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# Research on the performance evaluation and improvement strategy of the digital transformation demonstration of state-owned enterprises

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***Abstract :*** *In recent years, the central government has proposed to promote the integration of "real economy" and "digitalization".As the backbone of the national economy, state-owned enterprises must play a leading role, take the initiative to grasp and lead the transformation trend of the new generation of information technology industry, and achieve high-quality development in digital transformation .This paper takes 43 demonstration state-owned listed companies of digital transformation as samples and constructs a performance evaluation system from four types of capabilities: profitability, asset operation, debt repayment and development.Firstly, the entropy weight method is introduced to measure the weight of each index , and then the improved TOPSIS method is adopted to further conduct comprehensive evaluation and ranking of corporate performance.The research shows that the assets operation ability and debt paying ability have a great impact on the demonstration state-owned enterprises of digital transformation, but the development of industry performance is uneven, among which the performance level of transportation, storage and postal industry is higher than that of manufacturing and construction industry, which is closely related to the contribution degree of each enterprise to the corresponding industry.Therefore, state-owned enterprises should play a leading role in digital transformation demonstration and lead the industry to accelerate digital transformation.*

***Keywords -*** *Digital transformation; State-owned enterprises; Entropy method; TOPSIS method; Comprehensive*

## I. INTRODUCTION

With the global impact of COVID-19 and the resulting economic recession, the digital economy has gradually become an important force in preventing the risks of COVID-19 and promoting the global economic recovery. Therefore, the fifth Plenary Session of the 19th CPC Central Committee proposed to develop digital economy and build digital industrial clusters with international competitiveness. In August 2020, the State-owned Assets Supervision and Administration Commission of the State Council issued the Notice on Accelerating the Digital Transformation of State-Owned Enterprises, which made a comprehensive plan for promoting the digital transformation of State-Owned enterprises. In May 2021, deputy director of the State-owned Assets Supervision and Administration Commission of the State Council WengJieMing propulsion conference at the scene of the ascension to the world-class management again, to carry out the spirit of the fifth plenary session of the party's 19th, give full play to the important role of the digital and intelligent, to promote state-owned key enterprises to speed up to the world first-class enterprise, digital power the digital transformation of state-owned enterprises.

However, according to the latest Digital Transformation Index of Chinese Enterprises released by Accenture, only 11% of Chinese enterprises have significant effects of digital transformation, and most of them have ‘hidden defects’, that is, lack of the foundation of digital transformation, which makes it difficult for enterprises to achieve results (Accenture, 2021) [1]. As the backbone of the national economy, state-owned enterprises should play an active leading role, take the initiative to grasp and lead the trend of the new generation of information technology and industrial transformation, keep pace with the times, and accelerate the

digital transformation of state-owned enterprises. Therefore, it is worth thinking whether state-owned enterprises that have achieved digital transformation and upgrading have achieved good benefits, and judging which aspects need to be improved and promoted according to the comprehensive evaluation results, which is studied in this paper.

## II. LITERATURE REVIEW

2.1 Research status at home and abroad

The relevant literature in this paper mainly involves the connotation of enterprise digital transformation and the content of performance evaluation method

2.1.1 Connotation of digital Transformation

The concept of Digital Transformation was first proposed by Negroponte (2000) [2]. He believes that Digital Transformation refers to the digital penetration of enterprises' means of production, the Digital reconstruction of production relations and the Digital innovation of business activities. Acemoglu (2000) [3] argues that digital transformation should include two meanings: first, the input-output of a new generation of digital information technology, which breaks through the bottleneck of traditional resources with innovative elements; Second, the integrated application of digital technology in enterprises reflects the value and function of innovation. Domestic scholars Jin Chen et al. (2019) [4] argue that digital transformation is a high-level transformation aimed at constructing a digital mode suitable for the development of various enterprises through digital technology research and development and capacity cultivation based on digital transformation and upgrading. Fan He & Yuan Qin (2019) [5] believe that digital transformation is a unique strategic upgrading phenomenon of enterprises in the era of digital economy, and is characterized by neogenesis. Xiaohua Li (2016) [6] defined digital transformation as the sum of "entity enterprise" and "new-generation digital technology" from the perspective of combining industry and government. Xiaobi Zheng (2017) [7] believes that the essence of digital transformation is innovation-driven development, which reflects the whole process of value discovery and creation. Ying Wei & Xiaoyun Zong (2021) [8] define digital transformation as a process in which an organization changes value creation by using digital technology in response to environmental changes. Therefore, at present, there is no clear and unified definition of the connotation of enterprise digital transformation.

2.1.2 Enterprise performance evaluation method

At present, the research on enterprise performance evaluation is relatively mature, mainly including Cluster Analysis (Qingdong Li, 2005; Yuhui Jia & Jinhui Ning, 2021) [9-10], Principal Component Analysis (Tao Zhang et al., 2012; Yining Zha, 2021) [11-12], Balanced Scorecard (BSC) (Yunguo Liu & Guofei Chen, 2007; Haolan Huang & Subin Wen, 2016; Jingwen An et al., 2018) [13-15], Economic Value Added (EVA) (Guobin Yang & Chunfang Li, 2001; Jianli Li & Nianli Zhang, 2007) [16-17], Grey Relational Analysis (Hui G & Bifeng S, 2009; Yijun Chen et al., 2020) [18-19], Fuzzy Comprehensive Evaluation method (Ying He, 2011; Shunkun Yu et al., 2013; Xiaoxing Li et al., 2018) [20-22], Analytic Hierarchy Process (Zhidong Shen, 2013; Yingbo Ji et al., 2018) [23-24], Data Envelopment Analysis (DEA) (Jing Zhou & Jian Sun, 2015; Dequan Yang & Yunxia Xue, 2015; Donghui Hu & Renqiang Wu, 2016) [25-27], BP Neural Network method (Xu Jiang & Xueqin Hu, 2020; Zhengang Zhang et al., 2020) [28-29]. In view of the diversity of current enterprise performance evaluation methods, many of them ignore the weight of index data, resulting in a large difference between the final result and the real result. However, entropy weight method can reasonably assign weight to index data. Therefore, this paper introduces entropy weight method to measure the weight of each index. Then the improved TOPSIS method is adopted to further evaluate the enterprise performance comprehensively.

