Innovation of Platform Economy Business Model Driven by BP Neural Network and Artificial Intelligence Technology

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In order to enhance the competitiveness of enterprises, how to evaluate and enhance the competitiveness of B2B e-commerce enterprises and promote the orderly and healthy development of B2B e-commerce industry are discussed. This paper puts forward the research on the innovation of platform economic business model driven by BP neural network and artificial intelligence technology. BP neural network is used to study and evaluate the competitiveness of B2B e-commerce companies. According to the B2B e-commerce company competitiveness theory and BP neural network algorithm, combined with BP neural network and B2B e-commerce company competitiveness evaluation index system, a BP neural network model is designed to analyze the competitiveness of B2B e-commerce enterprises. Determine the expected value of network samples, select G1 method to determine the subjective weight, and select entropy weight method to determine the objective weight. With the help of the function in the MATLAB neural network toolbox, the neural network is trained. The results show that when the training times reach 3297 times, the sample mean square error is 9.9869e - 06, and the training network reaches convergence. The samples of three enterprises test the trained neural network and input the data of three test samples into the trained BP neural network, and the output results are 0.1531, 0.1371, and 0.1557, respectively. The network model constructed in this paper is effectively close to the training samples. The established BP neural network has good performance and can be used to evaluate the competitiveness of B2B e-commerce companies. Accelerate technological change and realize innovation. Technological capability is the inexhaustible driving force for the development of enterprises. Only with the innovation of keeping pace with the times can application-oriented e-commerce enterprises meet the needs of customers and the market, form the difference between goods or services, and then enable enterprises to win more customers and market share.

1. Introduction

Under the background of “Internet Plus,” more and more new ventures choose the platform economic mode as the entry point of innovation in the world. These enterprises have made important contributions to the development of new technologies and the integration of the global economy by constantly subverting and reconstructing the old business models. For example, Taobao, China’s largest online shopping retail platform, which creates sales myth every year, does not need to provide its own products; Uber, which provides smart travel services worldwide, does not need to provide its own drivers and vehicles; The online takeaway trading platform “hungry,” which covers more than 2000 cities in China, does not have its own restaurants or chefs [1, 2]. Under the trend of global economic adjustment, these platform enterprises challenge the traditional enterprise business model with the help of mobile Internet technology and point out a new way for the traditional industry while creating huge profits. Since the government put forward the development strategy of “mass entrepreneurship and innovation,” Internet platform enterprises have always played the role of stormtroopers. Various mass entrepreneurship space platforms provide entrepreneurs with development space and policy support.
with rich entrepreneurial resources, lead start-ups to make changes to the traditional industry pattern, and strive to make enterprises grow into global leaders in the industry. As platform enterprises have created more and more industrial myths, platform, as a leading organizational form in the Internet information age after factories and companies, has been recognized by the industry. As a mainstream business model, the creative destruction nature of platform economy has changed the original business logic. This model can not only bring “win-win” to economic participants, but also realize the value creation of the platform itself. At the same time, there is a rare phenomenon that winners in market competition realize winner take all. As the organizational carrier and value focus of platform economic development, platform enterprises aim to create a unique business ecosystem. This system provides value realization channels for transaction subjects from different types of bilateral markets and promotes the value exchange and interaction of bilateral users. Figure 1 business model innovation process integration model.

2. Literature Review

In response to this research problem, Chen and Ma found that the biggest difference between platform enterprises and traditional enterprises is that the platform does not involve specific transactions; that is, platform enterprises do not produce any specific products for trading subjects. The core task of platform enterprises is to establish a fair and transparent trading platform for buyers and sellers, escort both parties with reasonable and sound trading rules, continuously attract more bilateral users to participate in the platform through unique services, and finally realize the value integration and innovation of the whole trading network. Raddadi and Fava and others believe that compared with traditional unilateral enterprises, platform enterprises have typical characteristics, such as serving bilateral customers, nonneutral price, different roles, and different value orientations. In terms of value creation, as a specific part of a production process, unilateral enterprises can only think about how to create more value from the perspective of the enterprise itself. Thibaut et al. regard platform enterprises as modules based on business ecosystem, and enterprises can provide users with complementary products or services through the platform. At the same time, they believe that we should pay attention to distinguishing between industrial platform and product platform because their building module combination methods are different. On this basis, Fan et al. focused on the differences between industrial platforms and product platforms and proposed that the realization of user value of industrial platforms is mainly through the provision of complementary products and services, which come from different enterprises with complementarity. These enterprises realize complementarity through the technical platform with common reuse basis provided by industrial platforms. Susilo and Liu, based on combing the research on platform enterprises at home and abroad, believe that platform enterprises, as the central system in the platform business system, provide an open and connected transaction channel for buyers and sellers with reasonable transaction rules, as a third-party economy providing transaction channels and transaction management. Platform enterprises collect access fees from bilateral users in the

