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Enterprise Green Construction Cost Control Strategy Based on BP Neural Network

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Abstract. Most enterprises face the problem of insufficient environmental costs due to high investment and low profits in green construction. Therefore, this paper utilizes the advantages of neural networks to establish a green building construction cost estimation model based on BP neural networks. We analyze the problems in environmental cost accounting and control during the implementation of green construction, and obtain the engineering characteristic factors that affect cost control. Then, based on these characteristic factors, a suitable measure project cost prediction neural network model was constructed, which automatically extracts the regular relationship between engineering features and cost data from a large amount of past calculation data. Finally, a case study was conducted to estimate the environmental cost accounting system of a certain steel enterprise based on BP neural network. The analysis results indicate that the cost prediction model proposed in this article has better stability and can accurately estimate the cost of green buildings.

Keywords. green construction; BP neural network; environmental costs; MATLAB; training.

1. Introduction

In recent years, the rise of green building conforms to the scientific concept of development and can play a virtuous role in the sustainable development of the construction field. However, some enterprises believe that the construction cost of green building is too high and the construction procedure is complex. These factors restrict the popularization and development of green building construction to a certain extent [1]. From a macroeconomic perspective, the national level should consider how to give consideration to environmental protection and economic development; From a micro perspective, enterprises are facing the contradiction between environmental protection and cost control. China attaches great importance to environmental issues. In recent years, environmental policies and regulations have become more perfect and stricter, which has also brought pressure to relevant enterprises. How to balance the relationship between environmental protection and cost control is also an issue that enterprises need to be considered. It is a new challenge for enterprises [2]. With the continuous development of the construction market, it is necessary to control the cost of construction projects in a reasonable manner, so that limited funds can be used more reasonably in construction projects. It is necessary to take engineering planning and design as the source, and control the cost of construction projects at various stages of

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construction. As is well known, engineering costs are influenced by multiple factors and their composition is relatively complex. However, a cost engineer with rich experience, based on the type, characteristics, and related situations of the project. By referring to past experience and engineering data, the cost can be roughly estimated without the need for a large amount of complex calculations. The richer the experience, the more information is accumulated, and the more accurate the estimated cost is to imitate this brain thinking mode, which is exactly what artificial neural networks are good at [3].

This paper attempts to analyze the environmental control problems in enterprise green construction from the new perspective of neural network model. Firstly, the main cost influencing factors of green building construction were analyzed, and data related to construction costs were collected, including project scale, material costs, labor costs, equipment costs, etc. Then, input it as a training sample into the established BP neural network model. MATLAB is used to construct a neural network model, to analyze the prices of people, materials, and machines collected in the database as sample data, and predict the prices of people, materials, and machines. Finally, the dynamic engineering quantity and predicted price are combined to obtain the total dynamic cost. The experiment takes a certain engineering project as a case study and inputs historical prices as sample data into the prediction model proposed in this article for learning and training. The conclusion is that the green construction cost control based on BP neural network is effective, which provides a new optimization way for the overall construction quality management.

2. Preliminary Knowledge

2.1 Definition of Enterprise Environmental Cost

The environmental cost of an enterprise refers to all the expenses needed to solve environmental pollution and ecological damage in the process of raw material supply, production, transportation, use and recycling in the production activities of its products. According to the value chain theory, the formation of enterprise environmental cost should not be limited to the enterprise, but has a close relationship with external suppliers and customers. However, at present, most enterprises in China are only limited to the production link in terms of environmental cost control, and often use post accounting. According to the value chain theory, the competition between modern enterprises has become the competition between value chains. The traditional environmental cost control mode adopted by Chinese enterprises has been far from being able to adapt to the reality. Enterprises must fully consider the pollution and damage of products to the natural environment in all links of the value chain. According to the classification of value chain mentioned above, from the perspective of value chain theory, enterprise environmental cost control should start with internal and external value chains to form an enterprise environmental cost value chain, as shown in figure 1, to better implement environmental cost control [4,5].

