Research on the Optimization Method of Power Grid Financial Class Index Based on Random Walk Pagerank

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Abstract. At the 24th meeting of the Commission for Deepening Overall Reform of the CPC Central Committee, General Secretary Xi Jinping stressed the need to "speed up the construction of a number of world-class enterprises with outstanding products, outstanding brands, leading innovation and modern governance". It can be seen that improving the governance ability of power grid enterprises is the only way to cultivate world-class power enterprises. In enterprise economic management, benefit is the core of enterprise development. The role of financial management in it is to maximize the benefits. From the optimization of power grid enterprises, through the construction of financial index conduction relationship between the ISM model, the use of the PageRank model and study the index, from the specific index level to achieve optimization benefits, promote the power grid to further improve the financial index system, promote the power grid enterprise improve financial management level, effectively control the cost, improve the income, and then speed up the pace of building a world-class enterprise.

Keywords:financial index, First-class enterprises, PageRank algorithm, AISM model.

1 Introduction

To implement the general secretary xi to speed up the construction of the world-class enterprise important indicator spirit, response to Sasac's call—further optimize the management index system of central enterprises for "one profit and five rates", improve the power company to the system and improve the index is scientific nature, power grid enterprises need to improve the level of financial management comprehensively, using intelligent network model power grid enterprises to improve the economic benefit [1]. To construct the transmission relationship through complex network analysis method, the network topology structure analysis can help identify key nodes and connections, as well as the possible propagation paths between different nodes, help identify the relationship between indicators, screen core indicators and non-core indicators, and optimize the index system [2].

This paper selects the sustainable development factor interference analysis model (AISM) is on the basis of the arrangement and coding, the relationship matrix of increase of interference

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factors, introduce hierarchical structure, and further emphasize transfer relationship [3], establish a set of extraction rules against the simplest hierarchical directional topology hierarchy, build index transfer hierarchy structure model, and then get the conduction relationship between indicators [4]. Yi Liang et al. proposed the use of DEMATEL-ISM model to divide the influencing factors of the economic operation of the electric vehicle charging system into four levels, and put forward a comprehensive management scheme [5]. It can be seen that this is a way to reveal the influence and effects of transmission factors through the relationship between them.

In order to understand the core indicators in the conduction mechanism and identify the most effective intervention strategies, this paper introduces the PageRank algorithm to assist the central node analysis, which calculates the importance of each node according to the number of nodes linked by other nodes in the network and the importance of these linked nodes. J. Li et al. (2019) used the complex network game research and found that the supply-side tax and subsidy policies have different effects on the popularization of electric vehicles (ESCI) [6]. Rongkai Chen et al. (2022) found that investment subsidies have a greater impact on ESCI than various incentive policies such as construction subsidies [7]. It can be seen that PageRank algorithm can help reveal the influence degree of different nodes on the whole network, and remove or retain some indicators according to the influence degree, so as to realize the optimization of the index system [8].

To sum up, in the past, the financial index system of power grid enterprises may have the problem of the transmission relationship setting or the unreasonable weight distribution of indicators, which leads to the financial information is not timely and accurate, which cannot fully and effectively reflect the financial status and operating benefits of enterprises, and it is difficult to provide valuable management information support. The power grid financial index system constructed by using AISM and Pagerank model, from optimizing the transmission path to identifying the important nodes, can help enterprises to better understand the transmission mechanism and characteristics of the financial index system, and improve the economic benefits and stability[9]. At the same time, it promotes the transformation and expansion of intelligent and digital enterprise financial management [10], realizes the use of data to promote work, promotes the upgrading of power grid enterprise management, and builds a world-class enterprise.

2 Study on the optimization method and model of financial indicators

2.1 A.AISM model construction

AISM is an improved model based on ISM. The core of the method is based on the ISM result-first hierarchical extraction rules, using the idea of confrontation (Adversaria), plus the opposite cause-first hierarchical extraction rules, i.e., placing the elements from the bottom to the top, so as to establish a set of extraction rules opposing the simplest hierarchical directed topology hierarchical diagram.

