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An intelligent Model for Enterprise Resource Planning Selection Based on BP Neural Network

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ABSTRACT

Enterprise resource planning (ERP) is the managing business system that allows an enterprise of any organization to utilize a collection of integrated applications to manage its business and automate many back office functions related to technology. The selection itself of a suitable ERP is one of the most important parts in the implementation. This paper attempts to use artificial neural networks to choose an ideal ERP for any enterprise. This paper constructs a three-level BP neural network to analyze the principle and model of a suitable ERP. By using the samples to train and inspect the BP neural network, we conclude that the application of BP neural networks is an effective method to forecast suitable ERP. Thus the purpose of this study is to requite mainly three factors among the many others that influence the choice of a suitable ERP. By using statistics in several investigation-filled samples, we can collect a database for many cases that can in return help us create a model that manages the choice of an ideal ERP for the company and reduces the costs of failure.

Keywords

Enterprise resource planning; ERP; ERP implémentation; BP neural network

1. INTRODUCTION

The 21st century is regarded as the age in which informationization has become a massive and important concept in our professional activity. Additionally, computers have been used for decades as tools by companies that are involved in commerce in general, to achieve profitability and improve management. The information technologies such as material requirements planning (MRP) and manufacturing resource planning (MRPII) are built up from early versions of inventory control software.

Nowadays, Enterprise resource planning (ERP) has come to maturity by incorporating more functions such as logistics management, financial management, asset management and human resource management.. [1]

The selection of a suitable ERP decreases cost and increases interests for an enterprise. So, a rational supposition is that an ideal ERP is crucial in its implementation.

The artificial neural networks (ANNs) concept originates from biology. Its components are similar to and have the basic functions of neurons in an organism. The components are connected according to some pattern of connectivity, associated with different weights. The weight of a neural connection is updated by learning. ANNs posses the ability to identify nonlinear patterns by learning from the data. It can also imitate the knowledge-level activities of experts either physically or functionally. Therefore, ANNs can be used in business and banking applications for decision making, forecasting and analysis. In order to search the optimal weights for neural networks, a number of algorithms have been coined and developed. The back propagation (BP) training algorithms are probably the most popular ones. The structure of BP neural networks consists of an input layer, an output layer, as well as a hidden layer. The numbers of the input and output layer nodes are decided by task requirements. The optimal number of hidden layer nodes is determined by certain testing experiments. The BP training algorithms are well known for that. Yet they may have a slow convergence in practice, and the search for the global minimum point of cost function may be trapped at local during gradient descent. [3]

The remainder of the paper is organized as follows; the first section is for the abstract and introduction. The second section is dedicated to the literature review. The third one proposes a model of BP neural network for forecasting appropriate ERP for the company. The fourth section describes the sample selection and data analysis. As for the last section, it provides a summary to this work and conclusions.

2. LITERATURE REVIEW

Enterprise Resource Planning (ERP) is a standard of a complete set of enterprise management system. It emphasizes integration of the flow of information relating to the major functions of the firm.

The choice of a suitable ERP is the most important and crucial step. Many companies fail in their implementation due to their poor selection methods, which allows us to note that, the opinion of an expert is crucial for the right implementation to take place. There are several modules for implementing an ERP in a company, but the main one is the choice of an ERP.

There are numerous phases in the ERP implementation process. One of the earliest and most critical phases is the ERP selection phase. If an organization selects an inadequate ERP to fit their needs, the project will most likely destine to fail. Research and practice have provided several cases of ERP project failures because of a faulty selection process. No matter what amendments the adopting company undertakes in the later phases, if there is no fit, there is no success.[2]

Recently, scholars and researchers have proposed many tricks to provide better selection methods for a suitable ERP, for example, *Se Hun Lim and Kyungdoo* Nam have analyzed an Artificial Neural Network Modeling in forecasting successful Implementation of ERP systems.[5](See figure2)

