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Research Article

Synthetic Evaluation of the Food Processing Enterprise Alliance Ability Based on Hopfield Neural Network Improved by Schimidt Method

Jingli Zheng
School of Economics and Business Administration, Chongqing Normal University, Chongqing, China

Abstract: Food processing enterprise alliance as one innovation model of modern food processing enterprise strategic has become the important tools to improve the food processing enterprise competitive edge. Food processing enterprise alliance innovative ability has received great attention for the remarkable performance impetus. However, the complexity and integrity of food processing enterprise alliance innovative ability make no consensus in the conception and the evaluation. Based on the angle of process management, the study takes knowledge protection capacity (pre-alliance), cooperation regulation establishing capacity and relationship development and maintenance capacity (post-alliance) as main alliance ability and proposes an improved Discrete Hopfield Neural Network (S-DHNN) to evaluate alliance capacity. In view that the source of sample data is questionnaire statistical result, the study introduces noise with different intensity to simulate the questionnaire's subjectivity and randomness, whose result will be compared to other method such as traditional DHNN, Fuzzy synthetic evaluation model and Cluster analysis. The conclusion shows that the proposed S-DHNN has better anti-disturbance capacity and is suitable to the problem relate to food processing enterprise-alliance capacity based on questionnaire or interview.

Keywords: Alliance ability, food processing enterprise, neural network, synthetic evaluation

INTRODUCTION

With the development of the economic globalization, the market environment changed faster and faster and the lifecycle of product and technology become shorter and shorter. More and more food processing enterprise has make strategic adjustment in competitive relationship, that means the competition has turn to Co-competition rather than opposed competition, which depends on external forces, realize the personal development strategic objective via resource sharing and risk sharing to decrease the personal risk.

Strategic Alliance is the most obvious phenomenon in the cooperation strategy development. Strategic Alliance as one innovation idea of modern food processing enterprise organization style has become important tools in improving competition edge and lots of such research indicate that the competition will spread between alliance enterprises. As one important organization ability in enterprise, Strategic Alliance has been taken lots of concentration for its remarkable performance impetus, but still suffers from the consensus in the conception and the evaluation. Therefore, bases on the angle of processing management, transaction cost theory and recourse-based theory, the study takes knowledge protection capacity (pre-alliance), cooperation regulation establishing capacity and relationship development and maintenance capacity (post-alliance) as main alliance ability, establishes evaluation indicator system and evaluates the food processing enterprise alliance ability on the basis of mathematical model. The job above will provide reference and guidance in how to utilize strategic alliance strategy to gain competition edge.

PROBLEM AND RESEARCH METHODOLOGY

Conception definition of food processing enterprise alliance ability: This paper studies the constitutional dimension of alliance ability from the view of alliance process management and emphasizes the stage of alliance management. According to the study of Simonin (1997) and Gulati (1998), this study divides the alliance process into two stages: pre-alliance and post-alliance. Pre-alliance stage is formation stage and the main point of this stage is to choose suitable partners. Bronder and Pritzl (1992) and Mason (1993) think that unsuitable partners selection is the main reason of technology alliance failure. Brouthers *et al*. (1995) also took the idea that unsuitable partner selection will bring higher cost and risk than alone. Therefore, the choosing of a suitable partner concerns the realization of objective and companies should possess the ability to choose better partners from potential partners with different trust relationship (Mason, 1993). This study takes the idea that, when