2.2 BP Neural Network and Its Application in Construction Cost Control

BP neural network is a forward feedback neural network that learns the mapping relationship between input and output by training a dataset. The propagation process of

BP neural network includes forward propagation and backpropagation, where backpropagation is essentially "negative feedback". It is similar to a closed-loop system in control, where feedback is used to correct deviations and achieve satisfactory output results; For error processing, a gradient descent method and multiple iterations were used to find the minimum error. During this process, for each iteration, the weights between nodes in different layers will be updated once. Due to the dynamic update of weights, the error obtained from each forward propagation is also dynamically updated until the desired output effect is achieved

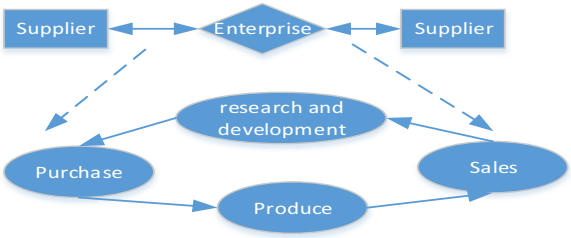

Figure 1. Enterprise environmental cost value chain.

In construction cost prediction, the BP neural network can predict the cost of a construction project by inputting some relevant characteristic parameters, such as project scale, material cost, labor cost, etc. In construction cost prediction, the BP neural network can be trained through a large amount of historical data to learn the complex relationship between input features and costs. Once trained, the BP neural network can be used to predict the cost of new construction projects and help project managers make decisions. However, it should be noted that the BP neural network also has some limitations in construction cost prediction. For example, if the input features are not comprehensive or the data quality is not high, the prediction results of the neural network may have certain errors. In addition, the training process of BP neural networks requires a large amount of computing resources and time, which may pose challenges for larger datasets.

3. Enterprise Green Construction Cost Control Based on BP Neural Network

3.1 Cost Control System of Green Construction Project

Green construction cost control is to take the target cost as the measurement standard, make full use of the existing limited resources such as human, material and financial resources, reasonably and evenly allocate the existing resources through value engineering, operations research and other contents as well as information management technology, strive to control all costs within the expected range, and achieve the goal of reasonable economic benefits to the greatest extent [6]. Combined with the general steps of construction cost control and the characteristics of green construction, this paper constructs a cost control system for green construction before, during and after the event, as depicted in figure 2.

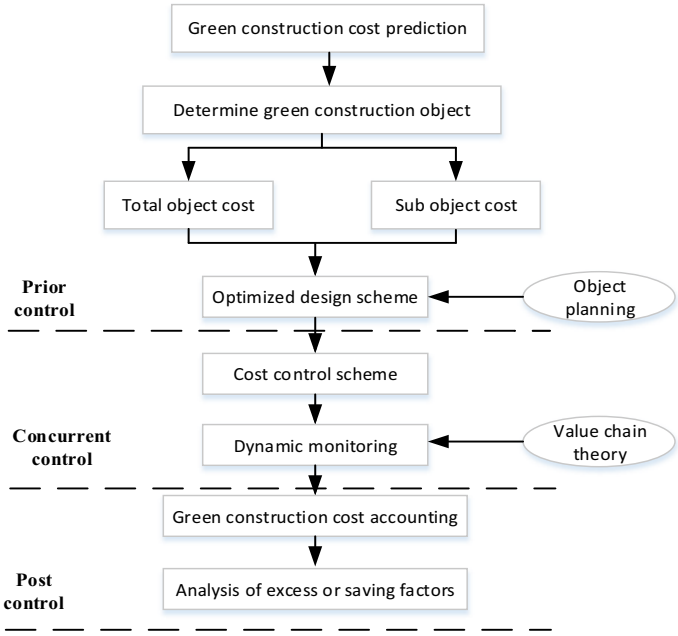

Figure 2. Green construction cost control system.

3.2 Analysis and Selection of Engineering Characteristic Factors

Engineering features refer to important factors that can characterize engineering characteristics and reflect the main cost components of the project. The selection of engineering features should refer to the statistics and analysis of historical engineering data, and be determined based on the experience of experts. Green building construction engineering refers to a construction method that minimizes negative impacts on the environment, improves resource utilization efficiency, protects human health, and improves building performance during the design, construction, and operation processes [7-9]. When performing green building construction projects, there are multiple characteristic factors that need to be considered and analyzed. The following are part of the common characteristic factors:

Energy efficiency: Green building construction projects should focus on efficient energy utilization, including the use of energy-saving equipment and technologies, optimizing the building's energy system, and reducing energy consumption and carbon emissions.

