# Chapter 114
# Analysis on the Operation Effects of Logistics Park Based on BP Neural Network

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**Abstract** With the rapid development of the construction and operation of Logistics Park, the operation effects and the development level of Logistics Park will become the focus of attention. In this paper, the factors affecting the operation effects of logistics park are proposed firstly. Then a set of evaluation metrics of the operation effects of logistics park is given. Besides, based on BP neural network, a model for calculating the operation effects is built. Finally, a case study has been studied with the model.

**Keywords** BP neural network · Logistics park · Operation effects

## 114.1 Introduction

With the development of logistics, logistics park has become a kind of emerging logistics management way. In Japan, Germany and other developed countries logistics park has developed rapidly. The construction of logistics park of our country began in Shen Zhen city in 1990s, and other cities also began the construction of logistics park rapidly. By 2008 in September, according to statistics, there had been 475 logistics parks in our country. Among them, 122 logistics parks have operated already, 219 were under construction, and 134 were being planned (China Federation of Logistics & Purchasing).

In the western developed countries, the rate of return on investment of logistic park is about 6–8 %. The income gained by the investors of logistics park usually comes from the return of rental and the land appreciation. In China, the vacancy rate of logistics park is more than 60 %, and even some logistics park is used for

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other purposes. With the rapid development of the construction and operation of logistics park, the operation effects and the development level of logistics park will become the focus of attention. In this paper, a set of evaluation metrics of the operation effects of logistics park will be built, and the method of BP neural network will be used for analysis of the operation effects of logistics park.

## 114.2 The Set of Evaluation Metrics

### *114.2.1 The Factors Affecting the Operation Effects of Logistics Park*

In the guidance of the government planning, logistics park is the large place in which several sorts of modern logistics facilities and several logistics organizations layout. Through sharing the infrastructure and the supporting service facilities, logistics park can give full play to its whole advantage and complementary advantages. The intensification and scale of logistics can promote the sustainable development of the city (Zhang 2004; Richardson Helen 2002; Marian 2006). When we plan the logistics park, we should consider regional economic level, customer industry, distribution of retail industry and the entire functional orientation.

The factors affecting the operation effects of logistics park have two aspects which are external factors and internal factors. The external factors include government's support and relative policy, the economic situation and the market environment. The internal factors mainly refers to the own operation ability of logistics park.

The policy environment mainly reflects the government's support to the development of logistics park. The local governments have provided some policies to logistics park, but these policies are not comprehensive and perfect. On the whole, in our country, the policy support to the development of logistics park is not enough. Soon, this situation will be changed, as we pay more and more attention to logistics and promulgate some related policy. The market demand of logistics park mainly includes target market's service demand, the adaptability of logistics park service and the matching degree of supply and demand of logistics park service. These factors directly affect the operation effects of logistics park.

The service ability of logistics park its own mainly includes: transportation, warehousing, distribution, packing and sorting, circulation processing, market development and maintenance, informatization level and management ability, etc. The internal factors are the foundation of the operation effects of logistics park.

### *114.2.2 The Set of Evaluation Metrics of the Operation Effects of Logistics Park*

According to the influencing factors and the set of metrics of related documents (Mingming 2010; Dai 2010; Zhong 2009), a set of evaluation metrics of the operation effects of logistics park is built, which includes the economic benefits, the condition of the enterprises in the park, park ability and social benefits four parts, as is shown in Table 114.1.

## 114.3 The Operation Effects of Logistics Park Evaluation Model Based on BP Neural Network

In 1985, the BP neural network model was brought out by D. Rumelhart from Stanford University. As BP neural network can solve the nonlinear problem well, it has become one of the most widely applied neural networks. BP algorithm solves the connection weight problem of the hidden layer in the multi-lever network model, improves the learning and memory function of neural, and especially solves the XOR problem. The BP neural network model is the prior to connection model that constitutes of input layer, output layer and some hidden layer (Yin 2003; Liu and Lu 2011; Hagan et al. 2002).

