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Enterprise IT application evaluation based on BP neural network in Tianjin city

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ABSTRACT

IT plays an important role in enterprises development. This study, evaluating enterprisesIT application, solve the problems as follows: understand enterprises IT applying degree, identify main influence factors of IT application, and hope to improve the ability of enterprises applyingIT.The significance of solving above problems can promote enterprises to apply IT better, advance enterprises developing and improve enterprises marketing competitiveness. In this paper, based on enterprises IT application data of Tianjin in 2011-2012,BP neural network analyzes the constructed index system of enterprisesIT application,evaluate and rank random 15 companies. The empirical results show that the IT application of enterprises in Tianjin has reached a certain level. The core innovation of this paper is to make sure the degree of applyingITis closely linked with applying software developing, system process integration and economic benefit. Compared with previous work, this paper selects main influence factors to improve IT application from management perspective, according to index weight and proposes a scientific and operable method, which has verified the consistent between evaluation result and practical result.

Keywords: Information Technology (IT); BP Neural Network; Evaluation Index; Application Evaluation

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INTRODUCTION

In today's information society, with the extensive application of the fierce competition and enterprise information technology, enterprise IT has become academic and business issues of common concern. Within the enterprise, make full use of information technology is to enhance the competitiveness of enterprises effective factor [1,2]. Therefore, if we can acknowledge the application degree of IT effectively, reform the current condition of IT application in enterprises with the major factors, and then we can improve the enterprises' comprehensive strength. Meanwhile, the evaluation of enterprises IT application status, strong and helps to straighten their corporate position, but also a major factor promoting the application of information technology companies to take advantage of timely adjustment of internal IT applications. This paper uses BP neural network method to rank enterprises according to IT application condition. The significance of this paper is to promote enterprises to apply IT better according to the main influence factors, as IT is an indispensable factor for enterprises' development.

Category affecting factors of enterprise it application

Paper selected as the application of information technology companies in Tianjin evaluated, focusing on a random sample of 15 enterprises IT application status. On the basis of previous practice and theory [3,4], to determine the first level evaluation index, and Select 14 second evaluation indexes are showed in Table 1.The index can reflect both companies in technology, production and management of internal IT applications, but also to reflect the impact of the external business environment. By refining indicators, the city can be more fully reflect the enterprise IT application status.

Table 1: Tianjin 15 evaluation index system of enterprise information technology applications

Goal	The first index	The second index	Index character	
			Qualitative indicators	Ration indicators
Enterprises IT applications degree evaluation system I	IT indicators I_1	network and communications technology I_{11}	√	√
		applications software development I_{12}		
		IT standards I_{13}	√	
		information demand I_{14}	√	
	information management I_2	information configuration management I_{21}	√	
		IT progress control I_{22}	√	
		IT personnel quality I_{23}	√	
	operational process metrics I_3	production performance I_{31} system runs integration I_{32}	√	√
		business process reengineeringforce I_{33}		
		scheme design level I_{34}	√	
	market environment indicators I_4	sales performance I_{41}	√	√
		customer satisfaction I_{42} product demand I_{43}		√

In this paper, Tianjin enterprise IT applications, for example, determined business-related data collection, qualitative indicators based on expert scoring method , quantitative indicators are selected from within the enterprise data. Select 15 IT application enterprises as the evaluation object, research enterprise IT application status. Table 2 shows the raw data.