Table 1: Alliance ability index system

Alliance ability	Knowledge protection ability	A1	Your company has strict and normative confidentiality rules and regulations for its patents.
		A2	Your company does not allow employees to take the information out of the company randomly.
		A3	Your company sets up specialized agencies or personnel to combat the patent infringement.
		A4	Your company makes clear direction and way of use for the technology in the league.
		A5	Your company usually sends its employees to do technical maintenance for the core equipment in the league.
		A6	Your company usually sends your own employees to put the efficient management and operation mode into the alliance.
		A7	The technology (product) involved in the cooperation can be decomposed into multiple standardized modules (mold or components).
		A8	Different modules are developed by the independent corresponding branch (company).
	Cooperation regulation establishing ability	B1	Your company has much experience in the alliance cooperation.
		B2	Your company has strict rules on the content of the contract.
		B3	Your company has strict rules on contract signing process.
		B4	Your company has complete regulations and requirements on the alliance operation and management rules.
		B5	Your company has strict regulations and requirements on the behavior of the coalition partners.
		B6	Your company can build complete supervision mechanism of partner behavior.
		B7	Your company has strict rules for the exit mechanism of league.
	Relationship development and maintenance ability	C1	Your company regulated internal work processes to cooperate with partners better.
		C2	Your company set up partner coordination process across company boundaries.
		C3	Your company adjusts the incentive system in order to develop good partnership.
		C4	Your company holds the internal meeting regularly and adjusts the working process to adapt to the partners.
		C5	Your company can always point out how to achieve the win-win situation in cooperation for the partners.
		C6	Your company has been trying to let partners know its products and services.
		C7	When the contacts changes, your company always notifies the partners in the first time.
		C8	Your company is ready to discuss with the partners even in the difficult circumstances.
		C9	Your company will listen to the views and opinions of partners carefully.
		C10	When differences appear, your company can always consider the point of view of the cooperation opponent's.
		C11	Your company can understand the needs of the counter parties deeply in conversation.

selecting suitable alliance partners, the personal core knowledge and the risk of the technology stolen by potential partners are the two main considerations. Therefore, partner selection should depend on self-core knowledge and technology protection ability. Post-alliance stage is the decision and later management. In this stage, we should consider signing cooperation clause with partners (Brouthers *et al*., 1995; Hoffmann, 2007; Sarkar *et al*., 2009; Mayer and Argyres, 2004), establish appropriate governance structure and govermance mechanism (Zheng and Long, 2012; Yang, 2001), share knowledge and information, resolve conflict, etc. According to the need of research, this study will take cooperation regulation establishing capacity and relationship development and maintenance capacity as main post-alliance ability. Therefore, based on the angle of process management, the ability which contains knowledge protection capacity (pre-alliance), cooperation regulation establishing capacity and relationship development and maintenance capacity (post-alliance) are the main food processing enterprise alliance abilities.

Problems and research design: To improve the reliability, validity and rationality of questionnaire indexes, we employed the small sample test method to test and improve the index system based on factor analysis. We deleted some insignificant variables and improved the index system locally according to the actual situation and literature review. We got the large sample questionnaire and complete union ability index system finally (Table 1).

DOSCRETE HOPFIELD NEURAL NETWORK

Hopfield network belongs to neural dynamic system and possesses the stable equilibrium state. The neurons in the network are connected with each other and the input of each neuron is passed to other neurons through the synaptic weights, then it may indirectly pass to themselves by other neurons, so the Hopfield network is a kind of feedback network. For the feed forward network, the neuron node in each layer receives the data input by previous layer. After processing the node input it to the next layer. In the process, the data flows forward, with no feedback connection and the current output is determined by the input and weight value:

$$v_i(t+1) = Sgn\ [\sum_{j=1}^{N} w_{ij} x_j(n)] = \begin{cases} 1 & u_i(t) \geq 0 \\ -1 & u_i(t) < 0 \end{cases} \quad (1)$$

Among them:

$$u_i(t) = \sum_{\substack{j=1 \\ j \neq i}}^{n} w_{ij} v_j(t) + b_i \tag{2}$$

where, N_1, N_2,…, N_n represent neurons, x_1, x_2,…, x_n are the initial inputs, u_i (t) is the input of neuron i at time t, v_j (t) s the output of neuron j at time t, then Sgn (t) is the relationship between input and output. At time t when v (t + 1) = v (t), the network state has converged to stable state.