Today, the quality of decision-making is a prime factor for success in top management which allowed us to choose the ANN view for its reputation; big business and banking applications for decision-making have used ANN. [3]

In a survey of business applications from 1992 to 1998, Vellido et al. found neural networks are matured to offer real practical benefits. Consequently, it can be used to assist in selecting potential suppliers (partners). Since the back propagation (partners) neural networks was proposed by *Rumelhart D E ECT*, a number of network models have been developed with the BP neural network as the one most favored by neural networks researchers. [3]

BP Neural Network

BP neural network is a multi-layer neural network of error back-propagation (see figure 1). It consists of three layers: a layer of "input" that is connected to a layer of "hidden" units, which is connected to a layer of "output" units. The activity of the input units represents the raw information that is fed into the network. The activity of each hidden unit is determined by the activities of the input units and the weights on the connections between the input and the hidden units. The behavior of the output units depends on the activity of the hidden units and the weights between the hidden and output units.

The multi-layer perception is trained under supervision using the back propagation algorithm. By using a training algorithm to adapt the interconnection weights, BP neural network has the ability to implement a wide range of responses to the patterns in a given training set. The network functions in two stages during training: a forward pass and a backward pass. In the forward pass, the input vector is presented to the network, and the outputs of the units are propagated through each upper layer until the network output is generated. The difference (error) between the network output and the desired output is computed for each output unit. In the backward pass, starting from the network output, a function of the error is fed back through the network layers to the input stage. The interconnection weights are adjusted during the backward pass to minimize the error. The forward and backward passes are repeated until the network converges, that is, until a measure of the error is acceptably small.

The convergence of the BP neural network can be tested in several ways. The most practical test for network convergence is the error limit test, i.e., to test if the absolute difference between the desired response and the response for each output unit is below a small specified error limit. Alternatively, training could be terminated when the sum of the squares of the errors for all output units is below a specified limit.

The learning algorithm of BP neural network is

shown as follows[18]:

1. Using random value (between 0 and 1) to initialize

Wji and θj. Wji is the link weight from neuron i to neuron

j, θj is neuron the threshold value of j (hidden layer and

Output layer).

2. Using the deposing training sample collection

{xP1} and the corresponding desired output collection

{yP1}. The p, l delegate sample number and the difference

Vector number separately;

3. Calculating each neuron output Oij :

(1) Regarding the input layer neurons, the output is

The same to its input,

Opi= xpi (1)

xpi is the pth sample's ith value;

(2) Regarding hidden layer and output layer, neuron

Output operation is as follows:

Oij=f (Σwjiopi-θj) (2)

Oij is the neuron i's output, also is the neuron j's

Input, f (x) is a non-linear differentiable non-decreasing

Function, generally, it is considered as sigmoid function,

f (x) =1/ (1+e-x) (3)

4. Calculating each neuron's error signal:

Output level: δij= (yij-oij) oij (1-oij) (4)

Input level: δij=oij (1-oij) Σδijwij (5)

5. Back-propagation, revises weight

Wj (t+1) =wj (t) + αδijoij (6)

α is the learning speed;

6. Calculating error

Ex= {ΣΣ} (opk-ypk)2/2 (7)

If E x is smaller than fitting error, finishes the network

Training; otherwise transfers it to 3, continues to train.

