

THE STUDY OF INNOVATIVE ENTERPRISE EVALUATION INDEX SYSTEM AND SOFTWARE

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ABSTRACT

On the basis of the national innovative enterprise's evaluation index system, this paper established a new innovative enterprise evaluation indicator system; furthermore, it puts forward the evaluation method. It includes four aspects: the innovation input, the achievement transformation, digestion and absorption of imported technology, and innovative carrier construction. By applying the analytic hierarchy method, it obtained Enterprise Evaluation weight coefficients of the index system. The research of the innovative enterprise evaluation indicator system result has been carried out by applying the BP Neural Network Model. By using of VB programming language and access database, it realized the trend prediction of innovative enterprise evaluation and result evaluation. The software of innovative enterprise evaluation has the functions of good interface, easy operation, comprehensive information and resource sharing.

Keywords: *Innovative Enterprise, Index System, the BP Neural Network Model, Evaluation Software*

1. INTRODUCTION

Innovative enterprises' building process of its evaluation index system is a process that the understanding of evaluation object's overall quantitative features is gradually deepen and perfect and a scientific practical indicator system is the basis of finishing the evaluation[1]. In the process of designing of evaluation, we should abide by the guiding thought which is to employ the idea of system theory and the method of system analysis, to combine the national conditions, to absorb and take example by the merits of related research both at home and aboard, therefore to strive to present the essential connotation and features of enterprise innovation. In terms of choosing index, qualitative index, quantitative index, aggregate index and per capita index, we must balance them[2]. In the premise of being scientific reasonable, we must strive for the use of index system is simple, featuring the operability for reasonably estimating the innovative enterprises and justly allocating the national innovative resources, thus to build a index system of innovative enterprises is ever so important.

2. EVALUATION INDEX SYSTEMS

2.1. Index Selection

Innovative enterprises are defined to have a certain innovative strength and a development

potential, possessing the independent intellectual property rights and self-owned brand, depending technological innovation to achieve the market competitive advantage and sustainable development of enterprises rely on. The selection of the evaluation index[3] is the important key to establish the evaluation system. According to the elements of the enterprise innovation ability and the purposes and principles of the design index system and as well take into account the elements of the enterprise innovation are too many, this will cause inconvenience in the evaluation. It will divide the enterprise technology innovation ability into four parts; they are innovation input capability, achievements transformation capacity, coupled with the introduction of technology digestion and absorption capacity, innovative carrier capacity, in all four one class indexes[4]. And secondary indexes are selected on this basis. As shown in Table 1.

Table 1: Index System

First grade index	Secondary index
Innovation input	R&D Personnel accounted for the proportion of the total number of staff and workers (%)
	R&D Investment accounted for the proportion of sales revenue (%)
Achievements transformation	The patent license number in those years (piece)
	Invention patent authorization



	number in those years (piece)
	The increase number of new products and put into production (piece)
	The leading products adopt new technology, new process and new equipment's quantity (term)
Introduction of technology digestion and absorption	Digestion and absorption expenses accounted for the proportion of imported technology expenditures. (%)
Innovation carrier	R&D institution construction situation High-tech enterprise situation

Fields of Support within the Range of Ongoing within the range of ongoing research and development and technology achievements, forming enterprise core independent intellectual property rights and the business activities of resident enterprise on this basis is knowledge intensive and technology intensive economic entity. Above city level high-tech enterprises: numerical based on the science and technology department statistics caliber. High-tech enterprises in technological innovation and enhance the ability of independent innovation, the development of enterprises in our country and technological innovation in a leading position in the construction of the main body, the amount of a certain extent, affects the city's overall innovation strength.

2.2. Index Interpretation

Innovation investment ability[5] is to show the enterprise innovation resources on quantity and quality and reflect the basic of index of enterprise innovation ability. Innovation investment ability mainly considers the enterprise internal investment including financial investment and human resource. R&D is part of the technical development, meaning for knowledge creation and application of the system creative work, and is a continuous process of explore, discover and apply new knowledge. Total sales revenue of sales income refers to the main product. R&D input costs accounted for the proportion of sales revenue[6]. Talent is the foundation of the enterprise; man is the decisive factor of the enterprise prosperity. Achievement transformation include the authorized number in invention patent and increase the number of new products at or above the provincial level, the leading product adopting new technology and new equipment. Patent license number refers to the annual report by the administrative department for the patent application no objection or objection was after examination so make a decision on the grant of the patent right and issue the patent certificate related to the matters shall be registered and announced the patent number. The digest and absorb index of the introduction technology refers to the control, application, copying and carry out the work of imported technology, and the basis of the innovation[7]. Introduction of technology digestion and absorption expenditure include: training, surveying and mapping to participate in the digestion and absorption of personal salary, tooling, process development fee, the necessary equipment, any expenses, etc. Innovation carrier contains research and development organization construction of new and high technology industries. Enterprise research and development institutions can be divided into national, provincial, municipal and level. High-tech enterprise generally refers to the state promulgated the National Key High-tech