The realization of discrete Hopfield neural network has two stages, memory stage and associative stage. In the memory stage, the external input the sample data and through a certain learning model to determine weight to make the system to the stable state; In the associative stage, for a given input, the system reaches the balance point by the evolution of its dynamic state according to the given input and the established weight value, then it get output.

Standard mode setting: According the index attribute of index system to set index values classification and regard it as a pre storage standard sample. Encode the standard sample to the standard mode.

Network establishment and weight determination: Generally, the discrete Hopfield network weights are designed by Hebb rule and the setting of network weights needs to meet the two conditions of $w_{ij} = w_{ji}$ and $w_{ii} = 0$, then:

$$w_{ij} = \begin{cases} \dfrac{1}{m} \sum_{k=1}^{n} u_i^k u_j^k, & j \neq i \\ 0, & j = i \end{cases} \tag{3}$$

The research constructs discrete Hopfield neural network through the software of MATLAB R2012a and the creating code is net = newhop (T), in which T is the standard mode input determined by the last step.

Input determination: Transform the index value of pre recognition of object into binary pattern of (1, -1) and the network input of the object that needs to be evaluated obtained.

Iteration convergence and stable output: The study sets the Hopfield network with m index and n classification and there are $m*n$ neurons. When the network meets the condition of steady-state, v_i (t+1) is the output state of neuron i at time t+1. Then it is available to determine the comprehensive evaluation level of the input sample.

SCHIMIDT-DHNN MODEL

Pairwise orthogonal training samples are easy to store and can form the stable points of Hopfield network. However, the input samples may not be pairwise orthogonal because of the nature of the training samples. In order to guarantee the stability of the network, Schimidt orthogonalization method is employed to pre-process the input samples of Hopfield network and make the input samples pairwise orthogonal.

Suppose vector α_1, α_2,…, α_n are in European Space V linearly independent, order:

$$\beta_1 = \alpha_1$$

$$\beta_2 = \alpha_2 - \frac{(\alpha_2, \beta_1)}{(\beta_1, \beta_1)} \beta_1$$

$$\beta_n = \alpha_n - \frac{(\alpha_2, \beta_1)}{(\beta_1, \beta_1)} \beta_1 - \frac{(\alpha_3, \beta_2)}{(\beta_2, \beta_2)} \beta_2 - \cdots - \frac{(\alpha_n, \beta_{n-1})}{(\beta_{n-1}, \beta_{n-1})} \beta_{n-1}$$

So β_1, β_2,…, β_n are non-zero and pairwise orthogonal. This process is called Schimidt orthogonalization process. The operation process of solving the food processing enterprise alliance ability evaluation problems by S-DHNN neural network is depicted in the Fig. 1.

The sample data of this research came from the result of the questionnaire. Because of the strong subjectivity and randomness of the questionnaire, this research simulated disturbing conditions by adding noise to verify the stability of the proposed evaluation model.

Table 2: Food processing enterprise alliance ability evaluation criteria

	The evaluation grade				
	Grade A	Grade B	Grade C	Grade D	Grade E
A1	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
A2	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
A3	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
A4	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
A5	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
A6	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
A7	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
A8	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
B1	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
B2	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
B3	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
B4	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
B5	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
B6	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
B7	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
C1	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C2	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C3	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C4	(85, 100)	(70, 85)	(55, 70)	(40, 55)	(25, 40)
C5	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C6	(85, 100)	(70, 85)	(55, 70)	(40, 55)	(25, 40)
C7	(95, 100)	(90, 95)	(85, 90)	(80, 85)	(0, 80)
C8	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C9	(85, 100)	(70, 85)	(55, 70)	(40, 55)	(25, 40)
C10	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)
C11	(90, 100)	(80, 90)	(70, 80)	(60, 70)	(0, 60)