![Figure 1: Business model innovation process integration model.](image-url)
market by continuously improving the transaction experience and benefit from successful transactions between buyers and sellers [9]. According to the characteristics of bilateral markets, Yang [10] believes that platform enterprises have the following characteristics: unique value, multcustomer, openness, and complexity and put forward that the platform in "platform enterprises" can be tangible or intangible. In essence, platform enterprises provide an intermediate layer of transaction (place, media, space, etc.). The middle tier can promote its various groups to reach transactions relatively efficiently and ideally [10]. Tian et al. [11] put forward the classic business model canvas, which is composed of nine elements: customer segmentation, value proposition, sales channel, customer relationship, revenue source, core resources, key business, partners, and transaction structure, which are closely connected and interact [11]. Pierre and Dillenbourg [12] believe that the business model consists of four chain elements that jointly create and deliver value, namely, customer value proposition, profit formula, key resources, and key process [12]. From the perspective of organization, He [13] decomposed the business model into transaction content, transaction governance, and transaction structure [13]. Based on the current research, listed B2B e-commerce enterprises are taken as the research object, an evaluation index system is constructed for its competitiveness, and analysis and research are carried out from four aspects: evaluation index screening, index weight calculation, sample research analysis, and suggestions. BP neural network is selected to train the selected samples to achieve an ideal simulation effect, and the simulation output results are used to evaluate the competitiveness of B2B e-commerce enterprises. It is feasible to evaluate the competitiveness of B2B e-commerce enterprises with the help of BP neural network, and the correct evaluation effect can be obtained; this method also has certain adaptability in evaluating the competitiveness of enterprises in other industries.

3. Method

BP neural network is applied to the competitiveness evaluation index system of e-commerce companies.

3.1. B2B Selection Principles of Competitiveness Evaluation Indicators of e-Commerce Enterprises. The selected evaluation indicators can not only systematically show the competitiveness of B2B e-commerce enterprises, but also compare the evaluation indicators to identify their weaknesses so as to put forward corresponding improvement suggestions for enhancing the competitiveness of B2B e-commerce enterprises [14]. There are many kinds of evaluation indicators. Before selecting the data of indicators, the applicability and rationality of indicators should be studied. Therefore, the selection of competitiveness evaluation indicators of B2B e-commerce companies must be based on exact standards. The selection principles of indicators in this study are listed as follows.

(1) Systematic principle: there are many and complex indicators affecting the competitiveness of B2B e-commerce companies. Considering that B2B e-commerce companies have many business activity procedures and many elements that play a role in all links of activities, the competitiveness evaluation indicators of B2B e-commerce companies must be determined from the perspective of the overall system [15].

(2) Scientific principle: the scientific principle has corresponding restrictions on the number, level, and contribution of indicators, and the number of indicators should not be too much or too little. If there are too many indicators, the level of the subcategory is too small, and the evaluation system focuses too much on the details of the competitiveness of B2B e-commerce companies, so it is impossible to study and evaluate the competitiveness of B2B e-commerce companies from a comprehensive perspective, which often makes the contents overlap and the indicators can be replaced with each other. The small number of indicators is not conducive to a detailed and better reflection of the competitiveness of B2B e-commerce enterprises. Each evaluation index has its own significance and scope of action, so the principle of scientificity must be followed [6].

(3) Effectiveness principle: when screening the competitiveness evaluation indicators of B2B e-commerce companies, the index data should be available and easy to collect. In addition, the data should not be redundant. The evaluation index system should be improved to the greatest extent, and the value of specific indicators can be run, tested, and verified in the selected method and model software.

3.2. Selection of Evaluation Methods for B2B e-Commerce Platform Enterprise Competitiveness. There are many evaluation methods for the competitiveness of B2B e-commerce enterprises [16]. Due to the two sides of things, each evaluation method also has two sides of advantages and disadvantages. Based on the industry characteristics and the specific development of enterprises, it is very important to adopt appropriate methods [17]. This paper summarizes some common evaluation methods of e-commerce enterprise competitiveness, which are discussed as follows.

(1) Principal Component Analysis

The first principal component explains the largest variance, and each secondary component is limited by orthogonality with the previous component. Generally speaking, the first few principal components can explain most of the variance of the original data set [18]. In evaluating the competitiveness of e-commerce enterprises, principal component analysis is mostly applied to the eigenvector decomposition and implementation of correlation matrix [19]. The high-dimensional data set cannot be
represented by graphics, and the principal component analysis method can identify the index correlation and patterns in the high-dimensional data set.

(2) Fuzzy Comprehensive Evaluation Method

When making a comprehensive judgment or decision on something, it is a combination of qualitative and quantitative methods to solve the fuzzy information that cannot be solved by other methods [20]. Fuzzy evaluation method can not only sort and evaluate the research object according to the comprehensive score, but also divide it into different grades. Evaluating the competitiveness of B2B e-commerce enterprises is a complex evaluation process with multiple factors and indicators. It cannot be simply divided into "good" or "poor" [21]. When evaluating the competitiveness of B2B e-commerce enterprises, most scholars adopt the decision analysis method based on fuzzy consistency theory. The main feature of fuzzy comprehensive evaluation method is that it can reasonably manage the initiative and fuzziness of human thinking so as to overcome the problem of single result of traditional mathematical methods.