3. INNOVATIVE ENTERPRISE EVALUATION MODEL

3.1. Based On the Analytic Hierarchy Process to Determine the Weighing Values for Assessment Index System of Innovative Enterprise

The whole process of analytic hierarchy process is to people's thinking process structured, hierarchic, and systematic. This process is mainly in hierarchical order pass, on the basis of the index system used to decompose the comprehensive system, through the same levels between the related factors of two transverse comparison, each other through different levels between the longitudinal comparison, using the results of the comparative advantages and disadvantages to calculate the coefficient of the weight of each index and ranking, eventually to determine the relative merits of the scheme[8]. Using analytic hierarchy process to evaluate analysis, should be on the basis of fully understanding the intentions of the maker's decision and through the establishment of hierarchical model, comparison, and complete the assessment process. Its modeling and assessment process has five steps:

①According to the factors of causal hierarchical relationships, hierarchical structure model is established. According to the research plan of the main factors involved in the correlation, stratification is based on these factors hierarchical structure is the first step on the analytic hierarchy process [9] is used to study the problem. Levels can be divided into three big levels: top (target layer), middle layer (layer standards) and the lowest layer (layer scheme).

②The structure judgment matrix

After establishing the hierarchy, the next step is to make sure how to determine a level of each element and its former corresponding domination of the weight of relative factors. Assume that a certain criterion layer has n factors,

$$\begin{bmatrix} 1 & a_{12} & a_{13} & \dots & \dots & a_{1n} \\ a_{21} & 1 & a_{22} & \dots & \dots & a_{2n} \\ a_{31} & a_{32} & 1 & \dots & \dots & a_{3n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & a_{n3} & \dots & \dots & 1 \end{bmatrix}$$

$$A = \{A_1, A_2 \dots A_n\}$$

in order to determine how much proportion these factors take to the level of the former, we should make a comparison between two lines. Using a_{ij} as the ratio of the factor A_i to factor A_j , the concrete number is determined by the relative importance of the former level. Compare all of these factors between two lines, the result consists of comparison between two judgment matrix $A = (a_{ij})_{n \times n}$, among

them, $a_{ij} > 0$, $a_{ij} = \frac{1}{a_{ji}}$, $a_{ii} = 1$,

Determine matrix:

Calculating the factors of relative weight that relate to the target layer from target layers to plan layer step by step, and determining the total order of the project relative to the target layer.

⑤ Hierarchy total sort and determine the optimal decision scheme. Through the hierarchy total order plan to validate the consistency of layer value of the weight of each factor, which is relative to the orders of the program standard of the final total score, according to the size of the numerical sorting, sequencing results can be as a final decision. Using analytic hierarchy process (ahp) in evaluation system index weight by constructing two comparative judgment matrix, calculated from the relative, the final weight of each level factors are 15,15,10,10,15,15,10,5,5.

Table 2: Index Weight

First grade index	Secondary index	Right subdivision
Innovation input	R&D Personnel accounted for the proportion of the total number of staff and workers (%)	15
	R&D Investment accounted for the proportion of sales revenue (%)	15
	The patent license number in those years (piece)	10
	Invention patent authorization number in those years (piece)	10
	The increase number of new products and put into production (piece)	15
Achievements transformation	The leading products adopt new technology, new process and new equipment's quantity (term)	15
	Digestion and absorption expenses accounted for the proportion of imported technology expenditures. (%)	10
Introduction of technology digestion and absorption	R&D institution construction situation	5
	High-tech enterprise situation	5

3.2. The BP Neural Network Model

The BP neural network of error back propagation neural network is referred to as "BP", it consists of an input layer, one or more of the hidden layer and an output layer structure, each time by a certain number of neurons composition. BP network is a kind of three or more than three layers of the hierarchical structure of the network, it not only have input layer node, the output layer node, still can have one or more of the hidden layer nodes. Construction of Three-tier topology is as follow:

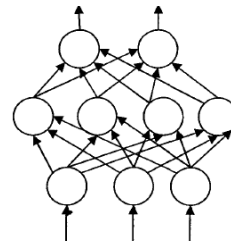


Figure 1: Layer BP neurons Model

As for the input layer BP neurons Model, the output and input are similar[10-11]. The Operating

rules of the Middle hidden layer and output layer are as follow:

$$y_{kj} = f\left(\sum_{i=1}^n w_{k-1i,kj} y_{k-1i}\right)$$

and $y_{k-1,i}$ is the output of the neuron(i) on the layers k to 1, as well as the input of the neuron on the layer k; $w_{k-1i,kj}$ is the connection weights of the i-th element of the layer k-1 and the j-th element of layer k;

y_{kj} is the output of the j-th neuron, as well as the input of the neuron of the layer k+1.