2.2 Literature review

At present, the connotation of enterprise digital transformation has not been unified at home and abroad, so various researches on digital transformation are still being explored. The possible marginal contributions of this paper are: ① The uniqueness of the research sample. At present, the definition of digital transformation is not unified, and it is more difficult to define digital transformation enterprises. This paper consciously chooses 43 demonstration state-owned enterprises of digital transformation published by the State-owned Assets Supervision and Administration Commission (SASAC) as research samples, which can not only avoid these problems, but also have official representativeness and uniqueness of samples. ② Novelty of research methods. This paper first gives full play to the advantages of entropy weight, and then combines

TOPSIS model to comprehensively evaluate the performance of digital transformation demonstration state-owned enterprises, so as to ensure the reasonable and accurate results.

## III. THE ENTROPY WEIGHT METHOD TO DETERMINE WEIGHT

3.1 Sample selection

In order to implement the spirit of General Secretary Xi Jinping's important instructions on promoting the two integrated development, summarize and refine the experience of digital transformation, and play the role of the "leader" of State-Owned enterprises, the State-owned Assets Supervision and Administration Commission of the State Council issued the typical Cases of Digital Transformation of State-owned Enterprises in 2020. 100 typical cases were selected from eight categories, including product and service innovation, intelligent production and operation, digital marketing services, digital ecology, new generation of information technology, industrial control safety, integration of two management systems, and integration [30]. This paper selects 43 listed state-owned enterprises from these 100 typical cases. It should be said that these state-owned enterprises are in a relatively leading position in the current digital transformation, which can explain the overall development trend of digital transformation to ensure the representativeness of the selected samples.

According to statistics, the 43 digital transformation demonstration State-Owned enterprises are distributed in eight industries. Manufacturing accounted for the highest proportion (37.21%), followed by electricity, gas and water production and supply (18.60%), mining, transportation, storage and postal, construction (both 9.30%), wholesale and retail (6.98%), and information technology and real estate (4.65%). In general, the industry distribution is relatively uniform, in line with the actual development of current enterprises, suitable for further research.

The variable data in this paper came from CSMAR database, Juchao website and the website of State-owned Assets Supervision and Administration Commission of the State Council by hand. Among them, entropy weight method is calculated by EXCEL2019.

3.2 Introduction of the entropy weight method

3.2.1 Principle of entropy weight method

In this paper, entropy weight method is used to determine the weight of performance evaluation indexes of the demonstration state-owned enterprises in digital transformation. Entropy, a concept derived from physics, is often used to measure information. Information entropy represents the magnitude of uncertainty and the amount of information that can be provided, which is inversely proportional to the variation degree of the index. In other words, the smaller the information entropy is, the greater the variation degree of the index will be, the greater the weight will be, and the greater the role it can play in the comprehensive evaluation will be, and vice versa. Entropy weight method is an objective weight assignment method to determine the index weight according to the variation degree of each index value. This method can avoid subjective problems caused by artificial weight assignment to a certain extent and make the evaluation result more scientific and reasonable.

3.2.2 The steps of entropy weight method

Assume that n indexes of a given m enterprises need to be evaluated. First, the initial evaluation matrix is formed $X = (x_{ij})_{m\times n}$, in which $1\le m\le 43$, $1\le n\le 22$, $x_{ij}$ is the j[th] measurement index of the i[th] evaluation object. The steps of the entropy weight method are as follows (Wentao Zhu et al., 2015; Chunxia Yu et al., 2020) [32-33]:

①Normalized processing of data. To eliminate differences in index attributes and orders of magnitude, the matrix was normalized like $X = (x_{ij})_{m\times n}$, and form a normalized decision matrixd $Y = (y_{ij})_{m\times n}$. The specific calculation formula is:

(Positive index) $$y_{ij} = (1-\alpha) + \frac{x_{ij}-min(x_j)}{max(x_j)-min(x_j)} * \alpha \quad (1)$$

(Appropriate index) $$y_{ij} = (1-\alpha) + \frac{max(x_j)-x_{ij}}{max(x_j)-min(x_j)} * \alpha \quad (2)$$

*among*, $0 < \alpha < 1$, *in general*, $\alpha = 0.9$.

②Calculate the proportion of each enterprise index to the total sample.

$$P_{ij} = \frac{y_{ij}}{\sum_{i=1}^{n} y_{ij}} \quad (3)$$

*among*, $i = 1,2,3,\cdots,m$; $j = 1,2,3,\cdots,n$.