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do

not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.The specific process is shown in Fig. 1.

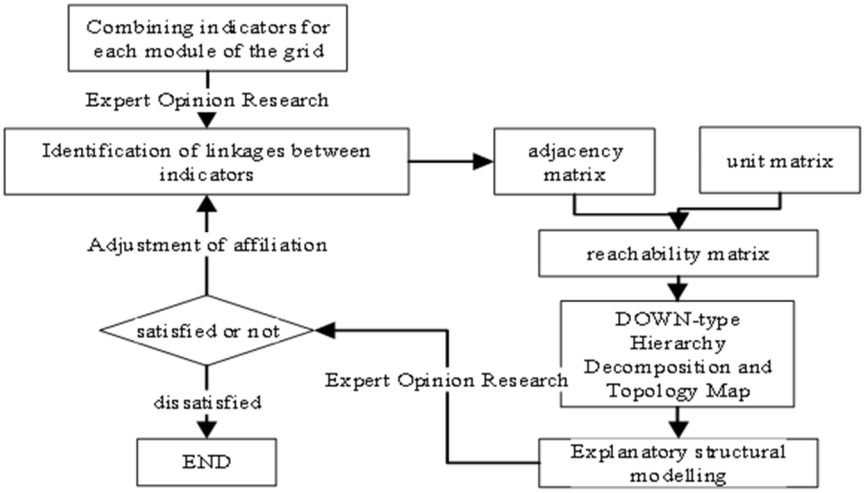

Fig. 1. ISM-based model construction for selection of prior, simultaneous and lagging indicators

1) Reachable set $R(S_i)$ and antecedent set $A(S_i)$

$R(S_i)$:Define the set of elements of the system that can be reached by the element S_i , which is the set of column elements corresponding to the element with value 1 in row i of the reachability matrix.

$A(S_i)$:The set of all elements that can reach element S_i, which is the set of row elements corresponding to elements with value 1 in column i of the reachability matrix.

The reachable set and the antecedents set reflect all the interrelationships between the elements, including direct and indirect relationships.

2) Element Hierarchy Level Classification

When $R(S_i) \cap A(S_i) = R(S_i)$, element S_i is in the highest level L_1 of the system; by removing the highest level element and repeating the above steps, level 2 L_2, level 3 L_3... up to the lowest level element of the system can be determined.

3) Structural modelling of indicator transmission relationships

Removing the strong linkage relations from the reachable matrix yields the reduced reachable matrix M', and by $M'' = M' - (M' - I)^2$, the structure matrix M'' can be derived by applying Matlab.

By stratifying the elements according to the hierarchical order of the elements, and then connecting the connectivity between the elements with directional lines according to the

structure matrix and compensating for the strong linkage relationship, the indicator transfer hierarchy structure model can be constructed, and then the inter-indicator conduction relationship can be obtained from the transfer hierarchy structure model.

2.2 Metrics Importance Algorithm for Random Wandering PageRank

The PageRank algorithm calculates the importance of each node according on the number of nodes linked by other nodes in the network and the importance of these linked nodes. The algorithm is usually used in the page ranking of the search engines. The ranking of an indicator depends on the significance of all the indicators pointing to it. This model can solve the importance PR value of the performance network nodes according to the relevance and importance, and rank the importance index according to the numerical size.

Let the set of indicator nets be a directed graph consisting of n indicator nodes and directed edges $G=(V,E)$, where the set of nodes is V and the set of directed edges is E. If indicator $V_1,V_2,...,V_k$ is a node chained into indicator V, then the importance PR value $PR(A)$ of indicator V is:

$$PR(A)=\frac{(1\text{-d})}{\text{n}}PR(A)=\frac{(1-d)}{n}+d\sum_{i=1}^{k}\frac{PR(V_i)}{C(V_i)} \tag{1}$$

$C(V_i)$: The out-degree of node V_i. The out-degree of node V_i is the number of directed edges starting from it. The improved PageRank algorithm is shown below:

$$PR(A)=\frac{(1-d)}{n}+d\sum_{i=1}^{k}\frac{PR(V_i)}{C(V_i)} \tag{2}$$

d :Damping factor, representing the probability that the correlation of the indicator affects other indicators.