F is the transfer function and the conversion function of the neurons in input information to the output. Generally, the function expression is:

$$f(x) = \frac{1}{1 + e^{-\frac{x}{q}}}$$

and when

$$q = 1$$

the graph is as follow:

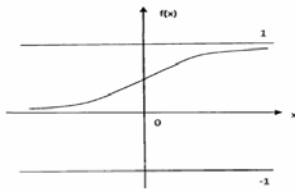


Figure 2: Function Diagram Of Sigmoid

The specific operating procedures of the BP neural network model are as follow:

Imagine the input neuron is h, hidden layer neuron is i, the output neuron is j, nh, ni, nj are respectively the number of the node of the 3 layers. θ_i, θ_j are the node i of the hidden layer and the threshold of the node j of the output layer. w_{hi}, w_{ij} are Input layer nodes h and hidden nodes i, the connection weights between the hidden layer nodes i and output layer nodes j. The input of each node is x, and the output is y.

Initialization. Set have been normalized input and output samples

$$\{x_{kh}, d_{kj} | k = 1, 2 \dots nk; h = 1, 2 \dots nh; j = 1, 2 \dots nj\}$$

nk is Sample size and connection weights w_{hi}, w_{ij} and threshold θ_i, θ_j s, respectively, given a random value in the interval of (-0.1, 0.1)

Suppose $k = 1$,

provide the internet with the sample

$$\{x_{kh}, d_{kj} | k = 1, 2 \dots nk; h = 1, 2 \dots nh; j = 1, 2 \dots nj\}$$

Calculate the hidden layer of each node of the input x_i , output

$$y_i (i = 1, 2 \dots ni)$$

$$x_i = \sum_{h=1}^{nh} w_{hi} x_{k,h} + \theta_i$$

$$y_i = \frac{1}{1 + e^{-x_i}}$$

(4) Calculating the output layer of each node of the input x_j , output $y_j (j = 1, 2 \dots nj)$

$$x_j = \sum_{i=1}^{ni} w_{ij} y_i + \theta_j$$

$$y_j = \frac{1}{1 + e^{-x_j}}$$

(5) to calculate the total input received by each node in the output layer changes, the error rate of change of a single sample point

$$\frac{\partial E_k}{\partial x_j} = y_j(1 - y_j)(y_j - d_{k,j})$$

and the single sample point error of the k th is

$$E_k = \sum_{j=1}^{nj} (y_j - d_{k,j})^2 / 2$$

the rate of change of the single sample point error when calculating the hidden layer nodes received a total input change,

$$\frac{\partial E_k}{\partial x_i} = y_i(1 - y_i) \sum_{j=1}^{nj} \left(\frac{\partial E_k}{\partial x_j} w_{ij} \right) \quad (i = 1, 2 \dots ni)$$

(6) Correction of the connection weights and thresholds

$$w_{ij}^{t+1} = w_{ij}^t - \eta \frac{\partial E_k}{\partial x_j} + \alpha(w_{ij}^t - w_{ij}^{t-1})$$

$$\theta_j^{t+1} = \theta_j^t - \eta \frac{\partial E_k}{\partial x_j} + \alpha(\theta_j^t - w\theta_j^{t-1})$$

$$w_{hi}^{t+1} = w_{hi}^t - \eta \frac{\partial E_k}{\partial x_i} + \alpha(w_{hi}^t - w_{hi}^{t-1})$$

$$\theta_i^{t+1} = \theta_i^t - \eta \frac{\partial E_k}{\partial x_i} + \alpha(\theta_i^t - w\theta_i^{t-1})$$

And t is the Number of corrections, learning rate $\eta \in (0,1)$, momentum factor $\alpha \in (0,1)$. when η is larger, algorithm converges faster, but unstable, may shock, when η is smaller, and the algorithm converges slowly; the function of α is opposite to the function of η .

