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Construction and Simulation of Competitiveness Evaluation Model for E-business Enterprise

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Abstract

With the development of information technology, E-business is the important way for enterprises to develop. But with more and more fierce competitiveness, the main problem which faced by the enterprise is how to take steps to keep the competitiveness. By setting up competitiveness evaluation model based on the discrete Hopfield neural network to help enterprise know the weakness and take steps to enhance the competitiveness. Firstly, the index systems which include 7 first level and 23 second level indexes established by investigation, the main indexes include basic resources, product advantages, price advantages, service capability, promotion capability, profitability, innovation and so on. Then build the evaluating model based on the discrete Hopfield neural network according to 20 enterprises. Through designing the ideal level evaluation and encoding ideal level evaluation index by Matlab, the analysis result can be achieved by Hopfield simulation. At last, a case study is used to test the model with the data of five customer to customer enterprises. Through the qualitative and quantitative evaluation, the enterprise can see which element or how many elements will affect the competitiveness, the weakness of competitiveness and clear direction to improve and enhance competitiveness.

***Keywords*:** *evaluation model, Competitiveness, e-business, simulation*

1. Introduction

With the development of information technology, the network economy develops rapidly, and e-business not only has become the mainstream of the economy, but an integral part of people's economic and social life. In 1996, after the first symbolic online transaction was completed, our e-commerce formed, and then rapidly developed [1]. And the C2C e-commerce site which is developed into a prototype in 2000, with the establishment of Taobao, it occupies a certain position in the network economy. According to CNNIC statistics, As of the end of July 2013, the number of Chinese Internet users reached 595 million, and the rate of Internet penetration reached 44.4%, As of June 2013, the number of China's online shopping users reached 271 million people, online shopping usage rate increased to 45.9%. Compared to the end of December 2012, the absolute values of Internet users' numbers was 28.89 million, and half-year growth rate was11.9% at the first half of 2013, online shopping become to be a mainstream.

In 2007, Taobao accounted for 83% of the market share, while the eBay was all the way down, now Taobao exists in people's lives everywhere [2], facing such a complex

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environment and so much competition, recognizing their own enterprises and other enterprises' competitiveness becomes particularly important.

The Article focuses on the field of C2C, tries to interpret enterprise competitiveness perspective, and models the entire enterprise competitiveness evaluation system with Hopfield neural network, in order to be able to develop a more practical perspective.

2. The Theory Outlined (Discrete Hopfield Neural Network)

2.1. Principle of Hopfield

Hopfield neural network is a fully connected and feedback network. It uses a binary neuron as neurons, the output of discrete values 1 and -1 respect neurons are in the active state or the inhibition [3], which is a feedback type layer network with a binary value output.

For example, the Hopfield neural network with three neurons, and the structure shown in Figure 1:

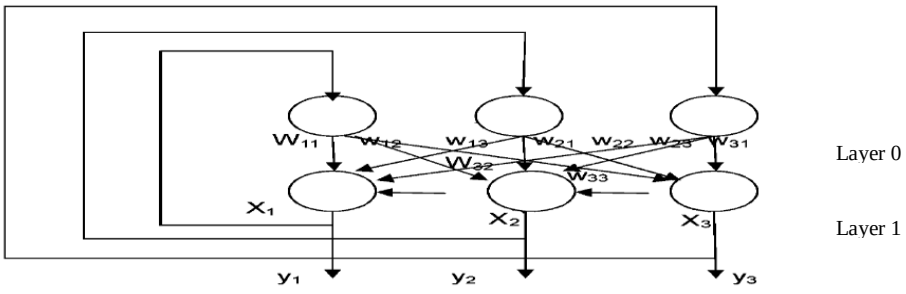

Figure 1. Network Structure

The first layer are neurons, so execute that the input information multiplied by the weight coefficient and seek accumulate, and output information by processing the nonlinear function f produces; layer 0 as the network input, is not the actual neurons, so there is no calculation functions. And f is a function of a simple threshold. If the output neuron is greater than the threshold, the output of the neuron is 1; less than the threshold, the output is -1.