Table 2: Enterprise IT application original training sample data

No.	IT indicators				information management			operational processmetrics				market environment indicators		
	I_{11}	I_{12}	I_{13}	I_{14}	I_{21}	I_{22}	I_{23}	I_{31}	I_{32}	I_{33}	I_{34}	I_{41}	I_{42}	I_{43}
1	0.78	0.67	0.78	45.2	0.81	0.82	0.69	897	0.51	0.89	0.92	699	0.83	650
2	0.60	0.63	0.79	38.3	0.80	0.80	0.66	600	0.48	0.78	0.76	360	0.82	500
3	0.57	0.64	0.82	31.0	0.81	0.76	0.65	918	0.56	0.87	0.90	677	0.89	470
4	0.53	0.68	0.75	41.5	0.84	0.79	0.62	991	0.61	0.91	0.92	698	0.90	440
5	0.51	0.73	0.84	29.9	0.78	0.75	0.64	997	0.46	0.78	0.79	962	0.76	420
6	0.48	0.74	0.78	22.9	0.79	0.73	0.66	318	0.55	0.92	0.93	152	0.91	400
7	0.47	0.68	0.76	40.0	0.74	0.77	0.66	800	0.49	0.90	0.91	376	0.93	390
8	0.46	0.71	0.74	37.7	0.75	0.78	0.65	220	0.47	0.95	0.96	101	0.94	380
9	0.45	0.73	0.81	16.8	0.77	0.72	0.61	594	0.46	0.74	0.75	267	0.80	380
10	0.46	0.79	0.83	60.0	0.78	0.77	0.64	300	0.43	0.69	0.68	138	0.62	370
11	0.69	0.72	0.77	50.9	0.82	0.81	0.66	910	0.42	0.69	0.78	698	0.74	570
12	0.63	0.77	0.80	29.5	0.83	0.79	0.64	987	0.44	0.78	0.75	911	0.70	520
13	0.51	0.74	0.81	40.9	0.79	0.74	0.63	330	0.62	0.91	0.83	168	0.86	420
14	0.50	0.73	0.79	36.6	0.78	0.73	0.65	300	0.49	0.87	0.86	150	0.80	420
15	0.47	0.75	0.82	59.7	0.77	0.73	0.66	370	0.54	0.90	0.95	174	0.96	380

BP NEURALNETWORK

BP (Back Propagation) neural network is a group of scientists, led by the Rumelhart and McCelland made in 1986, is one of the most widely used neural network model. BP neural network input layer (input layer), hidden layer (hide layer), the output layer (output layer) of three levels, between layers with no coupling and connection. Input signal propagation from the input layer to the hidden layer node function after treatment of the role of the spread of the hidden layer to the output layer node output signal from the output node and the final output layer node processing results . Usually transfer function(node cell characteristics) for the Sigmoid function, with continuous, differentiable characteristics [5].

Function is expressed as:

$$f(x)=\frac{1}{1+e^{-Ax}} \text{ where } 0<A\leqslant 20 \qquad (1)$$

(1) Determining the number of nodes in the input layer and the processing of input data samples. Standardize

processing, the index data between 0 and 1 for easy data entry and calculations BP neural network.
Standardized values:

$$X_{io} = \frac{X_i - X_{i\min}}{X_{i\max} - X_{i\min}} (2)$$

As X_i is the *i*th index value; X_{io} is astandardized indicator of the value of the *i*th; $X_{i\max}$ is the *i*th largest value index values; $X_{i\min}$ is the*i*th minimum index values.

(2)Determine the number of hidden layer nodes
Currently the number of hidden layer nodes is the most widely used

$$N_H = \sqrt{n+m} + a (3)$$

Which N_H is the number of nodes in the hidden layer, *n*is the input layer nodes number, *m* is the output layer nodes number, *a*isa random constant from 1 to 10.

In this paper, input node number is 17, output node number m is 1, so the number of hidden layer BP neural network nodes in the range of 6-15[6,7]. After repeated testing training, determines the number of hidden layer nodes is 13.

(3)Determine the level of output and Evaluation
Analysis and evaluation of the results in order to meet the needs of the expected output $y_l$digital visual instructions between 0-1 (Table 3) , and accordingly set the very poor, poor, fair, good, very good five levels to illustrate the results of the evaluation of energy-saving boiler equipment.

Table 3: Enterprise IT degree Rank

Expected output	Evaluation level
$0.8 \le y_l \le 1.0$	very good
$0.6 \le y_l < 0.8$	good
$0.4 \le y_l < 0.6$	fair
$0.2 \le y_l < 0.4$	poor
$0.0 \le y_l < 0.2$	very poor

Table 4: Evaluation of Enterprise IT Recognition

Evaluation of the output range	No.	Evaluation output	Expecting Evaluation	Absolute error	level
$0.8 \le y_l \le 1.0$	-	-	-	-	very good
$0.6 \le y_l < 0.8$	1	0.7043	0.70	0.0043	good
	11	0.6459	0.64	0.0059	
	12	0.6193	0.61	0.0093	
$0.4 \le y_l < 0.6$	3	0.4969	0.50	0.0031	fair
	5	0.4917	0.49	0.0017	
	4	0.4564	0.46	0.0036	
	2	0.4475	0.45	0.0025	
	13	0.4071	0.40	0.0071	
$0.2 \le y_l < 0.4$	14	0.3815	0.38	0.0015	poor
	15	0.3404	0.34	0.0004	
	8	0.3258	0.33	0.0042	
	10	0.3219	0.32	0.0019	
	7	0.3152	0.31	0.0052	
	6	0.2556	0.26	0.0044	
$0.0 \le y_l < 0.2$	9	0.1414	0.140	0.0014	very poor