(7) Set $k = k + 1$, take learning mode available to the network $(x_{k,h}, d_{k,j})$, go to step (3) until all mode of training is completed, proceed to step (8), The take learning mode available to the network, go to step (3) until all mode of training is completed, proceed to step (8) (8) Repeat steps (2) to step (7), until the network global error function

$$E = \sum_{k=1}^{nk} E_k = \sum_{k=1}^{nk} \sum_{j=1}^{nj} (y_j - d_{k,j})^2 / 2$$

(8) To determine whether the network error to meet the requirements. In the above learning step, step (3) (4) to enter the learning mode "forward propagation process[12], in step (5) (6) (7) network contrast" back propagation process, step (8)(9) Upon completion of the training and the convergence process. As we can see from the algorithmic steps of BP, BP model [13] alter a group of samples which contains input / output into a non-linear optimization problem. It applies the gradient descent method which is common in optimization. If regard the neural network as a mapping from input to output, it is a highly non-linear mapping.

4. EVALUATION OF THE SOFTWARE DEVELOPMENT BY INNOVATIVE ENTERPRISES

Evaluation of the software development by innovative enterprises is a basic function which evaluates index system and information database of input, query, delete, save and print and so on to innovative enterprises. Mathematician on the basic of keeping scoring record in all previous, evaluate each project by applying fuzzy mathematical method persevere the results of the evaluation, and then rank the results of the evaluation according to the innovation capacity of enterprises.

4.1 The Goals and Process of the Main Program Interface

After starting program and validating operator's password in the login screen will enter the main program interface. Main interface realizes the following functions:

- (1) Choose the main interface menu or toolbar, call the corresponding program and carry on the corresponding operation.
- (2) Get into the evaluation system interface and forecast decision system interface.
- (3) Display the information of developers, date of system and help menu.

The process is as follows: Build a new standard engineering, named "index system and information database and evaluate system to innovative enterprise" the system. VB under the system know to create a new form, and will give it a name "nlmain". Click the project menu and the "components" option under it, selected "Microsoft Windows is Control6.0" under the popup list. Click "ok" and add Imafe LIS controls, Toolbar control Status Bar control to the toolbox. In the form, add an imafe Li control, a Toolb at control, a Status Bar control. With the right button click Status B at control and choose "properties" from the pop-up menu[14]. In the property page, click the "pane" Tab and then set two panes. Set the style index 1 of the pane 0—sbrtext and input text "warning: all rights reserved". Set the style index 2 of the pane is 6—sbrDate. Click "editor" under the "tools" and set the program to menu in the menu editor.

4.2 Design of Module to Login the System

After start of the program one should enter to the login screen where operator password should be verified. The functions of design module to login the system are as follows. 1. Operator privileges

can be chosen through a mouse and a keyboard. 2. Rightness of password's authentication of the operator can lead to the entrance to the main screen. 3. Both error of operator's password and operator's error would be reminded to re-enter. 4. The system will automatically exit through password entered.

Implementation of the system is as follows: (1) in the new construction of "firm Login" two label controls, two text controls, the four command control and a anodal control are involved. (2) To set that caption property of the label control is "User Name (&U)" and "password (& p)". And to set the four caption properties of command control are identify, modify password, registration and cancellation. (3) Anodal control is that achieves to login access database-table and connection between two text data. (4) Part of the code is:

```

    If txt User Name=" " Then
        MsgBox " ", vbInformation, " "
    Exit Sub
    Else
        Dim cn as ADOBE.Recordset
        Dim rs Integer
        Set cn=New Connection
        cn.Cursor Location=adUseClient
        cn.Open"Provider=Microsoft. Jet.OLEDB.4.0;
        "& "Data Source=" & App.Path &
        "\login.mdb; "& "Persist Security Info=False;"
        Set rs= New Recordset
        rs. Open"select*from login", cn,ad
        OpenStatic,adLock Optimistic
    End If
    rs.Move First
    Do While rs.EOF= False
    If rs("username")=Trim(txt UserName)Then
        txt UserName=""
        txt Password=""
    Unload Me
    Frm Main.Show
    Exit Sub
    i=i+1
    If i=3 Then End

```

```

txt UserName=""
txt Password=""
txt UserName.Set Focus
End Sub
Private Sub frmlogin_Load()
    frmLogin.Caption=" innovative enterprise
evaluation indicator system "
    Text1=""
    Text2=""
    Text2.Password Char="*"
End Sub

```

5. SUMMARY

New and innovative index-system of enterprises' evaluation [15] in the article includes the content of the nationally innovative index-system of enterprises' evaluation, and the standard system is more scientific and rational, which is easy to practice. The index's weight is determined by the use of the analytic hierarchy and investigation from experts so as to reduce the workload of experts' scoring. Combining composited score with single score of index both that whether the standard of innovative is generally achieved or not and that the standard enterprises can be determined by anglicizing the compliance of individual indicators so as to fatherly enhance innovation capability. Application of VB programming language and the one of access database-table lead to the production of innovative enterprise-evaluation software so as to achieve a comprehensive evaluation of innovative enterprises and prediction of the evaluation results.

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