The formula of Binary neurons: $u_j = \sum_i + W_{ij} y_i + x_j$

x_j is an external input, and: $y_j = 1, u_j \geq \vartheta_j$; $y_j = 1, u_j < \vartheta_j$

2.2. Network Working Methods and Stability

Hopfield network runs by kinetic, its course of work is the neuron state evolution, evolutes in the direction of "energy" decreases from the initial state, until it reaches a steady state, names the network output, Its main work has both serial and parallel: serial work, namely asynchronous, means only one neuron changes at any time t, while other neurons remains unchanged; while working in parallel, that is synchronized, means some or all of the neurons' state change at any one time t.

The discrete Hopfield neural networks a binary nonlinear dynamic system with threshold and multi-input, in the movement system, the energy value of energy function is constantly reduced until the minimum attributed [4]. Coben and Grossberg made in 1983, if the weight coefficients matrix W of the Hopfield network is a symmetric matrix, and the diagonal elements are zero, then the network is stable.

2.3. Learning Rule

Discrete Hopfield network learning rule focuses its designing approaches of weight coefficient matrix. Common methods are orthogonal method and outer product method. This article relating to MATLAB tools uses the outer product method, which works as follows:

For a given memories sample vector {t_1, t_2, -------- t_n }, if the status of t_k is +1 or -1, then the link weights of learning uses the "outer product rule", which:

$$W= \sum_{k=1}^{n} [t^k (t^k)^T - 1]$$

The steps:

(1) According to a remembering sample, according to the formula before compute the weight coefficient matrix.

(2) Set the test sample p_i (i = 1, 2, ----- n) as the initial value of the network outputs y_i (0) = p_i (i = 1, 2, ----- n), set the iteration times.

(3) The formula for iterative calculation:

$$y_i(k+1) = f(\sum_{j=1}^{N} W_{ij} y_j)$$

(4) When gets the maximum number of iterations or neuron output state remains stable, the terminate ends; otherwise it returns the third step to continue.

The reason why the weights are designed is to ensure the system stability for asynchronously, that is, its weight is symmetrical; ensure that all requirements of the stable equilibrium points of the memory converges itself; ensure the number of pseudo stable point is least and the attractive way may be large as far as possible. Ensure the discrete Hopfield neural network can operate stably and effectively.

3. Model of C2C E-Commerce Enterprise Competitiveness Evaluation

3.1. Set up the Evaluation Index System

There's many factors impact C2C e-commerce enterprise competitiveness, this articles summers 7 first level and 23 second level factors influencing factors as the evaluation index by reading numerous articles, researching C2C e-commerce business enterprise characteristics and expert experience, as shown in Figure 2.

Basic resources (shop's Visibility, shop's design, shop's reputation, business experience, financial capital) [5].

Product advantages (product size, product information, product brand awareness).

Price advantages (product prices, logistics costs).

Service capability (goods and service satisfaction, transaction safety, credit, customer emphasis).

Promotion capability (promotional tools, promotional frequency).

Profitability (sales growth, subscriber growth, profitability, brand effect)[6].

Innovation (technical staff weighting, the proportion of innovative products, patented horizontal).

Finally, establish the C2C e-commerce enterprises' competitiveness evaluation index system according to the principle of establishing index system.