Enterprises it application and analysis
According to BP neural network has been designed structural model, we use learning and training model with the first 10 sets of data and verify the predict accuracy of the model with later five sets of data. In this paper, MATLAB software toolbox running for 15 sets of raw data were normalized surveyed, 144 times in training, network training

error achieve the objectives and requirements, BP neural network stops running, the output value of 15 sets of data evaluation as shown in Table 4 .

From the evaluation process, basing on selected evaluation index, we canacknowledge the enterprise IT application status. However, although the indicators are factors that affect the business applications of information technology, but also further analyze the size of the index weight, to enable enterprises to improve IT applications targeted. There are many ways to determine the weight. The objective method we use is indicators of empowerment variance method. Applying standardized data to calculate the standard deviation for each indicator and weight. The calculations we get in Table 5 and Table 6.

Table 5:Enterprise IT application quantitative index weights

Ration indicators	I_{14}	I_{31}	I_{41}	I_{43}
Weights	0.068	0.073	0.069	0.066

Table 6:Enterprise IT applications qualitative indicators weights

Qualitative indicators	I_{11}	I_{12}	I_{13}	I_{21}	I_{22}	I_{23}	I_{32}	I_{33}	I_{12}	x_{46}
Weights	0.073	0.086	0.070	0.071	0.072	0.060	0.085	0.073	0.065	0.069

The highest index weight is applying software developing, as 0.086, and the lowest index weight is controlling massage process, as 0.060. Thus, the heavier the weight, the more attention we need to pay. And we should develop more applying software and integrate information system to improve the application of IT in enterprises.

CONCLUSION

Table 4 showed the grade of 15 enterprises' IT application evaluation, within the permissible error range.Number1,11,12enterpriseinformation technology under evaluation in a better state level, and number evaluation for enterprise IT application level 9 in poor condition, and other businesses in general and poor states. Score higher enterprise has the following characteristics:First, under the same market conditions, the higher the level of their own management and technology, the higher degree of information technology applications; secondly, fundamental purpose of the enterprise for profit, only the application of information technology will help improve production performance and business performance, enterprise information technology the extent of the application will be higher.

BP neural network method, after BP neural network training, by determining the number of nodes in the hidden layer, and repeated a lot of training, training results and expectations within allowable error range of 15 sets of data can be effectively evaluated 10 sets of data to sort through. Table 3 shows the output of the BP neural network evaluation and assessment expectations maximum difference of 0.0093 within an acceptable range. So, in the data enrichment station, the evaluation results through BP neural network trained with credibility. BP neural network can either evaluate IT application enterprise based on time-series data, and also be used to predict the degree of IT application in enterprises.

This paper, using BP neural network method to analyze the impact factors of ITapplyingin enterprises, attempts to provide reasonable suggestions of promoting application of IT; on the other hand, 15 companies in Tianjin Empirical studies based on 14 kinds of IT application factors presented above, according to the expert scoring and statistical data within the enterprises, the use of econometric methods to explore the 15 enterprises IT application status ranking, to provide enterprises with an IT application quantitative basis. Future research should also note that the following aspects of the problem:

(1) Information technology factors that affect the application of data acquisition, qualitative data is obtained through expert scoring, with a certain degree of subjectivity, the calculation would have some impact. Meanwhile business is the development, future research should be dynamic, should fully consider the impact of the time value of IT applications, data reflect only a point in time enterprise IT application status and rank, where there is no persistence.
(2) In this paper, although the general evaluation of enterprise IT applications , but each industry has its own characteristics and personality, to better corporate IT applications , on the need for enterprise IT factor analysis for each industry characteristics.
(3) In this paper, BP neural network evaluation, but in the actual process, when many factors influence the relationship between corporate IT complexity while on the subject and uncertainties and involve a number of interest conflicts, you also need to try and use the new research methods. Or consider the time sequence, or to expand the panel data.

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