(3) Grey Relational Evaluation Method

In grey system, some information is clear, but others are not. Grey correlation is the variability of the relationship between things or the variability of the relationship between system factors and main activity factors. Grey correlation analysis is one of the important contents of grey system theory research. Its basis is the similarity or difference between the main development trend factors to measure the proximity between these elements [22, 23].

Through the summary of the above B2B e-commerce enterprise competitiveness evaluation methods, it can be seen that these evaluation theories have their own advantages, but the disadvantages are also obvious [24]. Some are too subjective, some do not have comparative function, and some fail to accurately and reasonably evaluate the competitiveness of complete B2B e-commerce enterprises. At the same time, B2B e-commerce enterprise competitiveness evaluation refers to the factors closely related to the enterprise’s scale, operation ability, viability, growth ability, technical ability, and so on. It is worth noting that various indicators have nonlinear correlation with each other [25].

3.3. Design of B2B e-Commerce Enterprise Competitiveness Evaluation Model Based on BP Neural Network

Improving the number of hidden layers of neural network can improve the nonlinear mapping of neural network, and the number of hidden layers should not be as many as possible. When the number of hidden layers is higher than the specified value, the performance of hidden layer will be weakened. Generally speaking, three-layer BP neural network can perform nonlinear mapping from \( n \)-dimension to \( m \)-dimension in any case.

3.3.1. Enter the Number of Layer Nodes. The number of input layer nodes is consistent with the number of parameters presented to the network as input. According to the B2B e-commerce enterprise competitiveness evaluation index system established above, the number of secondary indicators is the number of nodes in the input layer, which is 16.

3.3.2. Number of Output Layer Nodes. Because the research on the competitiveness of B2B e-commerce enterprises finally needs to calculate its competitiveness output value, there is only one value in the output layer, and the number of nodes in the output layer is 1.

3.3.3. Number of Hidden Layer Nodes. In order to obtain efficient, accurate, and reasonable results in a limited time, it is very necessary to determine a reasonable number of hidden layer nodes. There is no general and suitable method to determine the number of neurons in the hidden layer. The following three expressions can be selected as a reference:

\[
\sum_{i=0}^{n} C_i^M > k, \quad M = \sqrt{n + m + a}, \quad M = \log_2 n, \tag{1}
\]

where \( M \) is the number of neurons in the hidden layer, \( k \) is the number of samples, and \( a \) is a constant between \([0, 10]\), and \( m \) and \( N \) are the number of neurons in the output layer and input layer, respectively.

3.3.4. Activation Function. Generally speaking, BP neural network often uses linear function (purelin) and nonlinear sigmoid function (S-type function). S-type function includes logarithmic function and tangent function. As shown in formulas (2) and (3), its value range is in the range of \([0, 1]\) and \([-1, 1]\), respectively.

\[
\varphi(x) = \frac{1}{1 + e^{-x}}, \tag{2}
\]

\[
\varphi(X) = \frac{e^x - E^{-x}}{e^x + E^{-x}}, \tag{3}
\]

When dealing with nonlinear problems, in order to ensure the range of output values, nonlinear functions are usually used from input layer to hidden layer, and linear functions are used from hidden layer to output layer. After data standardization, the input layer meets the value range requirements of logarithmic sigmoidal function mapping within \([0, 1]\). Therefore, the function from input layer to hidden layer selected in this paper is logarithmic sigmoidal function, and the function from hidden layer to output layer uses purelin function. The operation process of the activation function is as follows:

For the \( s \)th data, the input of the \( j \)th hidden neuron is
3.3.5. Training Function. Training function is also an important parameter of BP neural network. Each training function needs to be selected according to the specific conditions, such as the research problem itself and training samples. Different training algorithms have different space storage, search mode, number of iterations, amount of calculation, calculation speed, convergence speed, and generalization ability. Select training function for network training.

3.4. BP Neural Network Training Sample Collection. The selection of BP neural network training samples should be reasonable and general, and the data collection should be objective, scientific and respect the facts [26]. Since the data of B2B e-commerce listed companies are open and transparent, the data of B2B e-commerce listed companies selected in this paper are from the 2016 annual report and relevant statistical reports. When selecting B2B e-commerce enterprises, they should be selected in a balanced manner among listed companies at all levels and can represent B2B e-commerce companies at all levels. The number of B2B e-commerce enterprise training samples should be objective and feasible. If the number is too small, it is difficult to ensure the demand for errors, making the evaluation conclusion inaccurate and scientific and unable to properly explain the samples and indicators.