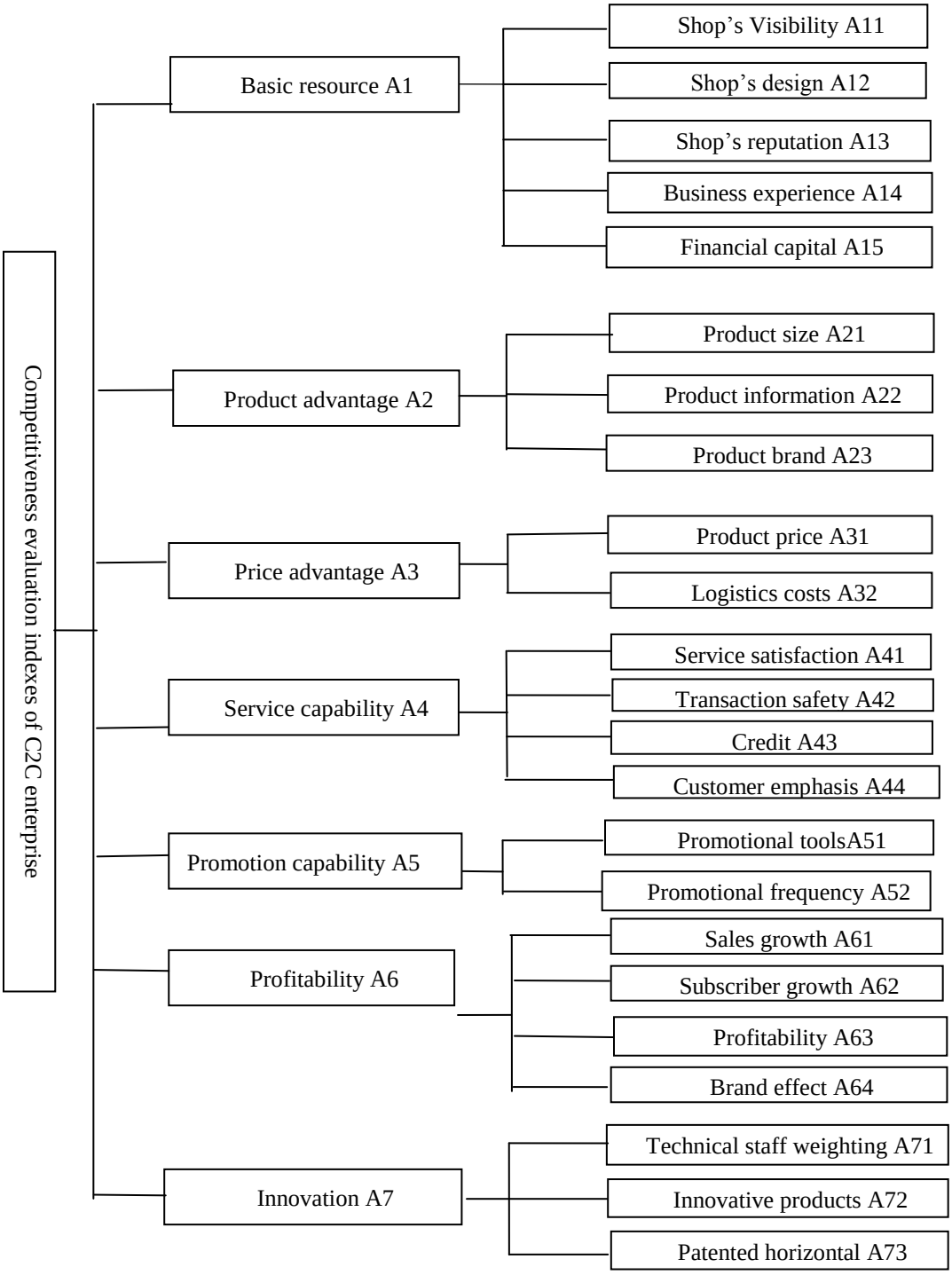

Figure 2. Competitiveness Evaluation Indexes of C2C Enterprise

Among them, the main indicators of the selection criteria are:

(1) Basic resources, including well-known shop, shop design, shop reputation, operating experience and capital funds, for a C2C e-commerce enterprises, in order to improve the level of service, it is necessary to invest in these areas for which network store

visibility, shop design and shop credibility are one basic reason that why the customer choose the shop, and shop's management experience and financial capital are the foundation for the shop to be bigger and stronger. So constantly optimizing the design of the shop and enhancing the shop's credibility is a powerful guarantee to enhance the competitiveness of C2C e-commerce enterprises.