③ Calculate the information entropy of each index.

$$E_j = -K\sum_{i=1}^{m} P_{ij} ln(P_{ij}) \quad (4)$$

$$among,\ K = \frac{1}{ln(m)},\ j = 1,2,3,\cdots,n;\ E_j \geq 0,\ P_{ij} = 0,\ E_j = 0.$$

④ Calculate the difference coefficient of the index.

$$D_j = 1 - E_j \quad (j = 1,2,3,\cdots,n) \quad (5)$$

For a given j, if the difference of $y_{ij}$ is smaller, $E_j$ will be larger and $D_j$ will be smaller. The results show that the $j^{th}$ index plays a smaller role in comprehensive evaluation and vice versa.

⑤ Calculate the weight of each index.

$$W_j = \frac{D_j}{\sum_{j=1}^{n} D_j} \quad (j\text{indicator} = 1,2,3,\cdots,n) \quad (6)$$

3.3 Weight determination of the entropy weight method

According to the above steps and formulas (4) ~ (6) of entropy weight method, the information entropy $E_j$, difference coefficient $D_j$ and weight $W_j$ of each are calculated by using Excel2019. The results are shown in Table 1:

Table 1 Financial performance evaluation index system and entropy weight of listed State-Owned enterprises in 2019

| First-level index | Secon-level index | Index nature | Ej | Dj | Wj | Comprehensive weight |
|---|---|---|---|---|---|---|
| profitability | ROA | Positive | 0.9958 | 0.0042 | 0.0087 | 0.0828 |
| | Net profit margin of total assets | Positive | 0.9958 | 0.0042 | 0.0086 | |
| | ROE | Positive | 0.9958 | 0.0042 | 0.0086 | |
| | Operating profit ratio | Positive | 0.9958 | 0.0042 | 0.0087 | |
| | Ratio of profits to cost | Positive | 0.9931 | 0.0069 | 0.0143 | |
| | ROI | Positive | 0.9836 | 0.0164 | 0.0339 | |
| Asset operating capability | Average accounts receivable turnover ratio | Positive | 0.9339 | 0.0661 | 0.1363 | 0.5357 |
| | Inventory turnover ratio | Positive | 0.9411 | 0.0589 | 0.1216 | |
| | Turnover of payable | Positive | 0.9454 | 0.0546 | 0.1126 | |
| | Turnover of current assets | Positive | 0.9511 | 0.0489 | 0.1008 | |
| | Turnover of total capital | Positive | 0.9687 | 0.0313 | 0.0645 | |
| Solvency | Current ratio | Positive | 0.9636 | 0.0364 | 0.0750 | 0.2618 |
| | Quick ratio | Positive | 0.9595 | 0.0405 | 0.0835 | |
| | Cash-flow-liability ratio | Positive | 0.9616 | 0.0384 | 0.0791 | |
| | Asset-liability ratio | Moderate | 0.9938 | 0.0062 | 0.0129 | |
| | Equity and liability ratio | Moderate | 0.9945 | 0.0055 | 0.0113 | |
| Development capacity | Total asset growth rate | Positive | 0.9831 | 0.0169 | 0.0349 | 0.1197 |
| | Net profit growth rate | Positive | 0.9959 | 0.0041 | 0.0085 | |
| | Increase rate of business revenue | Positive | 0.9755 | 0.0245 | 0.0506 | |
| | Capital preservation and appreciation rate | Positive | 0.9959 | 0.0041 | 0.0086 | |
| | Rate of capital accumulation | Positive | 0.9959 | 0.0041 | 0.0086 | |
| | Sustainable growth rate | Positive | 0.9959 | 0.0041 | 0.0086 | |

As can be seen from Table 1, the larger the $E_j$ value is, the greater the uncertainty of the index is, the smaller the variation degree is, the smaller the $D_j$ value is, and the smaller the weight of the index is; otherwise, the larger the index is Among the four first-level indexes selected, the weight of profitability is 0.0828, the

weight of asset operation ability is 0.5357, the weight of debt paying ability is 0.2618, and the weight of development ability is 0.1197. Therefore, it can be seen that among the first-level indexes, asset operation ability and debt paying ability have a great impact on the performance of state-owned enterprises in digital transformation among the 22 secondary evaluation indexes selected :①In terms of profitability, the weight of all indexes is generally low, but the return on investment(0.0339) and the profit rate on cost and expense(0.0143) have a slightly greater impact on profitability. The weight of the other four indexes is small and there is no significant difference, mainly because their $E_j$ values are generally high(0.9958), indicating the degree of variation The $D_j$ value(0.0042) is relatively small; ②In terms of asset operation capability, accounts receivable turnover(0.1363) has the largest weight, indicating that the efficiency of capital use plays an important role, followed by inventory turnover(0.1216) Accounts payable turnover(0.1126). Current asset turnover(0.1008) and total asset turnover(0.0645) have smaller weights; ③Solvency, liquidity ratio(0.0750) Quick ratio(0.0835) Cash flow debt ratio(0.0791) has a relatively large weight, and these three indexes are mainly used to reflect the liquidity ability of enterprises. Asset-liability ratio(0.0129) and equity-liability ratio(0.0113) are relatively small, and they mainly describe the long-term debt paying ability of enterprises. ④In terms of development capacity, the weight of growth rate of operating income(0.0506) is relatively high, followed by growth rate of total assets(0.0349), indicating that the growth rate of operating income and assets can better reflect the enterprise's future development capacity. The weight of the other four indexes is generally small and there is no significant difference. Therefore, among the second-level indexes, accounts receivable turnover, inventory turnover, accounts payable turnover, current assets turnover, quick ratio and cash flow liability ratio have a greater impact on the performance of state-owned enterprises in digital transformation, in other words, in the process of internal governance, state-owned enterprises should focus on the asset operation ability and debt paying ability, improve the efficiency of fund management and use, strengthen the liquidity ability of enterprises, accelerate the circulation of funds, and also pay attention to the improvement of profitability and development ability, so as to improve the performance management level of state-owned enterprises.