3.5. Standardized Processing of Sample Data. This paper collects the relevant data of B2B e-commerce enterprises according to the specific evaluation indicators. In this case, it is necessary to standardize the data to eliminate these obstacles. In this paper, maxmin function is used to standardize the original data, which is transformed into the value between (0, 1), so as to facilitate the training and learning of BP neural network. maxmin function formula is as follows:

$$\text{net}^t_{ij} = \sum_{i=1}^{16} w_{ij}^t I_i^t$$

The corresponding outputs are

$$h^t_j = \varphi(\text{net}^t_j),$$

$$= \varphi\left(\sum_{i=1}^{16} w_{ij}^t I_i^t\right).$$

Therefore, the input of the kth output unit is

$$Q^t_k = \varphi(\text{net}^t_k),$$

$$= \varphi\left(\sum_{j=1}^{14} W_{jk} h^t_j\right),$$

$$= \varphi\left(\sum_{j=1}^{14} W_{jk} \varphi\left(\sum_{i=1}^{16} w_{ij}^t I_i^t\right)\right).$$

4. Results and Analysis

4.1. BP Neural Network Training

4.1.1. Determine the Expected Value of Network Samples. In general, the expected value of BP neural network is the actual value after quantification. However, the competitiveness of B2B e-commerce enterprises covers a wide range and is complex, and the competitiveness value is not clear. Therefore, the weight of each index in the evaluation index system is calculated by the combined weight method, and then the competitiveness value of B2B e-commerce enterprises is obtained by the weighted summation method with the standardized data. The expected value of BP neural network training sample is the weighted summation value. As for the determination of evaluation index weight, scientific and reasonable methods need to be used. Generally, scholars mostly use subjective methods such as Delphi and analytic hierarchy process, and some scholars use more objective entropy weight method to obtain index weight. The proportion of subjective elements is relatively strong, and the result will produce a considerable degree of bias. Generally, it is difficult to meet the objective evaluation conditions, it is difficult to reflect the preference of raters, and sometimes it may deviate from the wishes of raters. In order to avoid the above problems and calculate a relatively objective and reasonable weight value, the evaluation model in this paper adopts the method of combined weight coefficient; namely,

$$W_j = a W_j^s + (1 - a) W_j^o,$$  \(8\)

where \(W_j^s\) is the combined weight coefficient of index \(J\), \(W_j^o\) is the subjective weight coefficient of index \(j\), \(W_j^o\) is the objective weight coefficient of index \(j\), \(a\) is the subjective preference coefficient, and \((1 - a)\) is the objective preference coefficient, \(a \in [0, 1]\). The function is established for the purpose of minimizing the sum of squares of deviations between subjective weight, objective weight, and combined weight:

$$\min z = \sum_{j=1}^{m} \left[ (W_j^o - W_j^s)^2 + (W_j^o - W_j^s)^2 \right].$$  \(9\)

Find the first derivative of equation (8) and make it 0 to obtain \(a = 0.5\).

4.1.2. Subjective Weight Calculation. G1 method is derived from the reference and innovation of analytic hierarchy process, which overcomes the shortcomings of AHP and omits the step of consistency check. In order to keep generality, let \(X_1, X_2, \ldots, X_m (m > 2)\) be m indexes after ensuring consistency and dimensionlessness. If the importance of index \(x\) is higher (or not lower) than \(x_j\), record \(x_i = x_j\). If the importance of index \(X_1, X_2, \ldots, X_m (m > 2)\) is \(x_1 = x_2 = \ldots = x_m\). The index \(x\) is higher than \(x_j\) when the number of researchers is more than 1. If the importance of index \(x\) is lower (or not higher) than \(x_j\), record \(x_i = x_j\). If the importance of index \(X_1, X_2, \ldots, X_m (m > 2)\) is \(x_1 = x_2 = \ldots = x_m\). The index \(x\) is lower than \(x_j\) when the number of researchers is more than 1.

$$y_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$  \(7\)

where \(x_i\) is the initial data, \(x_{\min}\) and \(x_{\max}\) are the minimum and maximum values of the same index, respectively, and \(y_i\) is the result of standardization processing.
$x_m$ compared with an evaluation standard, it indicates that the sequential relationship between indexes $X_1, X_2, \ldots, X_m (m > 2)$ is established according to “>”. For the indicator set $\{X_1, X_2, \ldots, X_m\}$, establish sequential connection according to the following process:

In the index set $\{X_1, X_2, \ldots, X_m\}$, select the most important index for an evaluation standard and record it as $X_1^\ast$. Among the remaining $m - 1$ indicators, for a certain evaluation standard, select the most important indicator, which is recorded as $X_2^\ast$. Among the remaining $m - (k - 1)$ indicators, the most important one for a certain evaluation standard is selected and recorded as $X_k^\ast$.

$X_j^\ast$ is used to represent the $j$th index ($j = 1, 2, \ldots, M$) of $\{x_j\}$ arranged in order relationship, from which a unique-order relationship can be obtained. Then, calculate the importance of adjacent indicators. If the researchers’ importance ratio between $x_k$ and $x_h$ is $r_h = W_{k,h}/W_k$, the relative importance of each indicator can be calculated according to the order relationship between the previous indicators. See Table 1 for the value of $r_k$.

Firstly, this paper calculates the weights $W_1, W_2, \ldots, W_5$ of five primary indicators: enterprise scale ($x_1$), enterprise benefit ($x_2$), enterprise financial ability ($x_3$), enterprise growth ability ($x_4$), and enterprise technical ability ($x_5$). According to Definition 2, the only order relationship between them is $x_1^\ast > x_2^\ast > x_3^\ast > x_4^\ast > x_5^\ast$, and their weights under the order relationship are $W_1^\ast, W_2^\ast, \ldots, W_5^\ast$.