(2) Promotion capability can be subdivided into promotions and promotional frequencies. Promotional tools which can be limit discounts, ranking and member discount and so on. Whether the promotional tools are various and whether it has a high frequency of promotion can help us to evaluate the C2C e-commerce enterprises' promotional ability. A variety of promotional tools and appropriate promotional frequency is an important credential to improve the competitiveness of C2C e-commerce enterprises.

(3) Service capabilities can be subdivided into goods and service satisfaction, transaction safety, credibility and customer emphasis. The credibility is the level of service that an enterprise in the industry reached which can well reflect the credit worthiness of the e-commerce businesses; Transaction safety is that whether customer information is safe during the transaction and payment process; customer emphasis can investigate the company's importance in the minds of customers [7]. For C2C e-commerce businesses, good service capabilities can provide strong protection to enhance the competitiveness of enterprises.

(4) Innovation is mainly divided into the proportion of technical staff, the proportion of innovative products and patent level. The proportion of IT staff and innovative products means that whether enterprises introduce a proprietary technical personnel, senior technical staff, have a development team with strength, have innovative products or not, such employees across the enterprise and the innovation products whether occupy a certain proportion. Solid technical development team can bring innovative products and patents; all of these are the key factor to enhance the competitiveness of C2C e-commerce businesses.

C2C e-commerce enterprise competitiveness is divided into five levels: very strong, strong, fair, poor and very poor. Set the classification of certain typical level of the corresponding evaluation as Discrete Hopfield neural network's equilibrium points, Hopfield neural network learning process is the process that typical classification level evaluation index gradually approaches the equilibrium point in neural networks. After learning, Hopfield neural network equilibrium point is the evaluation level of various corresponding indicators [8]. When corporate indicators to be evaluated are input, Hopfield neural network on the use of associative memory function gradually become a recent balance point, when the network is stable, equilibrium points corresponding to the level of classification shall be subject to evaluation level [9]. Figure 3 shows the main steps:

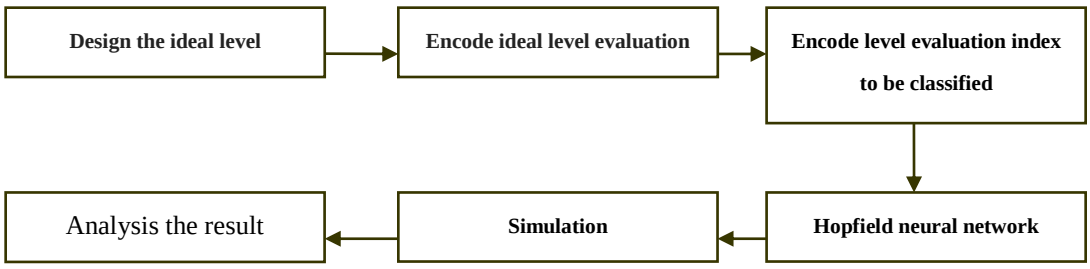

Figure 3. The Steps of Competitive Evaluation

3.2. Design the Ideal Level Evaluation

Article studied the relationship between 20 C2C e-commerce enterprises' competitiveness level and 23 evaluation indexes, the Group of Experts get the level by scoring the various indicators of 20 enterprises. Set each index's average corresponding to each grade samples as the ideal evaluation, that is, as the equilibrium point of Hopfield neural network, as shown in Table 1 below.

Table 1. Index Score Under Standard Level

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Ⅰ	95	91	94	92	91	95	93	88	92	92	94	92
Ⅱ	78	81	83	80	83	85	81	78	82	83	84	85
Ⅲ	62	68	63	66	63	66	63	67	67	67	66	65
Ⅳ	55	52	52	49	54	44	54	48	58	55	48	48
Ⅴ	31	43	38	39	32	30	35	35	33	28	33	35

	X 13	X 14	X 15	X 16	X 17	X 18	X 19	X 20	X 21	X 22	X 23
Ⅰ	91	94	91	92	92	88	93	90	93	93	94
Ⅱ	84	82	82	82	83	83	85	88	88	83	83
Ⅲ	65	74	77	66	71	66	63	68	65	69	65
Ⅳ	58	52	58	56	48	45	47	54	58	50	47
Ⅴ	30	29	30	28	38	35	29	28	30	36	39

3.3. Encode Ideal Level Evaluation Index

Discrete Hopfield neural network state only has two species 1 and -1, so encode the state when evaluation index will be mapped to neurons [10].