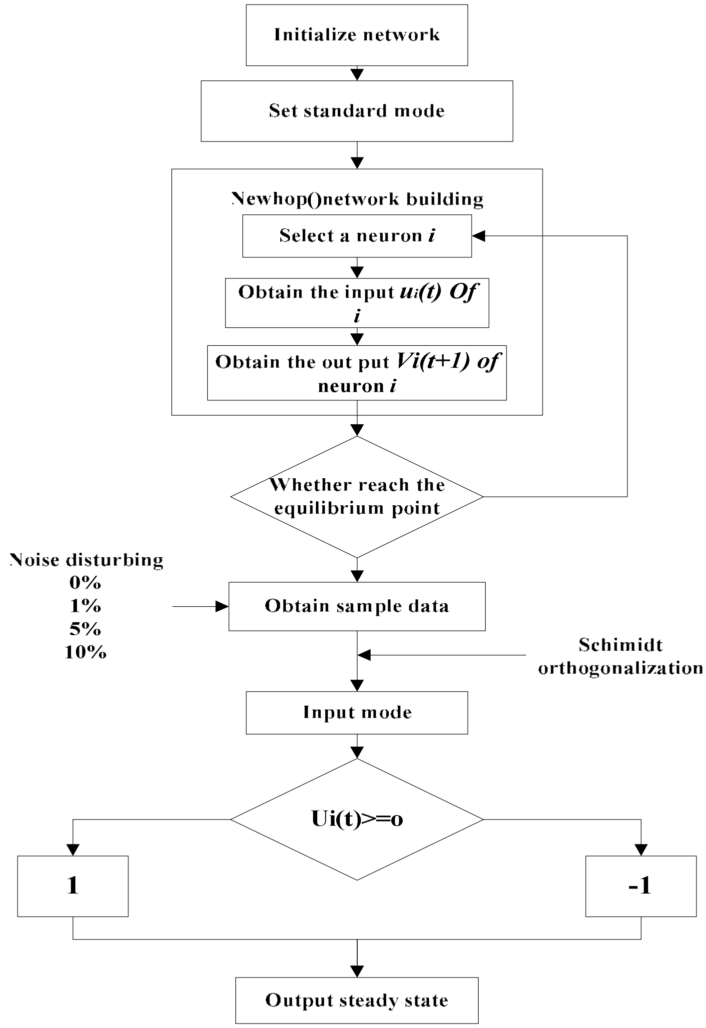


Fig. 1: S-DHNN neural network evaluation process

Case study:

Data: The questionnaires were distributed 1026 copies and returned 487 copies and the response rate was 47%. In this study, we selected the results of three representative enterprises (objects to be evaluated) as the sample data. Now the criteria of evaluation grade of food processing enterprise alliance ability are shown in Table 2 and 3.

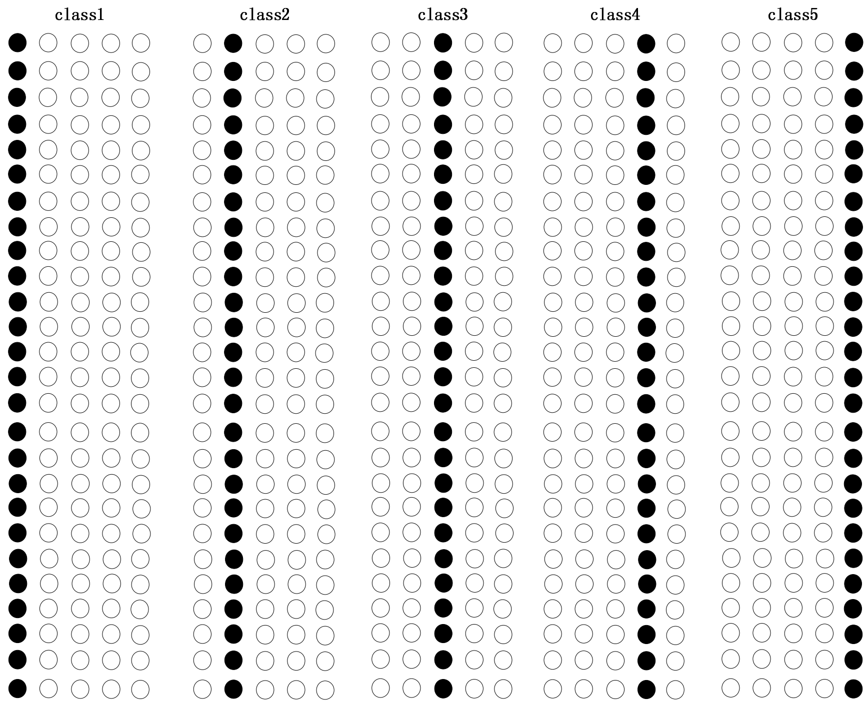
Evaluation: The standard input is converted to standard mode (Fig. 2a) and build a stable network, input associated samples (Fig. 2b), input the food processing enterprise alliance ability evaluation results of the three potential food processing enterprise alliance (Fig. 2c).