Then, there are

$$r_2 = \frac{W_1^\ast}{W_2^\ast} = 1.6, r_3, \frac{W_2^\ast}{W_3^\ast} = 1.4, r_4, \frac{W_3^\ast}{W_4^\ast} = 1.3, r_5, \frac{W_4^\ast}{W_5^\ast} = 1.1.$$  

(10)

The weight of the corresponding indicator according to the corresponding relationship, and get

| $i$ | $W_i^\ast$ | $W_i^\ast$ | $W_i^\ast$ | $W_i^\ast$ | $W_i^\ast$ |
|-----|------------|------------|------------|------------|------------|
| 1   | 0.1295     | 0.2292     | 0.3667     | 0.1637     |
| 2   | 0.1145     | 0.3667     | 0.1637     |
| 3   | 0.1455     | 0.1637     |
| 4   | 0.1356     | 0.1637     |
| 5   | 0.1145     | 0.1637     |

4.1.3. Combined Weight Calculation. It can be seen from the above that $\alpha = 0.5$ and formula (8) shows that the combined weight $W_j^c = 0.5W_j^\ast + 0.5W_j^\ast$. The final result is shown in Table 4.

Based on the final combination weight after calculation, the expected value of 23 companies is calculated by weighted summation of the standardized sample data, that is, the competitiveness expected value of the selected 23 B2B e-commerce enterprises. The results are shown in Table 5.

4.2. Training and Result Analysis of BP Neural Network

4.2.1. Determine the Number of Hidden Layers and Elements of the Network. In order to obtain efficient, accurate, and reasonable results in a limited time, it is very necessary to determine a reasonable number of hidden layer nodes. At present, there is no scientific and reasonable analysis formula that can be used to solve the correct number of neuron nodes. The general practice is to use the experimental formula to deduce the estimated value;

$$\sum_{j=0}^{K} C_M J^j > k, K \text{ is the number of samples } 23, M \text{ is the number of neurons in the hidden layer, and } N \text{ is the number of neurons in the input layer } 16. \text{ If } I > m, \text{ specify } C_M = 0; \text{ }$$

$$M = \sqrt{n + m + a}, \text{ } M \text{ and } N \text{ are the number of neurons in the output layer and input layer, respectively, } 1 \text{ and } 16. \text{ }$$

$$A \text{ is a constant between } [0, 10]; \text{ } \text{then the value range of } M \text{ is } [4, 13]; \text{ }$$

$$M = \log, N \text{ is the number of neurons in the input layer; then } M \text{ is } 4.$$ To sum up, the number of hidden layer nodes $m$ is within the range of $[4, 13]$, and the specific value must be trained by BP network for many times, which is determined according to the number of iterations and training accuracy. Take the integer between $[4, 13]$ and set the target accuracy to $1 \times 10^{-5}$; the number of training times is 5000. After repeated experiments, the number of hidden layer elements is finally confirmed as 14.

4.2.2. Training Results. The neural network is trained with the help of the function netatparam in the MATLAB neural network toolbox. The function includes the maximum learning times of parameters, the maximum allowable error, that is, the convergence accuracy target, the minimum allowable time, and so on. The maximum learning times is set to 5000 times. Generally, the smaller the convergence accuracy target is, the more accurate the training of the network can be guaranteed. Set it to a sufficiently small accuracy of $1 \times 10^{-5}$; other parameters are set as default values.
B2B e-commerce enterprises are randomly selected as training samples to train the neural network. When the training times reach 3297 times, the sample mean square error is $9.9869 \times 10^{-6}$, and the training network converges. The results are shown in Figure 2.

Then, the trained neural network is tested by using the samples of business Bao A3, agricultural products A12, and Baoxin software A19. The data of the three test samples are input into the trained BP neural network, and the output results are 0.1531, 0.1371, and 0.1557, respectively (Table 6).

According to Table 6, the maximum absolute error between the output value of the test sample and the expected value is less than 0.007, and the maximum relative error is less than 0.05. The error results of the test and the training

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### Table 1: $r_k$ value reference table.

| $r_k$ | Value reference |
|-------|-----------------|
| 1.0   | Indicators $x_{K-1}$ and $x_k$ are of the same importance |
| 1.1   | The ratio of indicators $x_{K-1}$ and $x_k$ is between equally important and slightly important |
| 1.2   | Indicator $x_{K-1}$ is slightly more important than $x_k$ |
| 1.3   | The ratio of index $x_{K-1}$ to $x_k$ is between slightly important and obviously important |
| 1.4   | The index $x_{K-1}$ is obviously more important than $x_k$ |
| 1.5   | The ratio of index $x_{K-1}$ to $x_k$ is between obviously important and strongly important |
| 1.6   | Index $x_{K-1}$ is more important than $x_k$ |
| 1.7   | The ratio of index $x_{K-1}$ to $x_k$ is between strongly important and extremely important |
| 1.8   | Index $x_{K-1}$ is more important than $x_k$ |

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### Table 2: Subjective weight of indicators.