Encoding rules: when a value is greater than or equal to the certain level's target value, the corresponding neuron state is set to "1", otherwise it is "-1". Article provides the desired 5 levels' evaluation indexes codes in Figure 4. Solid circle represents the corresponding neuron state is "1", *i.e.*, greater than or equal to the corresponding desired evaluation index value, on the contrary, hollow circles.

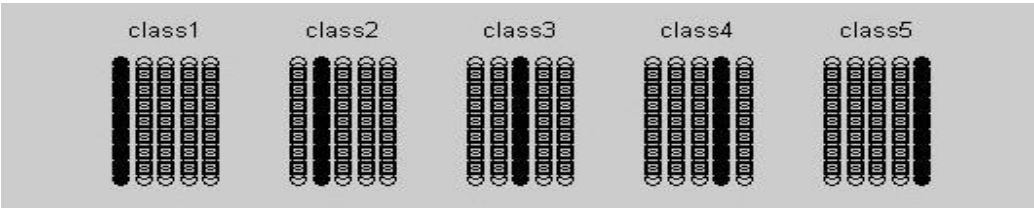

Figure 4. Simulation Diagram of each Index under Standard Level

4. Case Study

4.1. Analysis the Criteria Layers of Information Security

C2C e-commerce enterprises' level evaluation index which should be classified is shown in Table 2, according to the encoding rules described above, we can obtain the corresponding code, and know that when an indicator of the enterprise's achieves the target level of the corresponding scores of one standard, the highest level's circle of the five levels will be marked as filled circles, open circles otherwise, As shown in Figure 5.

Table 2. Index Score of Enterprises to be Evaluated

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
1	30	50	40	55	66	54	43	32	98	89	35	68
2	58	55	50	51	57	46	48	50	42	53	60	50
3	66	68	65	68	69	17	99	64	61	30	69	63
4	79	80	86	85	88	92	83	79	67	65	85	86
5	98	92	98	99	55	90	94	88	93	97	87	98

	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23
1	39	66	37	54	45	61	33	27	39	33	40
2	66	60	89	53	56	49	44	56	49	60	48
3	70	69	62	78	70	64	64	63	69	68	55
4	86	83	89	93	98	83	90	63	68	29	89
5	89	48	90	53	96	89	48	67	84	98	99

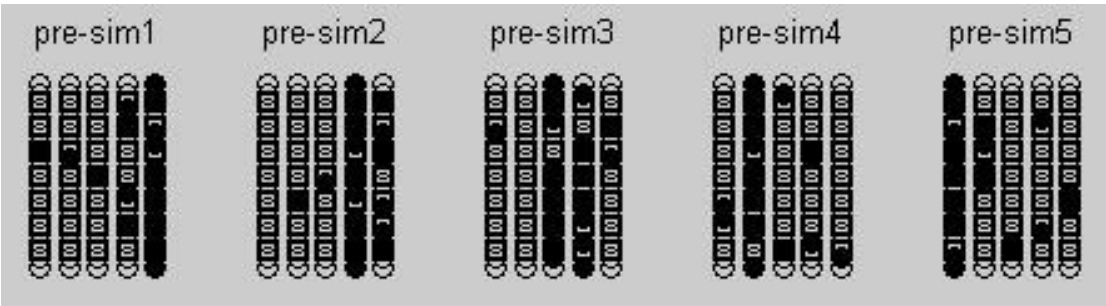

Figure 5. Enterprises' Competitiveness Index Rating Simulation

4.2. Network Construction

Build Discrete Hopfield neural networks' 5 ideal matrix using MATLAB neural network toolbox function whose level evaluation index coded as 5 11 * 5 matrixes, each matrix contains only "1" and "-1" values. 5 matrixes are stored in 'class.mat' file, followed by the name class_1, class_2, class_3, class_4, class_5.

