



# Application of Neural Network Technologies for Forecasting Competitive Strategy of Trade Enterprises

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## ABSTRACT

The article is devoted to the study of the specifics of forecasting the competitive strategy of commercial enterprises based on the use of the method of neural networks. The main advantages of the proposed sequence are clearly expressed multivariance of actions for strategy formation; the presence of direct and feedback links between the stages of the process, which includes not only strategic, but also analytical (information support), tactical (strategy implementation), and effective (strategy adjustment) blocks that ensure the quality of interaction between the processes of strategy formation and its implementation.

To solve the problems of analytical support for forecasting the competitive strategy of retail enterprises in the short term, the necessity of using the method of neural networks, which is a component of the system of methods for evaluating and forecasting the activities of retail enterprises, is justified. It is proposed to form a long-term competitive strategy of a trading enterprise taking into account its value, which is determined using a value chain model based on a balanced system of indicators. This allows you to increase revenue from sales of goods by improving service, forecasting demand, compliance with contractual discipline, improving logistics, as well as increasing the social responsibility of business, taking into account modern challenges of environmental protection and the introduction of an environmental economy of the enterprise and social responsibility of business

**Key words:** Neural network, trading enterprise, forecasting, financial and non-financial indicators, economic processes.

## 1. INTRODUCTION

The development of promising areas of enterprise activity based on mathematical modeling of the projected amount of revenue of a commercial enterprise when assessing the impact of internal factors and exogenous risks is possible on the basis of neural network systems that are subjective (expert) models of assessment and forecasting. Today, artificial neural networks are widely used to solve a large class of information processing problems — primarily for identification, simulation, intelligent control, and forecasting of time series of arbitrary nature under conditions of structural and parametric uncertainty. Neural networks are promising computing technologies that provide new postulates for the study of control and analytical tasks in the activities of commercial enterprises. In complex economic analysis, using the method of neural networks, the current state of the trading enterprise is evaluated, and in parallel, a cause and-effect analysis of changes in the main indicators under the influence of factors of influence is carried out. At the same time, in the process of analyzing the financial and economic condition of a trading enterprise, taking into account the forecast for short and long term periods, key indicators are justified, the value of which can lead to a change in the position of a trading enterprise in a competitive environment. Due to this, it is necessary to build a dynamic management tool — artificial neural networks, which can be used to take into account the impact of management decisions on the profitability and cost of a trading enterprise. If necessary, the volume of input data indicators can be increased, which will expand and clarify the information support of the control and analytical process of managing the activities of trade enterprises, not only to assess the current state, but also to select a competitive strategy.

Quantitative and qualitative parameterization on the evidence-based analytical basis of strategy selection, the development of indicative plans and business planning, the formation of a long-term strategy for business partnership, and the assessment of strategy implementation occurs within two processes. The first is the formulation process — a cognitive and decisive process aimed at defining the main strategic goals of the enterprise and identifying the main obstacles to their achievement. The second is the implementation process — the development of measures that will lead to the achievement of planned strategic goals:

- economic (high level of profitability and profit, economic potential and effective sources of financing, availability of solvency);
- technical and technological (availability of advanced management system software, low level of depreciation of fixed assets and intangible assets, high level of information support due to the use of information technologies);
- organizational and managerial (high level of corporate culture, effective organizational structure, degree of motivation of personnel, professional competence of management);
- marketing (availability of an effective strategy for promoting products to the market, optimal pricing policy, developed trade and representative network, recognizable brand, positive business image);
- socio-psychological (psychological attitude of consumers of goods, trust on the part of the population);
- geographical (geographical presence of a trading company in regions with developed market infrastructure and effective consumer demand).

## 2. MATERIALS AND METHODS

The use of a method for predicting the activity of enterprises based on the use of a neural network is characterized by a number of advantages and disadvantages. The advantages are that the use of neural networks allows you to study the dependence of the predicted value on independent variables based on numerical and textual data, provided that there are unknown patterns; for analysis, you do not need to solve the problem of interdependence between input indicators; the stability to noise in the input data is determined; the analyst does not need to have knowledge of the high technological capabilities of neural networks. This allows us to assume that sales in the future period will depend on the following parameters: sales in the last period; sales in the penultimate period; the number of working days, etc. However, you should also take into account uncontrolled environmental factors, in particular: the seasonal nature, the activity of competitors in the area where the enterprise is located, the number of buyers, and the period of delivery of the product [1-5].