The entropy weight method to get the weight of the objectivity, still need to further carry on the comprehensive evaluation to the enterprise performance Because of improved TOPSIS evaluation model is mainly through the way of combination of empowerment for the determination of weight is optimized, and further to evaluate sample quality level, not only can objectively reflect the gap between evaluation scheme, also can make the enterprise performance evaluation results more objective Therefore, this paper adopts the improved TOPSIS method for performance evaluation.

## IV. IMPROVED TOPSIS METHOD FOR PERFORMANCE EVALUATION

### 4.1 Introduction of the TOPSIS method

#### 4.1.1 Principle of the TOPSIS method

TOPSIS method is a kind of ranking method approaching ideal solution, which is referred to as ideal solution method and superior and inferior solution distance method. Its basic idea is to find the positive and negative ideal solutions of the evaluation objects, and conduct comprehensive evaluation and ranking of the evaluation objects by comparing the distance between them and the ideal solutions (Meng Wu et al., 2020) [34]. The index evaluation value of each evaluation object is compared with the optimal solution and the worst solution. If the index evaluation value of an evaluation object is closest to the optimal solution and furthest away from the worst solution, the comprehensive evaluation of the evaluation object is better. Otherwise, the worse. In this paper, the purpose of using TOPSIS method is to sort through the relative distance between the index evaluation value of each evaluation object and the optimal and worst solution, investigate the difference and change trend of each index, and then carry out comprehensive performance evaluation of each evaluation object.

#### 4.1.2 TOPSIS method calculation steps

According to the weight measured by entropy weight method, TOPSIS model is further established to calculate the distance between each evaluation object and the optimal and worst solution of index variables, and then the final score and ranking of each evaluation object are obtained. The specific calculation steps are as follows (Xuemei Zhang et al., 2018):

① By normalizing the decision matrix $Y = (y_{ij})_{m\times n}$ and the weight vector $W_j = (w_1,\ w_2,\ \cdots,\ w_n)$, constituting a weighted normalized decision matrix $Z = (z_{ij})_{m\times n} = (y_{ij} \times w_j)_{m\times n}$, $i = 1,2,3,\cdots,m;\ j = 1,2,3,\cdots,n$.

② Calculate the optimal and the worst solution

The optimal solution and the worst solution of the j[th] index are defined as $Z_j^+ = max\{z_{1j}, z_{2j},\cdots, z_{mj}\}$, $Z_j^- = min\{z_{1j}, z_{2j},\cdots, z_{mj}\}$, and make $Z^+ = (Z_1^+,\ Z_2^+,\ \cdots,\ Z_n^+)$, $Z^- = (Z_1^-,\ Z_2^-,\ \cdots,\ Z_n^-)$.

③ Compute the Euclidean distance

The distance between the i[th] evaluation object and the optimal solution and the worst solution is defined as:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(Z_j^+ - z_{ij})^2} \quad (7)$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}(Z_j^- - z_{ij})^2} \quad (8)$$

④ Calculate the closeness

Then the final score of the i[th] evaluation object is:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (9)$$

Where, $C_i$ represents the closeness of the i[th] evaluation object to the optimal solution, $0 \le C_i \le 1$.Rank the evaluation objects according to the comprehensive evaluation $C_i$ value, the larger $C_i$ is, the closer the evaluation object is to the optimal solution, and the better the comprehensive evaluation is. Otherwise, the worse.

4.2 TOPSIS comprehensive performance evaluation

According to the above steps and formulas (7)~(9) of TOPSIS method, the specific values of $D_i^+, D_i^-$ *and* $C_i$ are respectively calculated and ranked according to the values by enterprises and industries. The specific scores and rankings are shown in Table 2:

Table 2 Comprehensive value evaluation and enterprise ranking of TOPSIS method

| Enterprise name | $D_i^+$ | $D_i^-$ | $C_i$ | Comprehensive ranking | Enterprise name | $D_i^+$ | $D_i^-$ | $C_i$ | Comprehensive ranking |
|---|---|---|---|---|---|---|---|---|---|
| Longjiang Traffic | 0.1888 | 0.1747 | 0.4806 | 1 | Huihong Group | 0.2298 | 0.0497 | 0.1778 | 23 |
| Wenshan Power | 0.1990 | 0.1289 | 0.3932 | 2 | CRRC | 0.2352 | 0.0495 | 0.1738 | 24 |
| Yangtze Power | 0.1979 | 0.1276 | 0.3920 | 3 | Guoji Auto | 0.2342 | 0.0469 | 0.1667 | 25 |
| Conch Cement | 0.1893 | 0.1170 | 0.3820 | 4 | Huadian Power | 0.2356 | 0.0464 | 0.1645 | 26 |
| China Southern Airlines | 0.2113 | 0.1081 | 0.3385 | 5 | SAIC | 0.2310 | 0.0450 | 0.1631 | 27 |
| OCT A | 0.2199 | 0.0924 | 0.2959 | 6 | JAC | 0.2322 | 0.0442 | 0.1598 | 28 |
| Sinopec | 0.2157 | 0.0813 | 0.2737 | 7 | Baosteel Shares | 0.2336 | 0.0423 | 0.1534 | 29 |
| China Eastern Airlines | 0.2152 | 0.0772 | 0.2641 | 8 | Datang Power | 0.2394 | 0.0402 | 0.1438 | 30 |
| Minmetals Development | 0.2220 | 0.0779 | 0.2597 | 9 | Huaneng Power | 0.2385 | 0.0400 | 0.1437 | 31 |
| China Unicom | 0.2197 | 0.0756 | 0.2559 | 10 | SCG | 0.2403 | 0.0403 | 0.1435 | 32 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| State Grid Communications | 0.2259 | 0.0742 | 0.2474 | 11 | SDIC Power | 0.2362 | 0.0389 | 0.1414 | 33 |
| Huaibei Mining | 0.2191 | 0.0629 | 0.2231 | 12 | China Coal Energy | 0.2370 | 0.0387 | 0.1404 | 34 |
| CNPC | 0.2244 | 0.0641 | 0.2222 | 13 | Chinese Architecture | 0.2408 | 0.0389 | 0.1389 | 35 |
| Electric Energy Shares | 0.2325 | 0.0664 | 0.2221 | 14 | AVIC Aircraft | 0.2426 | 0.0390 | 0.1384 | 36 |
| CASC | 0.2288 | 0.0641 | 0.2189 | 15 | Aeroengine Power | 0.2437 | 0.0387 | 0.1371 | 37 |
| Inspur | 0.2324 | 0.0609 | 0.2075 | 16 | Power China | 0.2415 | 0.0383 | 0.1370 | 38 |
| Gangyan Gaona | 0.2353 | 0.0584 | 0.1989 | 17 | China Railway | 0.2406 | 0.0381 | 0.1366 | 39 |
| CSIC | 0.2310 | 0.0571 | 0.1982 | 18 | Yuneng Holdings | 0.2421 | 0.0361 | 0.1297 | 40 |
| Changan Auto | 0.2207 | 0.0536 | 0.1954 | 19 | COSCO Haifa | 0.2464 | 0.0302 | 0.1093 | 41 |
| Shenzhen property A | 0.2358 | 0.0521 | 0.1809 | 20 | LanShi Reshipment | 0.2512 | 0.0301 | 0.1070 | 42 |
| CGNPC | 0.2342 | 0.0514 | 0.1800 | 21 | Chinese Iron | 0.2457 | 0.0242 | 0.0895 | 43 |
| Zhengzhou Coal Mine Machinery | 0.2337 | 0.0506 | 0.1781 | 22 | | | | | |

Table 2 shows that the top five enterprises are Longjiang Traffic(0.4806), Wenshan Power(0.3932), Yangtze Power(0.3920), Conch Cement(0.3820) and China Southern Airlines(0.3385). The $D_i^+$ values and $D_i^-$ values of the top five enterprises are compared and analyzed. Among them, the $D_i^+$ value of Longjiang Traffic (0.1888) is less than that of the other four enterprises(0.1990 0.1979 0.1893 0.2113), and the $D_i^-$ value(0.1747) is greater than that of the other four enterprises(0.1289 0.1276 0.1170 0.1081), indicating that compared with Longjiang Traffic, these four enterprises are farther away from the optimal solution and closer to the worst solution, and their proximity to the worst solution is obviously higher than that to the optimal solution. In addition, The $C_i$ value of Longjiang Traffic is the highest and greater than 0.4, while the $C_i$ values of the other four enterprises are all less than 0.4. Therefore, among the top five enterprises, Longjiang Traffic is closer to the optimal solution than the other four enterprises, with the highest comprehensive evaluation. The bottom five enterprises are China Railway(0.1366), Yuneng Holdings(0.1297), COSCO Haifa(0.1093), LanShi Reshipment (0.1070) and Chinese Iron(0.0895). Compare and analyze the $D_i^+$ values and $D_i^-$ values of the last five enterprises, among them, the $D_i^+$ value of Chinese Iron(0.2457) is greater than that of China Railway and Yuneng Holdings (0.2406 0.2421), but less than that of COSCO Haifa and LanShi Reshipment(0.2464 0.2512), indicating that compared with Chinese Iron, China Railway and Yuneng Holdings are closer to the optimal solution, while Chinese Iron and LanShi Reshipment are farther from the optimal solution; At the same time, the $D_i^-$ value of Chinese iron(0.0242) is less than that of COSCO Haifa and Lanshi Reshipment(0.0302 0.0301), indicating that compared with COSCO Haifa and Lanshi Reshipment, Chinese Iron is closer to the worst solution, and the degree of Chinese Iron is obviously higher than that of the optimal solution In addition, because of Chinese Iron content and the $C_i$ value of the minimum is less than 0.1, the $C_i$ values of the other four enterprises are all greater than 0.1, therefore, in the bottom five enterprises, Chinese Iron is closer to the worst solution than the other four enterprises, its value is lower, so the enterprises should timely adjust enterprise mode of operation in order to improve enterprise performance, reduce the occurrence of financial risk.

According to the comprehensive evaluation $C_i$ value of enterprises, they are classified in the following order: Transportation, warehousing and postal services(0.2982), Real estate(0.2384), Information transmission,

software and information technology services(0.2317), Power, heat and gas supply(0.2195), Mining(0.2148), wholesale and retail(0.2014), Manufacturing(0.1810), Construction industry(0.1390) (see Table 3).