The rank evaluation index code of five enterprises is stored in 'sim.mat' file; 5-coding matrixes are named sim_1, sim_2, sim_3, sim_4, sim_5.

The specific code in MATLAB as follows:

```
Load class.mat
Load sim.mat
T = [class_1 class_2 class_3 class_4 class_5];
Net = new hop (T);
```

4.3. Simulation and Analysis

Network has been created, set five enterprises' level evaluation index coding (*i.e.*, Figure 5) as the Hopfield neural network input, Hop after a certain number times of learning, can get enterprises' competitiveness evaluation results (*i.e.*, Figure 6) using Matlab simulation function. Compare the simulation results and the real level; the model can be reasonably evaluated.

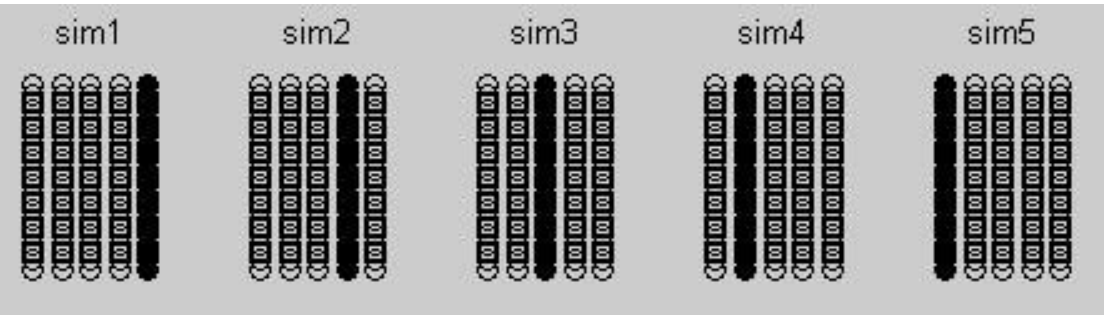

Figure 6. Simulation Results of Enterprises to be Evaluated

4.4. Analysis of Results

Compare Figure 6, the previous Figure 4 and Figure 5, we can see that the first enterprise's overall competitiveness is at the second level, and the remaining four were level two, five, three, four.

Seeing 7 first level indicators and 23 second level evaluation indicators, each level of competitiveness of enterprises is at a glance, and for the lower-grade companies they can choose to enhance some index: The technical personnel should be put in, such as the introduction of high-end technical personnel, improving the technological level of the development team, developing more innovative products to attract customers, essentially ahead of other competitors in the same industry; while in the service capabilities, should raise the level of pre-sales and after-sales service, improve product quality, as the spirit of "true, good service, and I feel beautiful" principle to enhance the service capabilities. On the other hand, enterprises should focus on cost savings problem in the assessment of the alternatives, fully analysis the advantages and disadvantages of various options, and then choose the most efficient solution to complete the project, so that make the cost to a minimum, to better enhance the competitiveness of C2C e-commerce businesses, to enable enterprises better develop themselves.

5. Conclusion

Thus, in evaluating the competitiveness of an enterprise, just score its index, latter through the neural network we can get the level of competitiveness of enterprises automatically and objectively, and recognize their own strengths and weaknesses, such as from indicators' simulation figure, we can clearly see all the indicators' level, and which provide a good basis for enterprise's development. Thus, in the article, Hopfield network is designed to be able to effectively classify the C2C e-commerce companies to be evaluated, and thus evaluate the competitiveness of enterprises more objectively and impartially.

In the articles' designed model, the evaluation value of each index is obtained through an objective evaluation, the method is simple without complex calculations, but it is not suitable for all occasions. If a company's strengths and weaknesses exist evidently, Hopfield cannot get classification and evaluation results very precisely.

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