Add 1, 5 and 10%, respectively of the noise disturbance to the input mode pre-sim and noise added by the code of "noise_level = noise disturbance value". The results of evaluating S-DHNN are detailed in Fig. 3.

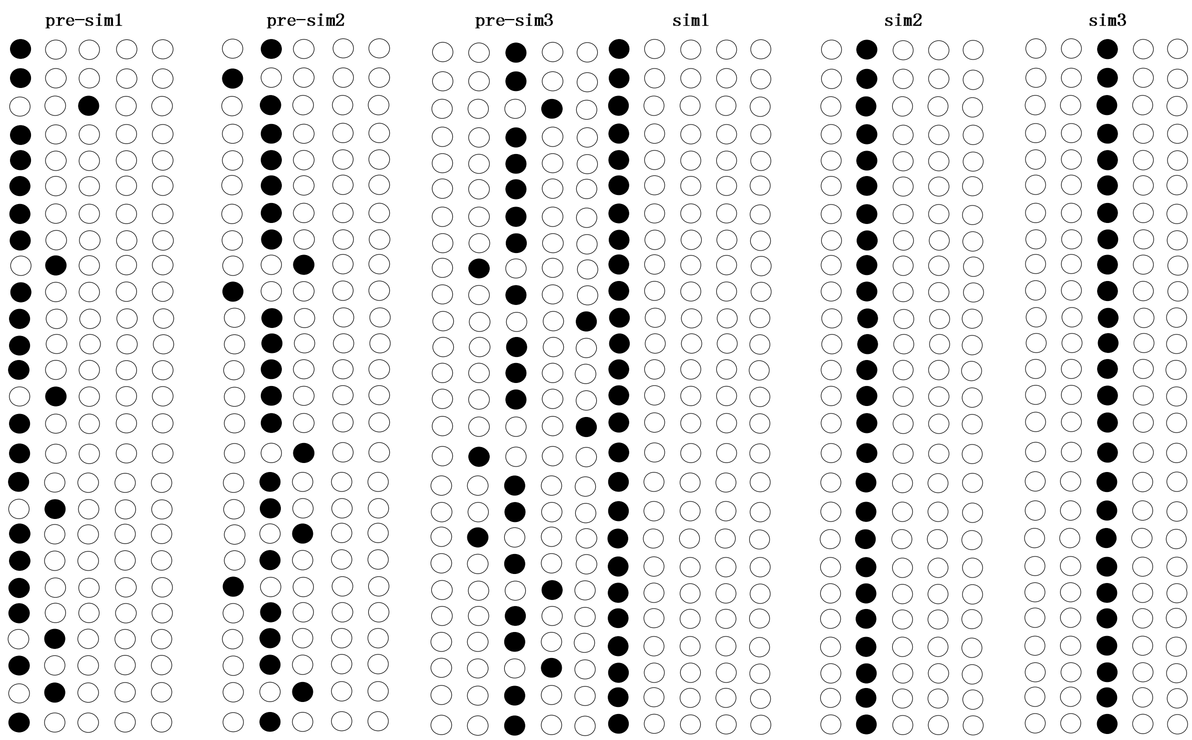
COMPARISON AND ANALYSIS OF THE EVALUATION RESULTS

To further emphasize the evaluation effect and anti-interference ability of S-DHNN model, this study compared the results of evaluation between Fuzzy Synthetic Evaluation Model (FSEM), Clustering Analysis method (CA) and S-DHNN model, DHNN model (Table 4).