Table 3 Comprehensive value evaluation and industry ranking of TOPSIS method

| Industry Category | Enterprise name | Comprehensive score | Industry ranking |
|---|---|---|---|
| Transportation, Warehousing, Postal industry | COSCO Haifa, China Southern Airlines, Longjiang Traffic, China Eastern Airlines | 0.2982 | 1 |
| Real estate industry | OCT A, Shenzhen Property A | 0.2384 | 2 |
| Information transmission, software, and information technology services industries | China Unicom, Inspur | 0.2317 | 3 |
| Power, heat, and gas supply industries | Yangtze Power, State Grid Communications, Wenshan Power, Huaneng Power, SDIC Power, Datang Power , Yuneng Holdings, Huadian Power | 0.2195 | 4 |
| Mining | Sinopec, Huaibei Mining, CNPC, China Coal Energy | 0.2148 | 5 |
| Wholesale and Retail | Guoji Auto, Minmetals Development, Huihong Group | 0.2014 | 6 |
| Manufacturing industry | Aeroengine Power, Zhengzhou Coal Mine Machinery, AVIC Aircraft, Changan Auto, CSIC, LanShi Reshipment, Electric Energy Shares, Baosteel Shares, CASC, Conch Cement, JAC, Gangyan Gaona, China Iron, CGNPC, CRRC, SAIC | 0.1810 | 7 |
| Construction business | China Railway, SCG, Chinese Architecture, Power China | 0.1390 | 8 |

At the top of the list are transportation, warehousing and postal services. Among them, Longjiang Traffic contributes the most(0.4806), followed by China Southern Airlines(0.3385) and China Eastern Airlines (0.2641), respectively ranked 1$^{st}$, 5$^{th}$ and 8$^{th}$. Although COSCO Haifa(0.1093) ranked 41$^{st}$, its contribution to transportation, warehousing and postal industry is small, making the industry still occupy a leading position. It can be seen that Oct A(0.2959) ranks 6$^{th}$ and makes great contribution to this industry, while Shenzhen Property A(0.1809) ranks 20$^{th}$. Due to the small number of enterprises in this industry, it is affected by minimum value, which leads to the decline of the comprehensive performance level of this industry and finally ranks second.The information transmission software and information technology service industry ranked third, and the two enterprises representing this industry were China Unicom(0.2559) and Inspur(0.2075), ranking 10$^{th}$ and 16$^{th}$ respectively. It can be seen that the comprehensive performance level of these two enterprises is almost the same. At the bottom of the list were manufacturing and construction, both with a combined performance below the average of 0.2.

Although the manufacturing industry includes a large number of enterprises, except Conch Cement (0.3820) ranked 4$^{th}$, 14$^{th}$ and 15$^{th}$. Electric Power(0.2221) and CASC(0.2189) made certain contributions to the industry, while the performance of other enterprises were all lower than 0.2. In particular, LanShi Reshipment (0.1070) and Chinese Iron(0.0895) ranked 42$^{nd}$ and 43$^{rd}$, dragging down the overall level of the industry. The four companies in the construction industry are SCG(0.1435), Chinese Architecture(0.1389), Power China

(0.1370) and China Railway(0.1366), ranking 32nd, 35th, 38th and 39th respectively. Its performance is lower than 0.2 with no significant difference, and its overall ranking is lower than that of the 43 typical demonstration state-owned enterprises in digitization. As a result, it lags behind other industries.

It can be seen that among the state-owned enterprises that have successfully realized digital transformation, the performance development of the industry is uneven due to the different contribution degree of each enterprise to the industry to which it belongs. The performance of the demonstration State-Owned enterprises in digital transformation is better mainly concentrated in the transportation industry Real estate industry and information technology, manufacturing and construction but do not have advantage, on the one hand, shows that narrowing the digital transformation of the gap between the industry is imminent, on the other hand shows that the digital transformation way is still a long way in our country, especially in manufacturing industry, be badly in need of a typical representative industry leading industry to realize the breakthrough of digital transformation, to achieve the high quality of economic development, the state-owned enterprise must take this responsibility.

## V. THE MAIN CONCLUSIONS,COUNTERMEASURES AND SUGGESTIONS

5.1 Main conclusions

Based on the financial data of listed State-Owned enterprises in 2019, this paper selects 43 demonstration state-owned enterprises of digital transformation as the research object, and firstly introduces entropy weight method to respectively conduct profitable asset operation The weight of each index of debt paying and development capacity is determined, and on this basis, comprehensive evaluation and ranking of enterprise performance are further carried out through the improved TOPSIS method. The research finds that:

①Asset operation ability and solvency are heavily weighted. Enropy method found that the accounts receivable turnover, inventory turnover, accounts payable turnover, current asset turnover, quick ratio and cash flow liability ratio have a great impact on the performance of state-owned enterprises in digital transformation. At the same time, the asset operation ability and solvency have a great impact on the performance of state-owned enterprises in digital transformation.Therefore, in the process of internal governance, state-owned enterprises should focus on the asset operation ability and solvency, improve the management and use efficiency of funds, strengthen the realization ability of enterprises, accelerate the circulation of funds, especially not financial problems.At the same time, enterprises should also pay attention to the improvement of profitability and development ability, in order to improve the overall effect of digital transformation.

