the construction and practical analysis of the effectiveness evaluation system for the innovative application of multi-source power data are proposed. The application practice scope of multi-source power data is large. When conducting the effectiveness evaluation, the multi-dimensional cross method is used to further expand the actual evaluation scope, design more flexible and changeable evaluation results, and calibrate the application evaluation data from multiple directions, Increase the consistency, integrity and correctness of data processing [8]. In addition, the construction of the effectiveness evaluation system and the integration of multi-source power data can promote the expansion of the connotation of power data quality and evaluation dimensions, and also facilitate the collection, transmission and storage of data information in the later period, providing reference and theoretical reference for subsequent evaluation and calculation [9].

2 Design the effectiveness evaluation system of multi-source power data application

2.1 Define the application evaluation indicators of basic multi-source power data

At present, the application of multi-source power data is extremely limited. Although it can achieve the expected evaluation effect, it cannot better ensure the authenticity and reliability of the evaluation results. To solve this problem, it is necessary to first define the application evaluation index of basic multi-source power data [10]. The effectiveness evaluation of power data covers a wide range, so it is necessary to define the actual evaluation area first, and set evaluation objectives [11] in combination with the corresponding innovative application content. It should be noted that the initial assessment objectives are mostly one-way, and the overall assessment efficiency and quality are low, affecting the implementation and processing of follow-up work [12]. Therefore, under the current measurement background, it is necessary to first calculate the effectiveness evaluation limit, as shown in Formula 1 below:

$$G = (1+k)^2 \times \Re \eta - \mu \tag{1}$$

In Formula 1: G indicates the effectiveness evaluation limit, k indicates the controllable range of the evaluation, $\Re$ represents the conversion ratio, η represents the amount of multi-source data, μ indicates power data conversion difference [13]. Combined with the current measurement, complete the calculation of the effectiveness evaluation limit, set it as the initial standard of the evaluation, and form a multi-dimensional evaluation structure [14]. Then, based on this, the evaluation indicators and parameters were adjusted from multiple perspectives [15]. See Table 1 for details:

Table 1. Evaluation Indicators and Parameter Adjustment from Multiple Perspectives.

Controllable names of power data validity evaluation indicators from multiple perspectives	Basic evaluation standard parameter values	Controllable evaluation standard parameter values
Directional evaluation difference	3.22	1.25
Controllable conversion ratio	2.06	3.18
Evaluation mean	16.35	17.54
Construction of preset evaluation objectives	Data content evaluation, data classification evaluation	Data content evaluation, data classification evaluation, data integration evaluation, and data transformation evaluation
Evaluation level	Data collection layer+target setting layer+identification and evaluation layer+evaluation and analysis layer	Data collection layer+target setting layer+identification and evaluation layer+comparison and evaluation layer+evaluation and analysis layer
Evaluation target coefficient	3.22	4.58

According to Table 1, complete the design and adjustment of evaluation indicators and parameters from multiple perspectives. Based on this, create a circular and stable evaluation structure, and strengthen the control of benchmark values of evaluation indicators at various stages [16]. It should be noted that the current evaluation criteria are not fixed, but with the processing of the demand criteria for the innovative application of multi-source power data, it has strong flexibility and pertinence, and builds the basic test background conditions [17].

2.2 Build multi-level evaluation standards and structure

The evaluation criteria and structure of the initial multi-source power data are generally set as a single structure. Although the expected evaluation goals can be achieved, the evaluation efficiency is low and the overall evaluation results are not accurate [18]. Therefore, it is necessary to design multi-level evaluation criteria and implementation structure [19]. First, deploy a certain number of monitoring nodes in the current data processing platform or system, and connect the nodes in the same area to ensure the authenticity and reliability of test data and information [20]. Then, the multi-level evaluation criteria will be developed first, and the transitional correlation will be carried out in three stages, as shown in Table 2 below:

Table 2. Multi stage and multi-level evaluation standard setting analysis table.