**Table 114.1** The set of evaluation metrics

| First level index | Second level index |
|---|---|
| Economic benefits | Return on capital employed($X_1$) |
| | Debt-to-asset ratio($X_2$) |
| | Asset maintaining and increase ratio($X_3$) |
| The condition of the enterprises in the park | Number of enterprises in the park ($X_4$) |
| | Gross asset of the enterprises in the park($X_5$) |
| | Annual gross income of the enterprises in the park($X_6$) |
| | Satisfaction degree of the enterprises in the park($X_7$) |
| | Loyalty of the enterprises in the park($X_8$) |
| Park ability | Storage area($X_9$) |
| | Annual freight Volume($X_{10}$) |
| | Delivery capacity($X_{11}$) |
| | Processing capacity($X_{12}$) |
| | Estate service capacity($X_{13}$) |
| | Informatization level($X_{14}$) |
| | Goods damage rate($X_{15}$) |
| Social benefits | Number of new employment($X_{16}$) |
| | Influence on the urban traffic($X_{17}$) |
| | Full Load Rate($X_{18}$) |
| | Energy saving and emission reduction($X_{19}$) |

The BP neural network can also deal with qualitative and quantitative knowledge. It's operation is very fast, and has strong learning and forecast ability. Therefore this paper using BP neural network model evaluates the operation effects of logistics park. The specific procedure is as follows:

(1) *The number of neurons*: In this paper, the BP neural network will use three layer structures, namely, input layer, hidden layer and output layer.

   a. *Input layer node*: The number of input layer node is the set of evaluation metrics. There are 19 input nodes.
   b. *Hidden layer node*: The number of hidden layer node is related to the number of input layer node, the character of sample data and the character of the unsolved problem. To determine the number of hidden layer node, we usually use the experience formula: $q = \sqrt{n+m} + a$. Among them, n is the number of input layer node, m is the number of output layer node, a = 1, 2,…, 10. Through several tests, 10 is the optimal number of hidden layer node.
   c. *Output layer node*: The results of the evaluation are output layer node. According the analysis, the number of input layer node is 19; the number of hidden layer node is 10; and the number of output layer node is 1.

(2) *The initialization of weight value and threshold value*: According to the set of metrics, the index is divided into two kinds of indexes, namely, qualitative index and quantitative index. Dealing with qualitative index, we generally use the expert scoring method, and for the quantitative index we use normalized processing. Generally, weight value and threshold value of initialization is the random number from $-1$ to 1.

(3) *The positive information transmission*: In this paper, we use sigmoid function to process network transmission, and purelin function to process transmission is in output layer. After confirming the number of each layer node and transmission function, we initialize the BP network again.
The output vector of hidden layer is $y = f_1\left(\sum w_{ij}x_i + a_i\right)$, the output vector of output layer is $y = f_2\left(\sum w_{jk}y_j + a_j\right)$.

(4) *The reverse error transmission*: Calculation the error E of network. If error E is less than the previously set error $\varepsilon$, the network training process is over, and the output value is approximated the expected value. Otherwise we proceed the reverse error transmission of output layer and hidden layer node.

(5) *Confirm the final evaluation results*. Calculating the global error function $E = \sum \varepsilon_k$, if $E < \varepsilon$ the training process is over. According to the final output value results, the greater the output value, the better the operation effects of logistics park. From very good to very bad, the output value is divided to six levels, very good (0.9–1), good (0.8–0.9), preferably (0.6–0.8), general (0.4–0.6), bad (0.2–0.4), very bad (0–0.2).

## 114.4 The Model Training and Testing

According to the set of evaluation metrics and the BP neural network theory, we establish the model steps. Using the initial, training and simulation functions of Matlab7 neural network tool box, it can quickly complete the network training process.

(6) *Selection of sample data*: Let the 19 indexes of the set of metrics as the input node, the simulation data of the set of metrics of front five logistics park $W_1$–$W_5$ as the training sample, and the back three logistics park $W_6$–$W_8$ as the testing. Normalizing the input data, the input data is shown as Table 114.2.

(7) *Determination of network structure*: The number of input layer node is 19, the number of hidden layer node is 10, and the number of output layer node is 1. The network structure figure is shown as Fig. 114.1. The transmission function of hidden layer node is sigmoid, and the transmission function of output layer node is purelin.

(8) *Model training*: The training time is 265, target error is 0.001, learning rate is 0.01, using Matlab to calculate the algorithm.
After 800 times training, the network overall error is in the range of target allowable error. The prediction error figure is shown as Table 114.3. The training is over.