| Primary index                  | Secondary index                  | Secondary index weight |
|--------------------------------|----------------------------------|------------------------|
| Enterprise scale               | Total assets $X_1$               | 0.0396                 |
|                                | Total number of employees $X_2$  | 0.0305                 |
|                                | Total sales $X_3$                | 0.0594                 |
|                                | Operating net profit margin $X_4$| 0.0440                 |
|                                | Return on total $X_5$            | 0.0572                 |
|                                | Return on net $X_6$              | 0.0366                 |
|                                | Year-on-year growth rate of total operating revenue $X_7$ | 0.00915 |
|                                | Current ratio $X_8$              | 0.0496                 |
| Enterprise financial capability| Quick ratio $X_9$                | 0.0354                 |
|                                | Asset liability ratio $X_{10}$   | 0.0295                 |
|                                | Fixed assets turnover $X_{11}$   | 0.0711                 |
| Enterprise growth ability      | Net interest rate of total assets $X_{13}$ | 0.0924 |
|                                | Growth rate of total assets $X_{12}$ | 0.0646 |
| Enterprise technical capability| Proportion of R & D personnel $X_{15}$ | 0.0744 |
|                                | Proportion of R & D investment in total sales $X_{16}$ | 0.0893 |

### Table 3: Objective weight of indicators.

| Primary index                  | Secondary index                  | Secondary index weight |
|--------------------------------|----------------------------------|------------------------|
| Enterprise scale               | Total assets $X_1$               | 0.0403                 |
|                                | Total number of employees $X_2$  | 0.0477                 |
|                                | Total sales $X_3$                | 0.0593                 |
|                                | Operating net profit margin $X_4$| 0.0301                 |
|                                | Return on total assets $X_5$     | 0.0347                 |
|                                | Return on net assets $X_6$       | 0.0212                 |
|                                | Year-over-year growth rate of total operating revenue $X_7$ | 0.0804 |
|                                | Current ratio $X_8$              | 0.0371                 |
| Enterprise financial capability| Quick ratio $X_9$                | 0.0490                 |
|                                | Asset liability ratio $X_{10}$   | 0.0139                 |
|                                | Fixed assets turnover $X_{11}$   | 0.1799                 |
| Enterprise growth ability      | Net interest rate of total assets $X_{13}$ | 0.0365 |
|                                | Growth rate of total assets $X_{12}$ | 0.0897 |
| Enterprise technical capability| Proportion of R & D personnel $X_{15}$ | 0.0710 |
|                                | Proportion of R & D investment in total sales $X_{16}$ | 0.1176 |
sample are very close. The established BP neural network has good performance and can be used to evaluate the competitiveness of B2B e-commerce companies. According to the training results of BP neural network, the competitiveness ranking of B2B e-commerce enterprises is obtained, as shown in Table 7.

By ranking the competitiveness of B2B e-commerce by BP neural network, we can understand the competitiveness of B2B e-commerce in China. The competitiveness of B2B e-commerce enterprises in various fields reflects the growth of different companies. This paper analyzes these 23 companies with the method of classification research. First, Figure 3 shows the competitiveness of these 23 companies.

### Table 4: Combination weight table.

| Primary index        | Secondary index          | Secondary index weight |
|----------------------|--------------------------|------------------------|
| Enterprise scale     | Total assets X₁          | 0.0400                 |
| Enterprise benefit   | Total number of employees X₂ | 0.0389                |
|                      | Total sales X₃           | 0.0594                 |
|                      | Operating net profit margin X₄ | 0.0370                |
|                      | Return on total net income X₅ | 0.0459                |
|                      | Return on net income X₆  | 0.0289                 |
|                      | Year on year growth rate of total operating revenue X₇ | 0.0859                |
|                      | Current ratio X₈         | 0.0433                 |
| Enterprise financial capability | Quick ratio X₉ | 0.0422                 |
|                      | Asset liability ratio X₁₀ | 0.0217                 |
|                      | Fixed assets turnover X₁₁ | 0.1255                 |
| Enterprise growth ability | Growth rate of total assets X₁₂ | 0.0772                |
|                      | Net interest rate of total assets X₁₃ | 0.0644                |
|                      | Brand value X₁₄          | 0.1151                 |
| Enterprise technical capability | Proportion of R & D personnel X₁₅ | 0.0727                |
|                      | Proportion of R & D investment in total sales X₁₆ | 0.1034                |

### Table 5: Expected values of 23 samples.

| Enterprise                               | Expected value             |
|------------------------------------------|----------------------------|
| Focus technology A₁                      | 0.203585113                |
| Shanghai steel union A₂                  | 0.207850128                |
| Business treasure A₃                     | 0.153025267                |
| Small-commodity city A₄                  | 0.247207125                |
| Zhejiang Dongfang A₅                     | 0.120882515                |
| Hikvision A₆                             | 0.439256148                |
| Smart energy A₇                          | 0.127821756                |
| Zhongyeda A₈                             | 0.101404129                |
| Ruimaojing A₉                            | 0.318937614                |
| Tengbang International A₁₀               | 0.153135323                |
| Zheshang Zhongtuo A₁₁                    | 0.16045568                 |
| Agricultural products A₁₂                 | 0.13641545                 |
| Deep SEG A₁₃                             | 0.159326222                |
| Longping Hi-Tech A₁₄                     | 0.20954871                 |
| Oriental group A₁₅                       | 0.246449142                |
| Wangsu Technology A₁₆                    | 0.424062233                |
| Aleaga A₁7                               | 0.189879302                |
| Zdg new A₁₈                              | 0.109041243                |
| Baoxin software A₁₉                       | 0.15511216                 |
| Changjiaosheng investment A₂₀            | 0.125483542                |
| Sinotrans Development A₂¹                | 0.175951754                |
| Haihong Holdings A₂₂                     | 0.293397612                |
| Shenzhen Huaqiang A₂₃                     | 0.196212136                |