Multi stage and multi-level evaluation standards	The first testing and evaluation stage	Second testing and evaluation stage	Third testing and evaluation stage
Evaluation of data content	Unit data content	Multivariate data content	Regional data content
Evaluation of data types	Basic assessment type	Hierarchy evaluation type	Group assessment type
Evaluation of data volume	Controllable evaluation scope	Targeted assessment scope	Uncontrollable evaluation scope
Evaluation of data conversion effectiveness	Evaluate conversion ratio between 1.2 and 1.5	Evaluation conversion ratio between 1.5 and 2.6	Evaluation conversion ratio between 2.6 and 5.4
Evaluation of data applications	Application position independent calibration	Collaborative calibration of application location	Application position conversion calibration

According to Table 2, complete the setting and verification analysis [21] of multi-stage and multi-level evaluation criteria. In combination with the current testing requirements and standards, the evaluation objectives of each level are defined, and the evaluation and ranking of multi-source power data are carried out to form a specific evaluation structure. Then, based on this, we need to design a multi-level evaluation structure [22]. We can integrate the established evaluation criteria with the preset evaluation objectives, design a more balanced evaluation system, and use the objectives as guidance to obtain the evaluation values and effective information of each cycle for future use [23].

2.3 Design power data validity evaluation model

The innovative application range of multi-source power data is relatively large, so in the process of designing the model, try to preset the corresponding processing goals, form a more reliable evaluation system, and expand the scope of evaluation. Since multi-source power data are mostly used in energy management, smart grid, power market transactions and other industries, it is necessary to ensure the hierarchy and pertinence of the evaluation model [24]. Guided by the evaluation objectives, the evaluation criteria for effectiveness were first adjusted [25]. This part generally refers to the corresponding changes in the content, classification planning and scope of the assessment. The specific effectiveness evaluation structure is shown in Figure 1 below:

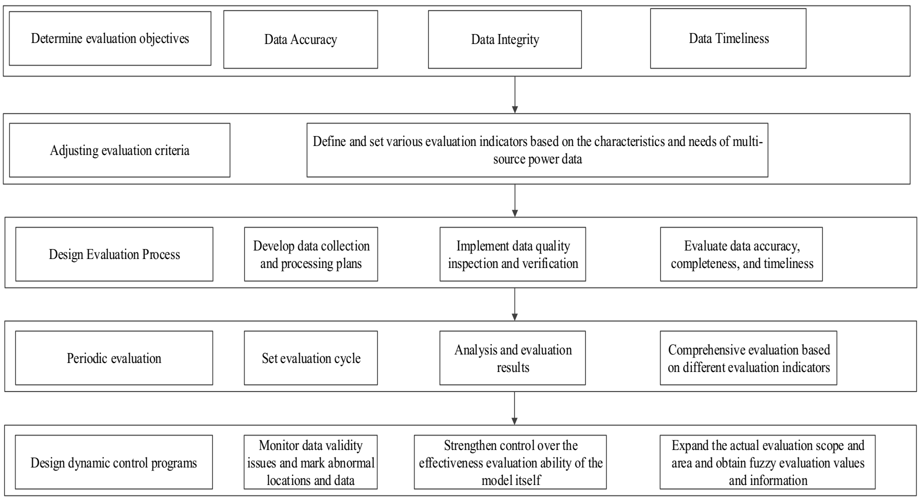

Fig. 1. Structure Practice Diagram of Power Data Validity Evaluation Model.

According to Figure 1, complete the design and analysis of the structural practice of the power data validity evaluation model. Based on this, combined with the innovative application of multi-source power data, the current effectiveness is measured periodically using the results of the designed evaluation model. Analyze the authenticity and reliability of the evaluation results from multiple perspectives. On this basis, it is also necessary to design dynamic control procedures in the current evaluation model structure. This program is generally associated with the built-in structure of the evaluation model, which is equivalent to a huge evaluation network. It verifies and analyzes the validity problems of data in the process of innovative application, marks abnormal locations and data, strengthens the control of the model's own effectiveness evaluation ability, expands the actual evaluation scope and area, and obtains fuzzy evaluation values and information.

2.4 Effectiveness evaluation of dynamic correction

The so-called dynamic correction mainly refers to the correction processing method for the fuzzy evaluation results obtained from the effectiveness evaluation model. In fact, most of the data obtained by the current model are basic fuzzy results, which do not have preset accuracy. Dynamic correction can be triggered from all processing links to strengthen the control of the rationality of evaluation indicators and parameters, and ultimately achieve the purpose of controlling accuracy. Combined with the requirements and standards of dynamic correction, the correction limit is calculated first, as shown in Formula 2 below:

$$p = \varepsilon\sigma - \frac{\upsilon}{\lambda + (1-n)^2} \times \sigma n \tag{2}$$

Equation 2: p is the correction limit, ε represents the average value of unit assessment, σ represents the number of evaluations, λ is the mean value of the directional assessment, n represents the preset evaluation standard value, υ represents the evaluation difference, and the calculation of the corrected limit value is completed in combination with the current test. Next, the results obtained from the model are dynamically revised in combination with the measurement standard changes of multi-source power data and preset parameters, so as to maximize the authenticity and reliability of the final evaluation results and improve the stability of the whole day's evaluation.