Material selection: Choose environmentally friendly, renewable, and low-carbon building materials to reduce the consumption of natural resources and reduce the environmental impact of building materials.

Water resource management: Adopting water-saving equipment and technologies to optimize the utilization efficiency of water resources and reduce water waste and pollution.

Indoor environmental quality: Pay attention to factors such as indoor air quality, lighting, and acoustics, provide a healthy and comfortable indoor environment, and protect the health and comfort of residents.

Waste management: Reasonably handle the waste generated during the

construction process to minimize the generation of waste and its impact on the environment.

Ecosystem protection: Protect and restore the surrounding ecosystem, reduce damage to biodiversity, and provide a good ecological environment.

Social sustainability: Consider the impact of architecture on communities and society, promoting social equity and sustainable development.

3.3 BP Neural Network Model Realization

Firstly, collect sufficient sample data, including various characteristics related to the cost of green building projects mentioned in the previous section. Ensure that the dataset has sufficient diversity and representativeness, so that the model can learn cost estimates in different situations. Preprocess the data. This includes steps such as data cleaning, feature selection, and feature scaling. Data cleaning can help us remove outliers and missing values, ensuring the quality of data. After completing the preprocessing, you can convert the data into input vectors for the model. It can be achieved by combining the eigenvalues of each sample into a vector [10]. We ensure that the data is divided into training and testing sets to evaluate the performance of the model. Once the model training is completed, a test set can be used to evaluate the performance and accuracy of the model. Figure 3 shows the flowchart of the construction steps:

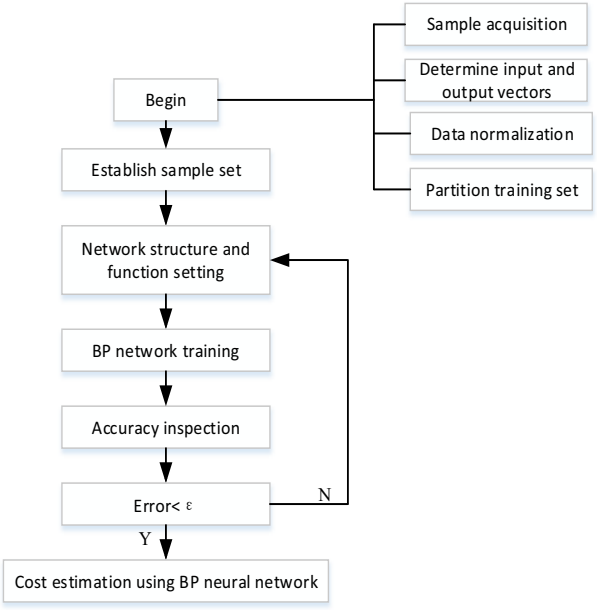

Figure 3. BP neural network modeling Process for cost control

The BP neural network structure established using MATLAB is 7-7-1. The transfer function of the node is selected as a sigmoid type function. The initial weight value is between (0,1), which is randomly generated. The number of neurons in the hidden layer

is determined by experience formula $n = \sqrt{(p+q)}$, where p is the index number of input vectors and q is the number of output index. Since the input index is 15 and output index is 1 in this article, there will be 4 neurons in the intermediate hidden layer. We set one output layer and the output value is the initialized prediction. The other parameters are set as default. The transfer function adopts tan-sigmoid and the output layer adopts linear function *liner*. Part of the codes in MATLAB is described as follows.

```
% Create input and target data
inputs =input_data; % Replace with input data
targets = target_data; % Replace with target data
% set the structure of neural network
hiddenLayerSize = 4; % Number of hidden layer neurons
net = newff(inputs, targets, hiddenLayerSize, {'tansig', 'purelin'});
% set training parameter
net.trainParam.epochs = 100; %    train the iteration number
net.trainParam.lr = 0.01; % learning rate
% train the neural network
net = train(net, inputs, targets);
% prediction with trained neural network
outputs = sim(net, inputs);
% providing prediction results
disp(outputs);
…
```