### Figure 2: Convergence accuracy of BP neural network training results.

Through the comparison between Zhongyeda and Hikvision, as shown in Figure 4, Hikvision is the only e-commerce concept enterprise focusing on the Internet of things and related businesses. The enterprise has a large volume and has invested a lot of energy in R & D personnel and R & D investment. Under the favorable economic and policy background of the Internet of things industry, its total sales, in the leading position of these 23 enterprises. Zhongyeda is mainly engaged in the distribution of industrial electrical products. The company has established an industrial electrical distribution network, which belongs to a professional vertical e-commerce. Its ranking is lower because the enterprise scale is relatively small, the enterprise profitability is poor, and it does not pay much attention to R&D.

Among the 23 B2B e-commerce enterprises selected in this paper, state-owned holding enterprises include Hikvision, small-commodity city, Longping Hi-Tech, and Haihong...
Holdings. As shown in Figure 5, these state-owned holding enterprises are relatively competitive, mainly in terms of enterprise scale, operating income and profit, brand value, and R & D investment. On the one hand, state-owned holding enterprises have many assets and large enterprise volume, which occupy natural advantages in capital and policies. On the other hand, state-owned holding enterprises pay more attention to comprehensive development, so they will invest capital and technology in the improvement and cultivation of each factor, which also improves their comprehensive competitiveness overall. In contrast, the turnover rate of fixed assets of state-owned holding enterprises is relatively small, the utilization efficiency of fixed assets is weak, and the asset

| B2B e-commerce enterprise | Network output value | Expected value | Absolute error | Relative error |
|---------------------------|----------------------|----------------|----------------|----------------|
| Business treasure A3      | 0.1531               | 0.1530         | 0.0001         | 0.0007         |
| Agricultural products A12 | 0.1371               | 0.1364         | 0.0007         | 0.0051         |
| Baoxin software A19       | 0.1557               | 0.1551         | 0.0006         | 0.0039         |

Table 6: Comparison of test sample output results and expected values.

| Enterprise                  | Competitive power | Ranking |
|-----------------------------|-------------------|---------|
| Focus technology A1          | 0.2035            | 9       |
| Shanghai steel union A2     | 0.2080            | 8       |
| Business treasure A3         | 0.1513            | 17      |
| Small-commodity city A4     | 0.2462            | 5       |
| Zhejiang Dongfang A5        | 0.1216            | 21      |
| Hikvision A6                | 0.4383            | 1       |
| Smart energy A7             | 0.1264            | 19      |
| Zhongyeda A8                | 0.1012            | 23      |
| Ruimaotong A9               | 0.3179            | 3       |
| Tengbang International A10  | 0.1540            | 16      |
| Zhejiang Zhongtuo A11       | 0.1577            | 13      |
| Agricultural products A12   | 0.1353            | 18      |
| Deep SEG A13                | 0.1610            | 14      |
| Longping Hi-Tech A14        | 0.2053            | 7       |
| Oriental Group A15          | 0.2466            | 6       |
| Wangsu Technology A16       | 0.4232            | 2       |
| Altega A17                  | 0.1910            | 11      |
| ZDG new A18                 | 0.1113            | 22      |
| Baoxin software A19         | 0.1530            | 15      |
| Changjiang Investment A20   | 0.1236            | 20      |
| Sinotrans Development A21   | 0.1761            | 12      |
| Haihong Holdings A22        | 0.2956            | 4       |
| Shenzhen Huaqiang A23       | 0.1953            | 10      |

Table 7: Competitiveness ranking of B2B e-commerce enterprises.

Figure 3: Evaluation results of B2B e-commerce enterprise competitiveness based on BP neural network.

Figure 4: Comparison of evaluation index values between Zhongyeda and Hikvision.

Figure 5: Competitiveness factors of state-owned holding enterprises.
utilization degree of enterprises is low, which limits the profit potential of the company to a certain extent.

Platform e-commerce mainly includes Focus Technology, Shanghai Steel Union, Business treasure, Commodity city, Zhejiang Oriental, Ruimaotong, Tengbang International, Oriental Group, and so on. Platform e-commerce shows bipolar development, with small-commodity city, Oriental Group, Ruimaotong, and Focus Technology ranking in the top ten, as shown in Figure 6. These companies are outstanding in brand value, technological innovation, and asset operation, so they rank high. Because enterprises pay more attention to the construction of e-commerce platform, they start early and involve deep industrial fields. After a long time of capital, talents, and brand precipitation, they have formed unique competitiveness in the field of comprehensive platform and have a high market share. As these platforms involve a relatively wide range of industrial fields, their overall financial capacity is not comparable to that of state-owned enterprises.