3 Experiment

This is mainly about the analysis and verification of the actual application effect of the construction of the effectiveness evaluation system for the innovative application of multi-source power data. Considering the authenticity and reliability of the final test results, the analysis is carried out in the way of comparison, and professional equipment and devices are used to collect related data and information. After summary and integration, it is ready for subsequent use. Next, according to the changes of current test requirements and standards, the final test results are compared and studied. Next, the associated test environment is built.

3.1 Experiment preparation

Combined with the current testing requirements and standards, the actual environment for innovative application testing of multi-source power data is built and related. First, connect the tested program to the execution structure of the system, import the designed evaluation matrix, and create a basic evaluation environment. Next, deploy a certain number of monitoring nodes at the edge through the set guidance target, collect data and information, summarize and integrate them for future use. Next, set the basic test indicators and values, as shown in Table 3 below:

Table 3. Basic Test Index and Value Setting Table.

Basic testing indicators	Basic evaluation parameter reference value	Edge controllable evaluation parameter reference value
Controllable evaluation type	Built-in evaluation, correlation evaluation, and transformation evaluation	Built-in evaluation, multiple evaluation, correlation evaluation, and transformation evaluation
Basic evaluation objectives	unit evaluation	group evaluation
Evaluate relative mean	16.35	14.32
Directional evaluation ratio	3.05	4.16
Controllable difference	1.25	1.01

According to Table 3, complete the setting and analysis of basic test indicators and values. Then, based on this, adjust the control parameters and values of each link through the designed evaluation matrix, build a stable and specific evaluation environment, complete the building of the test environment, and then conduct specific measurement and verification.

3.2 Experimental process and result analysis

In the above designed test environment, combined with the actual measurement needs and changes in standards, the effectiveness evaluation system of the designed multi-source power data innovation application is tested, verified and analyzed. You can first design six test evaluation targets in advance, execute and process the targets in order, obtain test data and information, and calculate the unit evaluation difference, as shown in Formula 3 below:

$$M = \theta^2 - \chi(1+h) \times \beta \tag{3}$$

In Formula 3: M represents the unit evaluation difference, θ represents the conversion evaluation ratio, χ indicates the preset error of evaluation, χ represents the stacking range, β represents the effective mean. Combined with the current measurement, the calculation of unit evaluation difference is realized. According to the current test, the verification and analysis of the test results are finally completed, as shown in Table 4 below:

Table 4. Comparison and Analysis of Test Results.

Basic testing objectives	Directional conversion ratio	Controllable evaluation time/s	Unit evaluation difference
Test Objectives 1	2.05	0.25	1.13
Test Objectives 2	3.16	016	1.25
Test Objectives 3	3.55	0.35	1.03
Test Objectives 4	4.16	0.27	1.09
Test Objectives 5	4.28	0.19	1.18
Test Objectives 6	3.99	0.26	1.25

According to Table 4, the analysis of test results is completed: for the six test objectives currently set, the final unit evaluation difference is better controlled below 1.3, which indicates that with the help of and under the innovative application of multi-source power data, the effectiveness evaluation system currently designed is more flexible and changeable, with strong pertinence, better evaluation effect and practical value.

4 Conclusion

In a word, the above is the construction and verification analysis of the effectiveness evaluation system for innovative application of multi-source power data. Compared with the initial data effectiveness evaluation system, this time, combined with the actual data volume and coverage, the designed multi-source power data effectiveness evaluation structure is more flexible and changeable, with strong pertinence and stability. Moreover, in the process of innovative application, we should set comprehensive evaluation objectives and tasks, transform the current evaluation contents, design a concrete and complete evaluation system architecture, strengthen the reliability and authenticity of evaluation from many directions, and form a strong contrast with the initial evaluation structure to ensure the credibility of the final evaluation results, greatly improve the actual application evaluation effect, and lay a solid foundation for the subsequent development of related technologies and industry progress.

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