The value of PR corresponding to each indicator node V_i is $d\frac{PR(V_i)}{C(V_i)}$. Considering the existence of isolated nodes, the initial value of PR for each indicator node is defined as $\frac{(1-d)}{n}$.

Define the n dimensional vector $P=(PR(1),PR(2),...,PR(n))^T$, P^{x+1} denotes the $(n\times 1)$ order matrix consisting of the importance PR of each node obtained in the $(x+1)$ th iteration, then the value of PR is:

$$P^{x+1}=\frac{1-d}{n}*E+d*(A^{'})^T*P^x \tag{3}$$

Where, d — damping factor, which takes values between 0 and 1, represents the inter-nodal transfer probability; E - $(n\times 1)$ order matrix and has all elements of 1.

Let ε be the iteration convergence smoothness threshold and the initial PR value of each node is P^0, the iteration ends when $\left|P^{x+1}-P^x\right|<\varepsilon$ is satisfied.

Equation (2) is obtained by expanding:

$$P^{x+1}=\begin{bmatrix}(1-d)/n\\(1-d)/n\\\cdots\\(1-d)/n\end{bmatrix}+\begin{bmatrix}l(p_1,p_1)\,l(p_1,p_1)\\l(p_2,p_1)\quad\cdots\\\cdots\\l(p_n,p_1)\end{bmatrix} \tag{4}$$

If there exists a link from node i to node j, then $\sum_{i=1}^{n} l(p_i,p_j)=1$; otherwise $\sum_{i=1}^{n} l(p_i,p_j)=0$.

Through PageRank algorithm, the transfer probability of each node in the quality of power grid finacial index system can be obtained, and then the importance between indicators can be quantitatively shown, the indicators with low importance can be removed, and the indicators with high importance can be highlighted, so as to optimize the existing index system.

3 Empirical Analysis

Through sorting out the indicators in the existing index system such as "F Province Company 2023 Standard Index System", "State Grid F Province Power Co., Ltd. (2022)", 25 indicators of the financial module are obtained. Through expert consultation, the adjacent matrix is shown in Table 1:

Table 1. F Adjacency matrix of financial indicators of provincial power grid companies

File name	A1	..	A7	..	A9	..	A12	...	A18	..	A23
A1	0	..	0	..	0	..	0	..	0	..	1
A2	0	..	0	..	1	..	0	..	1	..	0
A3	1	..	0	..	0	..	1	..	0	..	0
A4	0	..	0	..	0	..	0	..	0	..	0
...	..	..	..	..	..	..	..	..	..	..	..
A23	0	..	0	..	0	..	0	..	0	..	0

Limited by space, all matrix and all index names are not displayed. Among them, A1 refers to total profit. A7refers to asset-liability ratio. A9 refers to return on equity. A12refers to total labor productivity. A18 refers to R & D investment intensity. A23 refers to operating cash ratio. After building the adjacency matrix of the financial index system of power grid enterprises, it is necessary to layer the elements according to the hierarchical order of elements, and connect the connection relationship between elements and directed lines according to the structural matrix.as shown in Figure 2. below.

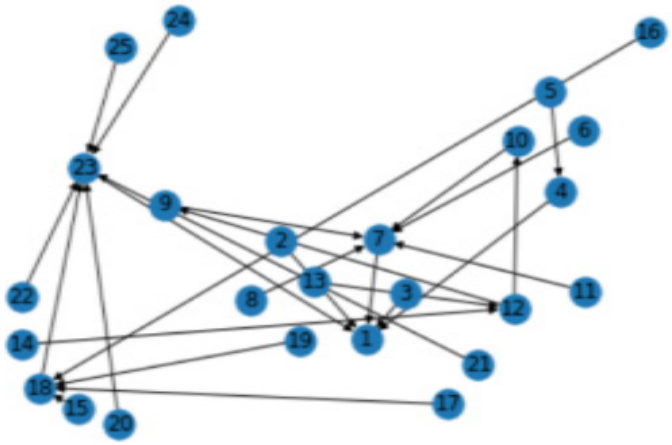

Figure 2. F. The transmission relationship diagram between the financial indicators of the provincial power grid