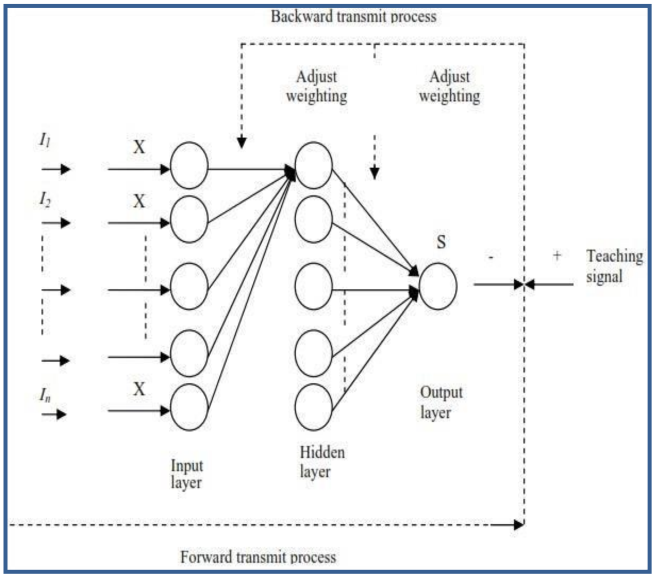


Figure 1: Structure of three –layer BP neural network

In my research I try to reconsider the factors that directly influence the proper choice of an ERP. First, I present the factors that directly influence the choice of an ERP with multiple articles in the same way. Then I present my 3 factors that I have reviewed from an investigation, I will speak in-depth about the investigation in chapter Analysis example.

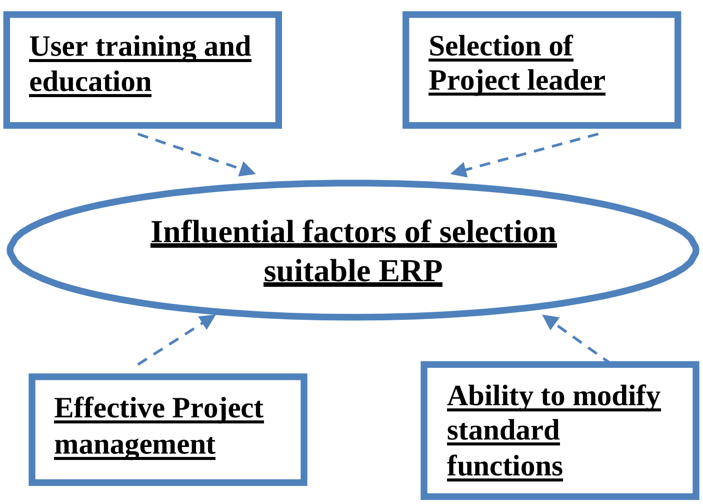


Figure 1: Influential factors of selection ERP (Concluded by the other articles)

3. EXAMPLE ANALYSIS

The empirical data for this research comes from the investigation in an online platform. Indeed, this survey consists of more than 48 well-chosen and well-defined questions. But our goal is to minimize the questions. The minimum possible is to have the most interesting factors that influences the choice of ERP, then use them as Layer BP neural network. I was able to have more than 80 filled with different consultants which gave me a database to base this research upon. This database consists of several replies from consultants in Morocco.
After the data collection, I found out that to have results in our research, the rematch of the moderating indicators that directly influences the final result is missed.

I used Software R statistical software that analyzes all the data and chooses the moderating indicators that influence greatly the final result.

Indeed I was able to work with the method logistic regression (Anova) which gave me 3 moderator indicators as I confirm this with another method of:

Step by step (see figure 3)

Analysis of variance (Anova): is a collection of methods for comparing multiple means across different groups

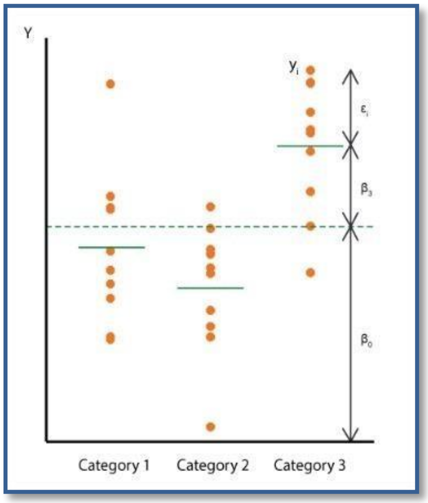
ANOVA MODEL

If p is the number of factors, the ANOVA model is written as follows:

$$y_i = \beta_0 + \sum_{j=1...q} \beta_{k(i,j),j} + \varepsilon_i$$

Where y_i is the value observed for the dependent variable for observation i, k $_{(i,j)}$ is the index of the category (or level) of factor j for observation i and ε_i is the error of the model.