②The performance evaluation results of each enterprise vary greatly. According to the improved TOPSIS method and ranking of the enterprise, found that Longjiang traffic, Wenshan Power, Yangtze Power, conch cement, China Southern Airlines ranked top, among them, Longjiang traffic is closest to the optimal solution, ranking the first in comprehensive evaluation and the best in performance evaluation; China Railway, Yuneng Holdings, COSCO Haifa, LanShi Reshipment and Chinese Iron ranking temporarily behind, as Chinese Iron is the closest to the worst solution, its comprehensive evaluation score ranks the last, and the performance evaluation result is poor. Therefore, the bottom companies should adjust their internal governance strategies in a timely manner, improve their asset operations and debt repayment conditions, and enhance their corporate performance.

③The performance gap in various industries is very large, and there is an urgent need for leading enterprises to lead the industry to achieve digital transformation. According to the industry analysis, the transportation, warehousing and postal industry are balanced enterprises, even if the individual enterprises rank behind, thus threatening the industry's overall level, such as in the manufacturing industry, if the rest of the balance of the industry.In addition, due to the small number of digital typical enterprises covered by the construction industry in this article, and each enterprise does not have obvious advantages, which cannot drive the improvement of the comprehensive level of the whole industry, which eventually lags behind other industries.This requires these demonstration state-owned enterprises to play the role of the industry leader, leading the industry to accelerate the digital transformation.

5.2 Countermeasures and suggestions

① Give full play to the unique advantages of state-owned enterprises and lead the leapfrog development of the national economy

As the pillar of the national economy, state-owned enterprises are inefficient due to their own heterogeneity and are more prone to the interference of property rights system and government intervention, but at the same time, they can also obtain more abundant resources and opportunities than other enterprises.With the comprehensive promotion of digital transformation and upgrading work, state-owned enterprises should, while constantly improving their operating efficiency and performance level, give full play to their own advantages, concentrate their resources, seize the opportunities, and lead the high-quality development of the national economy.

② Strengthen the benchmarking management of state-owned enterprises, and enhance the core competitiveness of enterprises

According to the four types of unbalanced capacity development in the comprehensive performance evaluation, this paper believes that the benchmarking management should be strengthened in state-owned enterprises and establish the benchmark enterprises in various industries, so as to enhance the comprehensive competitiveness of enterprises.For any enterprise, setting up benchmark enterprises and realizing benchmarking management are an important means and method to improve the business efficiency. State-owned enterprises should always take world-class as the ultimate goal of enterprise development, actively cope in the process of various problems at the same time, more to learn from domestic and foreign industries benchmarking enterprise business philosophy and strategy, complement each other, enhance enterprise core competitiveness, create enterprise value, to ensure the digital transformation of state-owned enterprises.

## REFERENCES


[1] Accenture.Research on the Digital Transformation Index of Chinese Enterprises in 2020 [J].*Software and integr at ed circuits, 2021 (01): 68-78.* DOI: 10.19609/j.cnki.cn10-1339/tn.2021.01.024.

[2] Negroponte, N.From being digital to digital beings[J].*IBM Systems Journal, 2000, 39(3-4): 417-417.*

[3] Acemoglu D. Labor- and Capital- Augmenting Technical Change[J]. *NBER Working Papers*, 2000.

[4] Jin Chen, Wenchi Yang, Fei Yu. Ecological Collaborative Innovation Strategy in Digital Transformation – Bas ed on strategic research of Huawei Enterprise Business Group (EBG) In China [J].*Tsinghua Management Revie w, 2019 (06): 22-26.*

[5] Fan He, Yuan Qin. Research on the Economic Consequences of Digital Transformation of Real Enterprises dri ven by Innovation [J].*Journal of Northeast University of Finance and Economics, 2019 (05): 45-52.* DOI:10.19 653/j.cnki.dbcjdxxb.2019.05.006.

[6] Xiaohua Li.The theoretical basis of "Internet +" transformation of traditional industries [J].*Economic review, 20 16 (03): 57-63.* DOI: 10.16528/j.cnki.22-1054/f.201603057.

[7] Xiaobi Zheng. "+ Internet", "Internet +" and Economic Development: An ultra-marginal General Equilibrium A nalysis [J].*Economic dynamics, 2017 (06): 32-44.*

[8] Ying Wei, Xiaoyun Zong. A research framework for enterprise adaptation to digital Transformation: a literature review [J].*Scientific and technological Progress and Countermeasures, 2021,38 (11): 152-160.*

[9] Qingdong Li.Financial performance evaluation and cluster analysis of listed companies [J].*Industrial technolog y and economy, 2005 (08): 146-148.*

[10] Yuhui Jia, Jinhui Ning. Research on the Performance Evaluation of Enterprises to be listed on the Science and T echnology Innovation Board under the IPO boom [J].*Economic system reform, 2021 (02): 102-108.*

[11] Tao Zhang, Fei Xu, Chunyan Yang. Construction of performance evaluation index system of state-owned enter prises based on scientific and technological innovation--Take Shandong Province SASAC supervised enterprises a s an example [J].*Journal of Shandong University of Finance and Economics, 2012 (6): 44-50.*

[12] Yining Zha .The impact of digital transformation on enterprise performance -- A case study of Suning Shopping [J].*Business, 2021 (01): 4-5.*

[13] Yunguo Liu, Guofei Chen. Research on enterprise Performance Evaluation combining BSC and EVA--Case stu dy based on GP enterprise Group [J].*Accounting Research, 2007 (09): 50-59 + 96.*

[14] Haolan Huang, Subin Wen. Performance evaluation of MTO machinery Manufacturing enterprises based on BS C framework [J].*Finance and Accounting, 2016 (22): 20-22.*

[15] Jingwen An, Wei Zhu, Songlin Li , Yaxuan Sun. Performance evaluation of coal enterprises based on the exten ded BSC-FANP model [J].*Statistics and Decision Making, 2018,34 (18): 181-184.* DOI:10.13546/j.cnki.tjyjc.20 18.18.042.