Finally, the secondary modification is made according to the modification opinions of experts, and the conduction relationship between indicators is obtained according to the logical discrimination of the adjacency matrix, as shown in Figure 3 below. As can be seen from Figure 3 of the important degree index chart between the financial indicators of power grid in F province, Importance from high to low, A1, A23, A7, A18, A12, Find the corresponding index names in the adjacency matrix of Table 1.

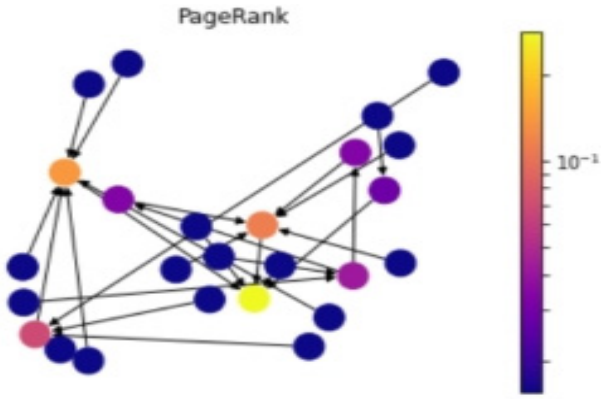

Figure 3. F. Important degree indicator chart between the financial indicators of the provincial power grid

"One profit and five rate" is the five indicators set around the business index dimension (including financial indicators) of the central enterprises in the 2023 annual assessment., the matrix is shown in Table 2:

Table 2.One profit and five rate assessment index

A profit	total profit
Five rate	Asset-liability ratio, return on equity, total labor productivity, R&D investment intensity, operating cash ratio

According to the importance of the indicators: First, To ensure that the total profit growth rate is higher than the national GDP growth rate, Strive to achieve better performance; next, The asset-liability ratio remained stable; last, The return on equity, r&d investment intensity, total labor productivity and operating cash ratio were further improved.

4 Conclusions

Considering the shortcomings of the financial index system construction of the existing power grid enterprises, such as the reduction of the credibility of the index system due to the confusion of the transmission relationship hierarchy; some important indicators have not been fully concerned, and some non-important indicators are included in the core indicators of the system, resulting in redundant information surplus. Therefore, according to the benefit needs of power grid enterprises, according to the indicators in the existing index system of F Province Power Co., LTD., the AISM model is constructed to sort out and improve the transmission relationship between indicators, and screen the core and non-core indicators according to the PageRank algorithm, so as to realize the effective improvement and optimization of the financial index transmission system.

Pagerank The algorithm was originally used as an algorithm for search engine ranking, but it was used in combing the financial management index system. The innovation lies in: First, the traditional linear weighting method cannot consider the complex relationship between indicators, and the calculation results may be relatively simple and rough. However, PageRank algorithm uses a nonlinear method to calculate the influence between indicators, which solves the problem of complex relationship.

After experimental validation can be obtained with the national assessment state management dimension class index policy, get the conclusion and sasac for "five rate" of "a increase a steady four ascend" clear instructions, further verify the PageRank and AISM model optimization financial index conduction relationship accuracy and practicability, provides a convenient method for economic index management.

To sum up, in order to ensure the maximum enterprise benefits on the basis of reliable power supply, we need to constantly explore appropriate ways. Financial work relative standardization, digital, choose to use complex network quantitative analysis form a complete data index system, and according on the model, can form with data to reveal the problem, promote the work of management mode, help to improve work efficiency, ensure the enterprise production and operation efficiency, speed up the pace of building world-class enterprises.

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