Using a neural network allows you to take into account factors that can be used to make short-term forecasts. Using a neural network architecture (a perceptron with a single hidden layer) and a database (retail turnover and other data from the external and internal environment),

you can get an effective forecasting system. External parameters must be taken into account when enabling the appropriate input to the neural network. This uses an algorithm to determine the importance and significance of input variables, with the exception of parameters that have little effect.

The advantage of neural networks is that the expert does not choose a mathematical model of time series behavior. The neural network model is built adaptively without the participation of an expert in the training process.

The disadvantage of this method is the need for specialized software tools; the complexity of meaningful interpretation of neural networks and nondeterminism. This refers to the so-called "black box", in which the logic of decision-making by the neural network is hidden from the expert. Thus, the model does not allow us to clearly and transparently determine the contribution of each indicator to the improvement or deterioration of the financial condition of a merchant. To do this, there are algorithms for "extracting knowledge from the neural network", which formalize a list of logical rules, creating an expert system based on the network. However, these algorithms are not embedded in neural network packages, and the rule sets generated by such algorithms are quite large [6].

Therefore, to solve the problems of analytical support for forecasting the competitive strategy of trading enterprises, we propose to use the method of neural networks, which is a component of the proposed system of methods for evaluating and forecasting the activities of trading enterprises [10].

Neurons United in a system of a certain architecture are called a neural network, the type of which is determined by the task that is assigned to the enterprise [7-9].

An important parameter for building a neural network is the optimization algorithm and the ability to learn. The optimization algorithm is extremely important for building a neural network, because it can smooth out errors in the process of forming a training set and speed up learning, so the algorithm for eliminating input components is chosen (the data that degrades the overall result is deleted).

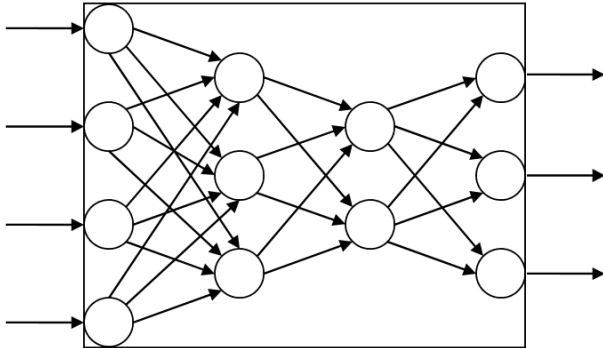
The neural network is evaluated based on the reaction of relatively simple elements of the same type, where each of the neurons contains synapses (unidirectional input signals  $x_1, \dots, x_n$ , associated with other hidden neurons) and an axon (the initial values of  $y_1, \dots, y_m$ , are associated with both hidden and input neurons) [14].

In preparation for forecasting, the entire data set is divided into three sub-samples. The first is training, during which a set of examples is selected for the effective functioning of networks, each of which contains a pair of data: input  $x_i$  and  $y_j$ . Data from multiple observations  $x_i$  is used to train the perceptron. In this case, each neuron of the hidden layer receives signals from the neurons of the input layer. After performing operations on the signals, the weights of the neuron change, which transmits its output to all the neurons of the next layers, providing one forward transfer

(feedforward) to the output  $y_j$ , thereby providing efferent connections [11-13].

The second pid is considered as a validated, because it is designed to provide the ability to evaluate the forecast and determine the optimal complexity of the model. The last sub-sample is used to evaluate the effectiveness and realism of the proposed model. It tests the network after training [15].

Figure 1 shows a four-layer network, the first layer of which contains four neurons, the second-three, the third-two and the fourth — three neurons.



**Figure 1:** structure of a four-layer neural network

The development and use of neural networks using NeuralTools involves four stages.