As can be seen from Table 4, when the noise disturbance is less than 1%, the evaluation results of CA model changed; When the noise disturbance increased to 5%, the evaluation results of FESM model appear 1 time change, CA model appears 2 times change, DHNN model appear 1 time change; When the noise disturbance increased to 10%, S-DHNN model began to appear 1 time change, the probability of evaluation results' changes of other models continue to increase. Therefore, this study proposed that Schmidt orthogonalization process improving discrete Hopfield neural network evaluation model is more stable and is



(a) Standard mode



(b) Sample mode (c) Output mode

Fig. 2: Input and output of S-hopfield network (0% noise disturbance)

able to overcome the problems of sample data distortion caused by subjective factors or outside large influence and improve the stability of the evaluation results. From the evaluation results of S-DHNN, the evaluation grade of food processing enterprise alliance ability of object 1 is A, which declares a good ability in its own alliance.

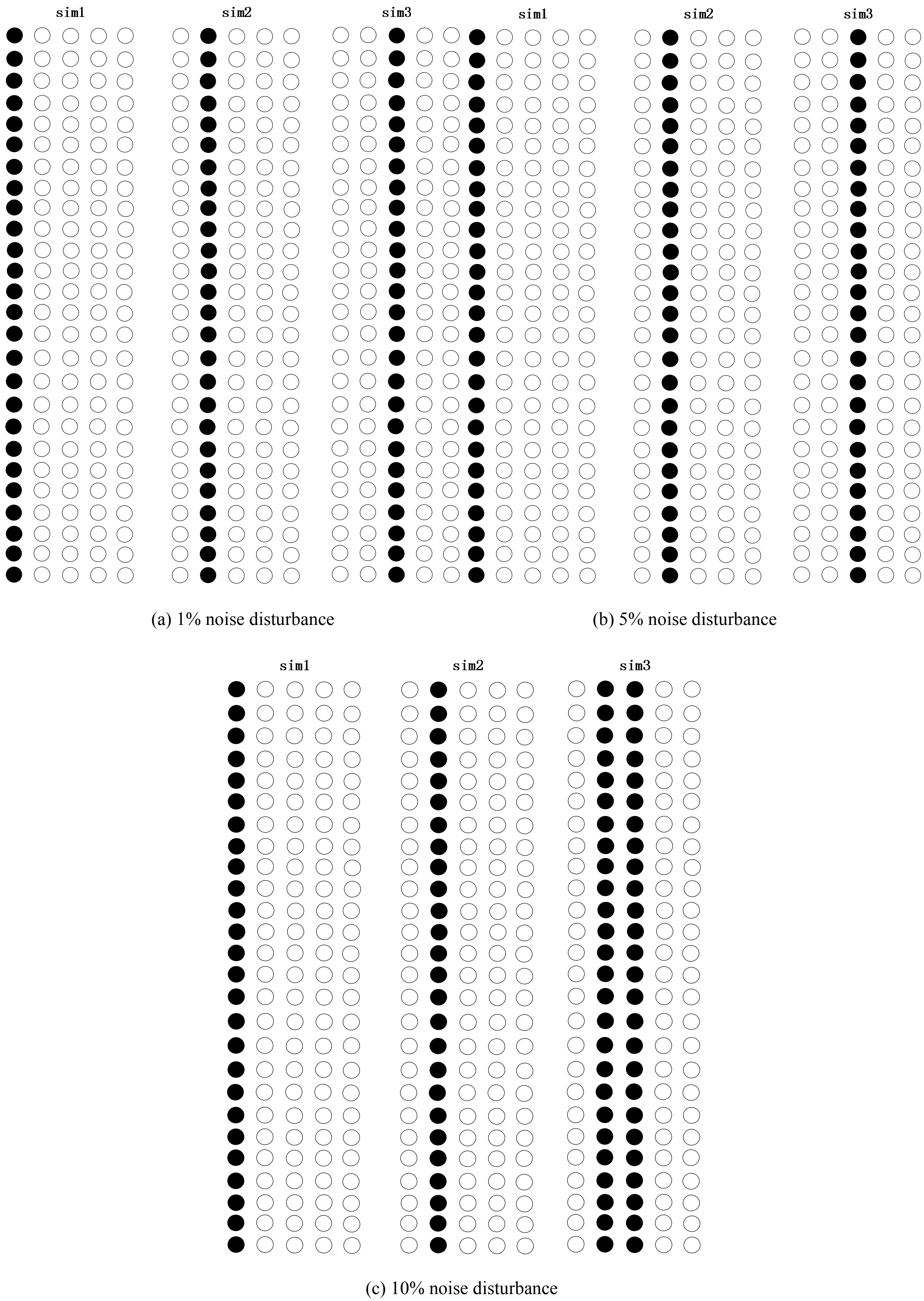


Fig. 3: The results of evaluation after noise disturbance (S-DHNN model)

Table 3: Sample data of food processing enterprise alliance ability

	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5
Object 1	98	96	86	92	91	92	97	97	88	96	99	93	98
Object 2	91	96	91	88	88	87	94	95	77	99	94	87	92
Object 3	86	88	84	77	74	78	86	89	84	86	68	77	89
	B6	B7	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Object 1	84	96	91	92	82	86	94	89	98	88	93	87	94
Object 2	90	95	80	88	83	69	85	87	93	90	79	77	83
Object 3	74	79	86	79	77	84	79	54	88	75	49	77	72

Table 4: Comparison of evaluation results

Model	Noise disturbance (%)	Object 1	Object 2	Object 3	Disturbance
S-DHNN	0	I	II	III	0