The chart below shows data that could be analyzed using a 1-factor ANOVA. The factor has three categories. Data are orange points. The dashed green line is the grand mean and the short green lines are category averages. Note that we use arbitrarily the sum (ai) =0 constraint, which means that β_0 corresponds to the grand mean.



The hypotheses used in ANOVA are identical to those used in linear regression: the errors ε_i follow the same normal distribution N (0, s) and are independent. It is recommended to check retrospectively that the underlying hypotheses have been correctly verified. The normality of the residues can be checked by analyzing certain charts or by using a normality test. The independence of the residues can be checked by analyzing certain charts or by using the Durbin Watson test.

Finally I had 3 moderator factors that I will use:

X1: Effective Project Management
X2: Level of implementation difficulty
X3: Percentage of coverage before adaptation

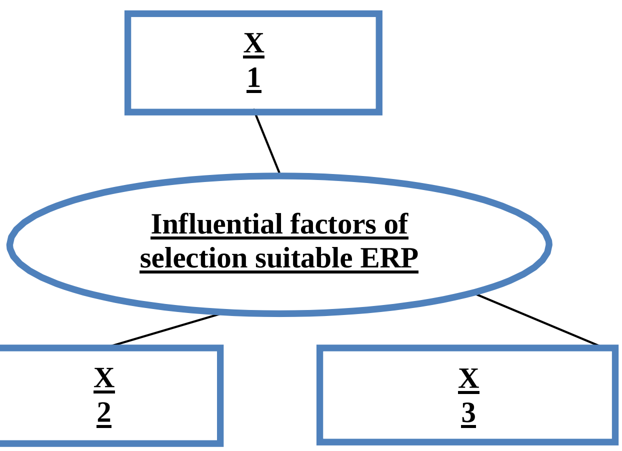


Figure3: Influential factors of selection ERP in this research (concluded by the software R)

This paper constructs a three-layer BP neural network model which can forecast suitable ERP for any Enterprise. We forecast 80 samples of Expert opinion. The first 50 samples are used to train the neural network, and the last 30 samples are used to inspect the training effect. The result shows that BP neural network can be employed to the selection of suitable ERP for any enterprise. Compared to traditional methods, BP neural network has more advantages. The principle of BP neural network is simple. It has strong maneuverability, fast speed and satisfying fitting precision. The enterprises can employ it to avoid a great deal of calculation and human errors. At the same time, they don't need to waste much time and human resources on collecting the data or opinions of experts. So the BP neural network can help enterprises reduce costs greatly through the information which technologies of ERP can provide.

As seen in the three boxes: Current ERP is the choice of an expert, ERP estimated is our ERP that is concluded by our model of BP Neural network and the relative error

Note: ERP has been replaced by numbers for statistical software.

Table1

NETORK TRAINING RESULT

Question	**Current ERP**	**ERP Estimated**	**Relative error %**
X1	5	4	10%
X2	6	5	10%
X3	12	10	20%
X4	4	3	10%
X5	5	4	10%
X6	4	3	10%
X7	6	4	20%
X8	6	5	10%
X9	7	6	10%
X10	5	4	10%
X11	4	3	10%

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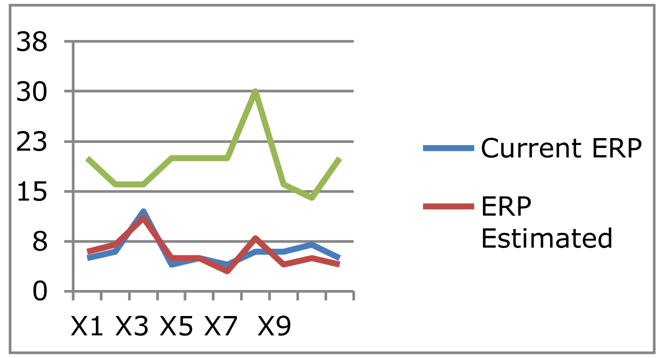
X12	5	4	10%
X13	6	4	20%
X14	7	6	10%
X15	3	4	10%
X16	3	4	10%
X17	6	4	20%
X18	5	4	10%
X19	4	3	10%
X20	7	5	20%
X21	4	3	10%
X22	3	3	0%
X23	5	4	10%
X24	4	3	10%
X25	6	7	10%
X26	3	4	10%
X27	5	5	0%
X28	5	7	20%
X29	5	4	20%
X30	3	4	20%