Step 1. the Data that is used in NeuralTools is defined in the data sets to prepare. Data Set Manager allows you to set data sets so that they can be repeatedly applied when designing networks. Before modeling neural networks, input data was entered. This step allowed you to get rid of a significant data span and get aligned ranges of variables. The option was chosen when the standardization of indicators is based on the variation scale [16].

Stage 2. During training, a neural network is created based on a set of data. After all, when predicting the neural network configuration is loaded from the database. The forecast results are presented to the user as an HTML report. After completing the training, the network configuration is stored in the database. When the application is running, a database is used for storing information [17,18].

As scientists notes, "the most important decision that an analyst should make when working with neural networks is the choice of a set of variables to describe the modeled process of analyzing the company's financial and economic activities" [1]. Accordingly, data is compiled based on observations for which the values of both dependent and independent variables are known.

According to the study factors of the first level connections are the net income, cost of goods sold, distribution costs; the level of derivative — trading margin, speed of customer service; in turn, factors of the second level are sales prices, product range and sales organization, a separate rhythm, and use of resources.

Stage 3. During testing of the neural network, we checked the possibility of predicting the initial values. The data that was used for testing were certain sets of historical data.

The main strategic indicator that is calculated during forecasting should be the basis of the strategy. Therefore, we have proposed the ratio of the market value of the enterprise to the value of its assets as the main strategic parameter. The indicator of the enterprise value in absolute terms can be used to characterize the enterprise by the criterion of its financial stability. Among other strategic indicators, we have highlighted profitability, the amount of gross profit, the amount of current assets and reserves [17].

Stage 4. a neural network is Developed that is used to predict unknown initial values. The NeuralTools tool allows you to set parameters for automatically searching for the best network with appropriate strategic indicators [18].

According to the research, the amount of net profit tends to grow annually by about 20% and is the result of effective management of a trading enterprise, provided that it retains competitive advantages and market positions. The assessment of the amount of current assets and inventory indicates an increase in the amount of accounts receivable and cash, which is evidence of balancing the enterprise at the level of the growth strategy. The question of the correct and clear choice of strategy is quite important, because choosing a strategy in the short term and its compliance in the long term depends on the economic and political environment, as well as legislative support for the activities of enterprises of various forms of organization [18].

Therefore, based on the data we proposed the company use a corporate strategy of sustainable balanced growth on the basis of "key success factors", which provides for the protection of market share based on the optimization of capital structure; policies of cash flow management and financial risk management policy organizational structure, modification of the product (private label); maintaining a balance between quality of service and quality of communications; implementation of price leadership( cost leadership), optimization of cash flows, evaluation and outsourcing of individual business processes.

The main advantages of this method are to increase revenue from sales of goods by improving the level of service, accuracy of deliveries and forecasting demand; compliance with contractual discipline; reducing costs by reducing inventory levels, minimizing overhead and transaction costs in procurement, warehousing and sales, as well as improving the use of logistics capacity; achieving customer oriented business processes, their openness to knowledge exchange between business partners; increasing social responsibility of business, taking into account modern challenges of environmental protection.

### 3. CONCLUSION

To eliminate the identified shortcomings in the models of formation and implementation of competitive strategies of commercial enterprises, we have developed a sequence of formation and implementation of competitive strategies, which allows you to choose a more rational one based on a clearly expressed

multivariance of actions; the presence of direct and feedback links between the stages of the process, including not only strategic, but also analytical (information support), tactical (strategy implementation), effective (strategy adjustment) blocks. In order to solve the problems of analytical support for forecasting the competitive strategy of commercial enterprises in the short term, the necessity of using the method of neural networks, which is a component of the system of methods for evaluating and forecasting the activities of commercial enterprises, is justified.

To form a long-term competitive strategy of a commercial enterprise, we suggest using the value chain model of enterprise value creation, which should take into account the increase in revenue from sales of goods by increasing the level of service, uniformity of purchases of goods and forecasting demand; compliance with contractual discipline; reducing costs by reducing the level of inventory, as well as overhead and transaction costs in procurement, warehousing and sales, and improving the use of logistics capacity; achieving customer-oriented business processes, their openness to knowledge exchange between business partners.

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