	1	I	II	III	0
	5	I	II	III	0
	10	I	II	**II/III**	1
DHNN	0	I	II	III	0
	1	I	II	III	0
	5	I	II	**II/III**	1
	10	**I/II**	II	**II/III**	2
FSEM	0	I	II	III	0
	1	I	II	III	0
	5	II	II	III	1
	10	II	III	IV	3
CA	0	I	II	III	0
	1	I	I	III	1
	5	I	I	II	2
	10	II	I	II	3

Bold indicates the evaluation results changed

The evaluation grade of object 2 is B and object 3 is C, which means the enterprises can take the appropriate strategic alliance strategy based on the evaluation results of their own alliance ability.

CONCLUSION

Knowledge protection ability is regarded as the enterprise's major alliance ability before the establishment of alliance (pre-alliance) and cooperation regulation establishing ability and relationship development and maintenance ability are regarded as the enterprise's major ability behind the establishment of alliance (post-alliance). This study built a new alliance ability evaluation index system from two stages of pre-alliance and post-alliance. We applied Schmidt orthogonalization method to improve discrete Hopfield neural network and built a comprehensive evaluation model to achieve the identifying of own alliance ability. Given the research data sources (questionnaire statistical results) were involved much subjective factors, this study simulated the uncertainty of the questionnaire results by adding 1, 5 and 10%, respectively noise disturbance and compared the evaluation results with DHNN model, FSEM model and CA method. Comparative analysis of the results concluded that S-DHNN model has better anti-disturbance capacity, which can be resistant to less than 10% noise disturbance and is suitable for the problem related to food processing enterprise alliance capacity based on questionnaire or interview.

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