As shown in Figure 7, the platform e-commerce of Business treasure, Smart energy, Zhejiang Oriental, and Zhongyeda rank lower in 17, 19, 21, and 23, respectively, so their competitiveness is relatively weak because they are relatively backward in terms of enterprise scale, profitability, capital operation, and innovation ability.

E-commerce service enterprises mainly include Wangsu Technology, Altega, Baoxin software, and Zhejiang University Wangxin, ranking 2, 11, 15, and 22, respectively, as shown in Figure 8. Although the scale of these four enterprises is roughly the same, Wangsu technology has a relatively large competitive advantage in enterprise efficiency, financial ability, growth ability, and technical ability, mainly due to its preference for technological development and technological innovation. Enterprise users have included various websites, online game enterprises, and operators, which has brought relatively high profitability.

4.3. Improving Enterprise Competitiveness and Innovation.

According to the analysis and summary of the competitiveness of the above enterprises, corresponding improvement suggestions should be put forward according to the actual situation of various enterprises. The efficiency of state-owned holding enterprises in the utilization of fixed assets is relatively low, and the asset utilization degree of enterprises is low. The enterprise shall formulate the use plan of fixed assets, analyze the demand for fixed assets, complete the strategic option analysis, list the asset items, formulate the management performance measures and asset management plan, complete the capital budget, and finally implement it
with the approval of the management. In addition, the company should also pay attention to the acquisition of fixed assets. The goal is to enable the enterprise to obtain reasonable and useful property for the enterprise in the most economical and effective way. The acquisition solves the problem of initial control of assets. The more common ways are purchase, value exchange, accepting government or individual donations, tax foreclosure, and so on. Implement the operation and maintenance of fixed assets in accordance with the maintenance strategies and policies under the framework of laws and regulations. In addition, enterprises should change their management concept from extensive to intensive, strengthen the level of asset management, and focus on internal asset management. In addition, we should scientifically adjust the enterprise asset structure and combine the assets with relatively low risk in order to seek the maximum benefits.

The competitiveness level of platform e-commerce is characterized by polarization. For backward companies, because they are relatively backward in company scale, profitability, capital operation, or innovation ability, they should clarify their business areas and strive to seek inter industry cooperation. In particular, these enterprises should pay attention to the application of business intelligence and collect and convert the internal and external resources of the enterprise from multiple angles into a structured data system so as to shorten the time to obtain relevant information and realize the efficient utilization of resources. It is better for enterprises to introduce REP system to realize the efficient management and operation of sales, marketing, manufacturing, operation, logistics, procurement, finance, new product development, and human resources and provide the basis for effective e-commerce. Specifically, it controls and confirms the company’s cash flow in real time, promotes the implementation of interdepartmental cooperation, and reduces the time required to generate regular reports. Through transaction data analysis and prediction of business trends, improve profitability, enable financial personnel to quickly create financial revenue reports and expenses, improve relationship management with suppliers, facilitate efficient management of employees, and provide online access to data so as to save access time and other aspects. For the top platform e-commerce enterprises, their financial ability is relatively weak, which may hinder the effective investment of enterprises and affect the ability of enterprises to further grow. Enterprise financial ability is reflected in the realization of organizational objectives and production efficiency. The higher the financial ability, the lower the cost and the improvement of enterprise value. On the one hand, enterprises should pay attention to internal financing, which refers to the funds independently obtained by enterprises, mainly including retained earnings and depreciation. This is not only the key element of the company’s survival and development, but also an effective way to improve the competitiveness of e-commerce enterprises in finance. On the other hand, the company should also pay attention to the integration of external financial resources because this is the key factor for the rapid growth and competitiveness of the company. In addition, the effective use of resources, effective control, effective management of working capital, and reliable financial prediction are very important to the improvement of enterprise financial ability.

5. Conclusion

This paper innovates the business evaluation system based on BP neural network and artificial intelligence technology. Taking 23 listed B2B e-commerce enterprises as analysis samples, this paper evaluates the competitiveness of B2B e-commerce enterprises with specific indicators such as total assets, total employees, total sales, proportion of R & D personnel, and proportion of R & D investment in total sales. The neural network is trained and tested with the data of 23 enterprises. Finally, the trained network is used to obtain the competitiveness value of B2B e-commerce enterprises, analyze the evaluation results, point out the advantages and disadvantages for different types of enterprises, and provide relevant improvement suggestions. This paper selects 23 B2B e-commerce enterprises and compares the competitiveness gap between enterprises horizontally. For a specific enterprise, it does not collect, sort out, and analyze the company data for many consecutive years, ignoring the vertical analysis and exploration of the company’s competitiveness. Therefore, the follow-up research work should take a representative B2B e-commerce enterprise as the research object, study the development route of its competitiveness, study and analyze the reasons for the enhancement or weakening of enterprise competitiveness, and provide experience and reference for relevant enterprises in B2B e-commerce industry.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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