GRAPH OF CURVE RESULT



We can find that the simulated outputs are basically consistent with the desired outputs and all the relative errors are below 20%. We can also find that in the training samples or the inspection samples, the simulated rank of the samples are consistent with the actual ERP selection of the samples. It proves that the results for the forecasting are precise. We can adjust the weights and thresholds by training the network time after time to improve precision and reduce the relative error. By doing this, we can get simulated outputs which are quite accurate and close to the desired outputs

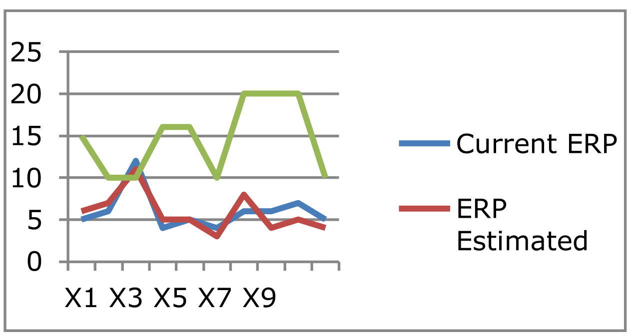
Table2

NETORK INSPECTING RESULT

Question	Current ERP	ERP Estimated	Relative error %
X1	5	6	10%
X2	6	7	20%
X3	12	11	10%
X4	4	5	10%
X5	5	5	0%
X6	4	3	10%
X7	6	8	20%
X8	6	4	20%
X9	7	5	20%
X10	5	4	10%

X11	5	5	0%
X12	5	4	10%
X13	3	3	0%
X14	6	5	10%
X15	3	4	10%
X16	3	4	10%
X17	5	5	0%
X18	2	2	0%
X19	5	4	10%
X20	6	5	10%

GRAPH OF CURVE RESULT



We can find that the simulated outputs are basically consistent with the desired outputs and the entire relative
Errors are below 20%.

In order for us to be successful, we need to use other means and other methods to compare the results and find the difference
that compelled me to look for other methods in the same way. This allowed me to choose the linear regression as a linear approach for modeling the relationship between a scalar dependent variable *y* and one or more explanatory variables (or independent variables) denoted *X*. The case of one explanatory variable is called *simple linear regression*. For more than one explanatory variable, the process is called *multiple linear regressions*.[1] (This term is distinct from *multivariate linear regression*, where multiple correlated dependent variables are predicted, rather than a single scalar variable.)

4. CONCLUSION

In this research, we constructed a three-layer BP neural network model which can forecast and select the suitable ERP for any Enterprise. We forecast 80 samples of Expert opinions. The first 50 samples are used to train the neural network and the last 30 samples are used to inspect the training effect.
The result shows that BP neural network can be employed in the selection of suitable ERP for any enterprise..
The principle of BP neural network is simple. It has strong maneuverability, fast speed and satisfying fitting precision. The enterprises can employ it to avoid a great deal of calculation and human errors. At the same time, they don't need to spend much time and human resource on collecting the data. So the BP neural network can help enterprises reduce costs greatly. Besides this, the information technologies of ERP can provide data which are more comprehensive, accurate and timely for the application of neural network. It is an advisable approach for the enterprises which implement ERP to apply neural network. Therefore, we can conclude that the forecasting model based on three-layer BP neural network proposed in this paper is valuable in practice.

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