**Table 114.2** Normalization input datas

| Index | $W_1$ | $W_2$ | $W_3$ | $W_4$ | $W_5$ | $W_6$ | $W_7$ | $W_8$ |
|---|---|---|---|---|---|---|---|---|
| $X_1$ | 0.046 | 0.035 | 0.058 | 0.035 | 0.044 | 0.040 | 0.031 | 0.052 |
| $X_2$ | 0.043 | 0.037 | 0.055 | 0.037 | 0.041 | 0.026 | 0.036 | 0.040 |
| $X_3$ | 0.038 | 0.033 | 0.052 | 0.029 | 0.049 | 0.036 | 0.037 | 0.049 |
| $X_4$ | 0.037 | 0.023 | 0.048 | 0.032 | 0.033 | 0.041 | 0.042 | 0.033 |
| $X_5$ | 0.033 | 0.030 | 0.050 | 0.030 | 0.036 | 0.046 | 0.046 | 0.026 |
| $X_6$ | 0.030 | 0.026 | 0.042 | 0.029 | 0.042 | 0.048 | 0.044 | 0.022 |
| $X_7$ | 0.045 | 0.032 | 0.047 | 0.031 | 0.037 | 0.039 | 0.053 | 0.048 |
| $X_8$ | 0.044 | 0.034 | 0.049 | 0.033 | 0.040 | 0.051 | 0.058 | 0.046 |
| $X_9$ | 0.085 | 0.092 | 0.067 | 0.111 | 0.078 | 0.056 | 0.099 | 0.088 |
| $X_{10}$ | 0.075 | 0.072 | 0.055 | 0.094 | 0.069 | 0.053 | 0.082 | 0.086 |
| $X_{11}$ | 0.068 | 0.085 | 0.056 | 0.087 | 0.062 | 0.062 | 0.076 | 0.079 |
| $X_{12}$ | 0.071 | 0.078 | 0.057 | 0.094 | 0.065 | 0.061 | 0.065 | 0.070 |
| $X_{13}$ | 0.074 | 0.081 | 0.055 | 0.105 | 0.059 | 0.067 | 0.063 | 0.092 |
| $X_{14}$ | 0.068 | 0.075 | 0.060 | 0.092 | 0.071 | 0.072 | 0.061 | 0.093 |
| $X_{15}$ | 0.060 | 0.066 | 0.058 | 0.084 | 0.063 | 0.078 | 0.059 | 0.085 |
| $X_{16}$ | 0.050 | 0.055 | 0.043 | 0.020 | 0.049 | 0.060 | 0.031 | 0.014 |
| $X_{17}$ | 0.049 | 0.049 | 0.046 | 0.016 | 0.046 | 0.053 | 0.033 | 0.012 |
| $X_{18}$ | 0.051 | 0.050 | 0.050 | 0.030 | 0.059 | 0.069 | 0.044 | 0.038 |
| $X_{19}$ | 0.033 | 0.047 | 0.052 | 0.011 | 0.057 | 0.042 | 0.040 | 0.027 |

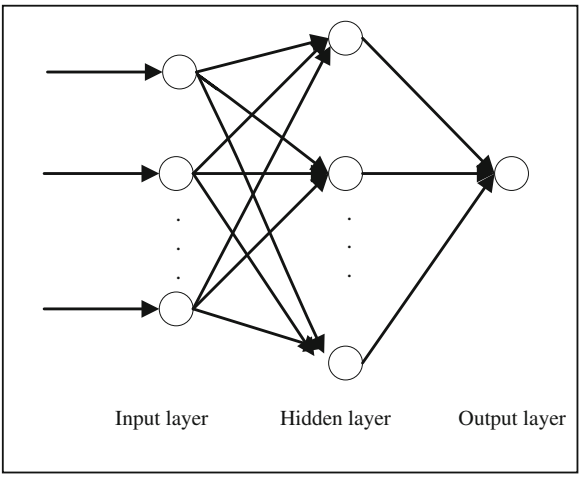


**Fig. 114.1** The network structure figure

**Table 114.3** Forecast error table

| Sample | $W_1$ | $W_2$ | $W_3$ | $W_4$ | $W_5$ |
|---|---|---|---|---|---|
| Expect output | 0.613 | 0.411 | 0.513 | 0.783 | 0.535 |
| Network forecast | 0.607 | 0.395 | 0.509 | 0.788 | 0.533 |
| Forecast error | 0.006 | 0.016 | 0.004 | −0.005 | 0.002 |

(9) *Model testing*: Using the network which has already been trained, we can get network output value of the three samples. The network output value of $W_6$ is 0.488, $W_7$ is 0.752, $W_8$ is 0.613. The network output of $W_7$ is the better one.

## 114.5 Conclusion

In this paper, we have studied the influence factor of the operation effects of logistics park, and establish the set of evaluation metrics of the operation effects of logistics park. Through the BP neural network model, the operation effects of logistics park have been analyzed, then the manager of the logistics park can find the shortage of the operation process, and furthermore, can improve the operation of logistics park.

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