4. Experimental Analysis

The neural network toolbox in MATLAB provides a series of functions and tools that can help create, train, and evaluate neural network models to solve cost prediction problems for measure projects. Matlab provides four basic functions: new network function newff(), initialization function init(), training function train(), and simulation function sin(). These four basic functions can complete the initial construction of the BP network Create a new neural network model: In the toolbox window, select "NEW", then select "Neural Network", then select "Feedforward Backpropagation", which will create a new BP neural network model. In the network editor, you can set the structure of the network, add input layers, hidden layers, and output layers, and set the number of neurons for each layer. Set a three-layer BP neural network in the MATLAB toolbox window, with an error target of 0.001, a training function of trainlm, a network feature function of MSE, and initial weights and thresholds set using random data between 0 and 1. The relevant settings of the BP neural network model used in this article are shown in Figure 4. Train the neural network model using gradient descent method. In each training iteration, the training samples are input into the network, the output is calculated and compared with the target value, and the weight and bias of the model are adjusted based on the error. Use the first 300 items in the data as training samples and the last 300items as test data samples to monitor changes in training errors. When the training error gradually decreases and approaches 0.001, the training can be stopped. The training error curve during such process is depicted as figure 5.

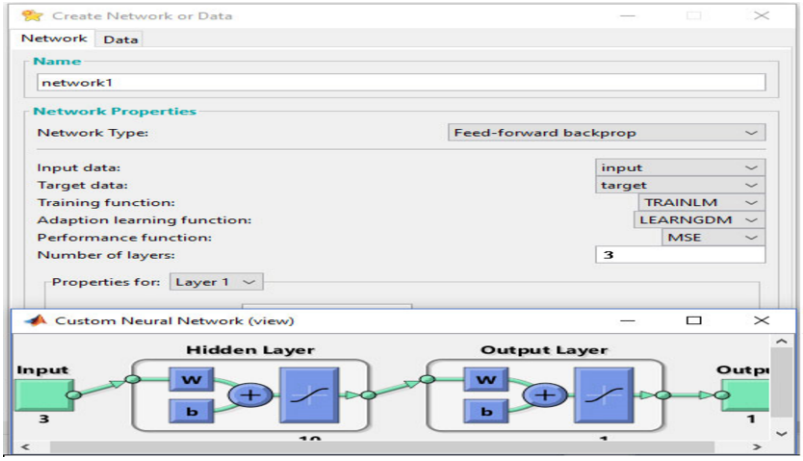

Figure 4. BP neural network settings in Matlab toolbox

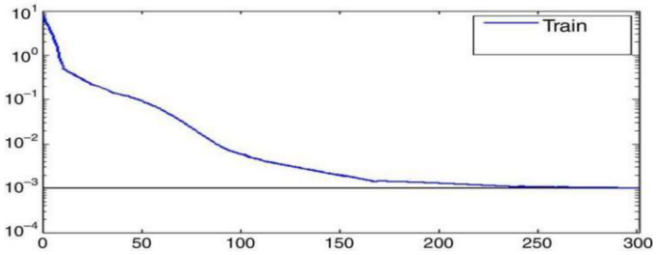

Figure 5. BP network training error curve

The production process of the steel company in the case is the link that mainly discharges various pollutants to the natural environment, and its cost accounting is a very important part. Through cost accounting, the enterprise's business decisions can be improved, many important information can be provided to the management authorities, and assets and income can be measured. The core of the sustainable development strategy of resource-based enterprises is to integrate environmental protection into the process of national economic and social development. The operation of the system needs to be in line with the enterprise environmental management system. The so-called enterprise environmental management system is a circular implementation mode, including the establishment of environmental management targets, the formulation of environmental management plans, the implementation of environmental management plans, environmental management performance evaluation, etc. First of all, we will use the classification of environmental costs to calculate and collect environmental costs, and get the basic data of environmental costs in recent years, as shown in table 1.

Table 1. Example of environmental costs in recent years

Item	Content	Amount of money(million yuan)		
Environmental pollution cost	Sewage charge	2017	2018	2019
	Environmental protection fee	2318	2149	2521
Treatment cost	Environmental monitoring	612	665	700

	fee			
	Transportation cost	134	253	310
	Greening fee	97	103	112
	Facility operation cost	5326	5586	678
Prevention cost	Labor cost	3718	5526	8531
	Training fee	117	201	219
	R & D expenses	97120	116000	136990
Proportion of annual average operating cost(%)		91	100	112

From table 1, it can be seen that the environmental cost of the company gradually increased from 2017 to 2019, and the annual average proportion in the operating cost was 91%, 100% and 112% respectively The resource and regional characteristics of raw material consumption in the iron and steel industry determine that the proportion of logistics cost in the overall cost of raw materials is not low The proportion of environmental cost relative to the cost other than procurement cost has been enough to attract the attention of the company and perform environmental cost management.