[16] Guobin Yang, Chunfang Li .Enterprise performance evaluation index -- EVA[J].*Economic Management, 2001 (09 ): 21-24.*DOI:10.19616/j. cnki.bmj.2001.09.008.

[17] Jianli Li, Nianli Zhang. Construction of the enterprise performance evaluation system with value creation as the co re[J].Accounting Monthly,2007(08):39-41.DOI:10.19641/j.cnki.42-1290/f.2007.08. 016.

[18] Hui G, Bifeng S.Study on effectiveness evaluation of weapon systems based on grey relational analysis and TOPSI S[J].*Journal of Systems Engineering and Electronics, 2009, 20(1): 106-111.*

[19] Yijun Chen, Wenli Hu, Zhixia Wu .Construction and evaluation method of performance evaluation index system o f liquor enterprises--Based on BSC and entropy weight improved TOPSIS model [J].*Journal of Sichuan Universit y of Light and Chemical Technology (Social Sciences Edition), 2020,35 (05): 68-87.*

[20] Ying He. Research on comprehensive evaluation and promotion path of financial competitiveness of Telecom operation Enterprises based on value orientation [J].*China Industrial Economy, 2011 (11): 109-118.* DOI: 10.19581/j.cnki.ciejournal.2011.11.011.

[21] Shunkun Yu, Lisha Zhou, Chen Li.Application research of ANP-Fuzzy method in performance appraisal of electric power enterprises [J].*China Management Science, 2013,21 (01): 165-173.* DOI:10.16381/j.cnki.issn1003-207x.2013.01.025.

[22] Xiaoxing Li, Junkai Du, Yao Fu.Construction of Enterprise Environmental Performance Audit Model based on structural entropy power-fuzzy comprehensive evaluation [J].*Enterprise Economy, 2018,37 (02): 102-107.* DOI:10.13529/j.cnki.enterprise.economy.2018.02.014.

[23] Zhidong Shen.Using the hierarchical analysis method to construct the performance evaluation system of state-owned enterprise [J].*Audit research, 2013 (2): 106-112.*

[24] Yingbo Ji, Fuyi Yao, Wenjing Tong, Qi Zhang.Design and application of performance evaluation index System of assembly building EPC enterprise [J].*Science and Technology Management Research, 2018,38 (11): 188-194.*

[25] Jing Zhou , Jian Sun.Performance evaluation of cold-chain logistics enterprises based on the AHP-DEA model [J]. *Social Science Collection, 2015 (05): 114-119.*

[26] Dequan Yang, Yunxia Xue.Performance evaluation of logistics enterprises based on cross-efficiency DEA and entropy IAHP [J].*Operations Research and Management, 2015,24 (03): 172-178.*

[27] Donghui Hu, Renqiang Wu.The influence of New Third Board market maker system on the operating efficiency of science and technology enterprises-- Based on the DEA efficiency evaluation perspective [J].*Scientific and technological Progress and Countermeasures, 2016,33 (24): 94-98.*

[28] Xu Jiang, Xueqin Hu. Research on Performance Evaluation Index System of Logistics Enterprises Based on Combined Empowerment Model [J].*Management Review, 2020,32 (08): 304-313.* DOI: 10.14120/j.cnki.cn11-5057/f.2020.08.025.

[29] Zhengang Zhang, Mengxin Xie, Dan Lin.Performance evaluation System of Chinese manufacturing enterprises based on BP neural network--Take listed white goods manufacturing enterprises as an example [J].*Technology management research, 2020,40 (15): 217-223.*

[30] Sasac Science and Technology Innovation Bureau.Circular on the issuance of typical cases of digital Transformation of State-Owned enterprises in 2020[EB/OL].http://www.sasac.gov.cn/n2588030/n2588934/c17505367/content.html,2021-03-10/2021-05-04.

[31] Formulated by the Financial Supervision and Evaluation Bureau of SASAC of the State Council.*Enterprise performance evaluation standard value.2020*[M].Economic Science Press, 2020.

[32] Wentao Zhu, Lizhong Duan ,Yuanyuan Shi ,Jinpeng Zhang ,Yanjiang Qiao.The Performance Evaluation and Forecast of the whole pharmaceutical industry based on the Enterprise Performance Evaluation Standard Value [J].*Economics and Management, 2015,29 (04): 46-50.*

[33] Chunxia Yu, Ru Man, Zhiqin Zou.Research on dynamic evaluation of investment value of listed companies in artificial intelligence industry based on entropy-TOPSIS[J].*Industrial and Technical Economy, 2020,39 (12): 138-146.*

[34] Meng Wu, Li Ren, Chenlin Gan, Yingrong Chen.Performance evaluation and obstacle factor diagnosis of farmers' land investment behavior in urban suburb-- A multi-group comparative analysis from the perspective of multi-functional value of cultivated land [J].*China Land Science, 2020,34 (02): 37-45.*

[35] Xuemei Zhang, Jie Zheng, Hengqin Zhao.Research on comprehensive performance evaluation of listed mining companies based on multiple weighting TOPSIS methods [J].*Business Accounting, 2018 (10): 42-48.*