After learning and training, the training effect of stees price and the final output of steel bar price training results are shown in Figure 6. The model with optimal predictive ability depends on multiple factors, including data characteristics, model complexity, and selection of training algorithms, when the number of input layer nodes and hidden layer nodes is fixed. Some datasets may require more input layer nodes to capture more feature information, while others may only require fewer input layer nodes. When the data is basically fitted, it indicates that the model can better capture patterns and relationships in the data. This means that the model can accurately predict unseen data, so the prediction results of the BP neural network are relatively ideal.

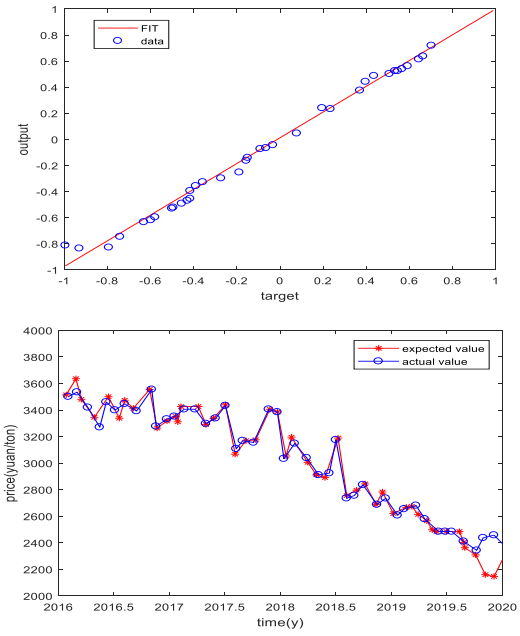

Figure 6. Training results of steel bar price.

In project actual cost management and bidding quotation, cost management personnel often use the total direct engineering costs of personnel, materials, and machinery to estimate the proportion of measure costs The advantage of using BP

network for cost prediction is that it can compensate for the lack of objective experience. Traditional cost prediction methods may rely on expert experience and subjective judgment, while BP networks can learn complex relationships between inputs and outputs through a large amount of data, providing more objective and accurate prediction results. When there are complex nonlinear relationships in the data, using BP neural networks can avoid situations that cannot be reflected by linear regression models and improve the fitting ability of the model. Table 2 provides a comparative analysis between the predicted results of BP neural network and regression model and the actual expected results.

Table 2. The comparison of BP neural network, regression model and actual results

Sample s	A	B	C
Actual cost	175.203	135.114	168.712
BP output	0.9812	0.25597	0.99028
Predicted cost	146.520	135.575	176.361
Regression model	159.668	124.228	147.256
Error predicted by BP	0.17%	-1.98%	3.56%
Error predicted by regression model	-12.38%	-10.03%	-11.28%

From the above comparison, it can be seen that the BP prediction error is within 6%, which fully meets the requirements for the prediction of measure projects. Because the measure cost of general projects does not exceed 100 yuan per square meter, even if the prediction error reaches 6%, the error is only 6 yuan. At this time, the maximum prediction error is 2.85%. For projects, the error at this time can already meet the requirements. Therefore, the specific weight of each factor can be obtained, so as to urge them to continue to improve the utilization and efficiency of equipment capacity, implement total quality management, and achieve the win-win goal of product quality and green generation.

5. Conclusion

This paper studies the information disclosure of environmental costs in iron and steel enterprises from the overview of environmental costs to the current situation, problems, reasons, suggestions and other aspects, and puts forward the enterprise green construction cost accounting and control strategy based on BP neural network. We analyzed the main characteristics and influencing factors of green building construction, trained the BP neural network using historical construction cost data, and validated and optimized the model using a validation dataset. By continuously iterating the training and validation process, optimizing the parameters of the network model to improve the accuracy and reliability of construction cost prediction. In the case study, a BP neural network price prediction model was constructed using MATLAB to predict prices for relevant time periods, verifying the feasibility of this scheme. In future work, we will try to utilize a hybrid neural network to improve the accuracy of prediction results, while also optimizing the problems of local optima and excessive iterations in traditional hybrid neural networks, to achieve high prediction accuracy and high implementability.

Acknowledgments

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