Neural network models and methods in the tasks of personnel development management in companies

Tretyakov Oleg Vladimirovich
Candidate of Economic Sciences, Head of Department
Perm National Research Polytechnic University
Perm, Russia

Abstract. The article provides a structured analysis of the areas of application of mathematical methods and models in personnel management tasks. A technology is proposed that, together with neural network algorithms for predicting the success of a person in a company, allows the use of fuzzy expert technologies. It is emphasized that the practical use of the proposed methods and models makes it possible to move from solving individual problems of personnel management to a systematic approach to solving a complex of problems of human resource management.

Keywords: management of personnel development, forecasting the success of a person in a company, neural network technologies, fuzzy linguistic technologies.

The neural network is rapidly entering production and management activities. Fierce competition poses problems for modern business that can be effectively solved with modern data analysis tools. Neural network technology allows you to analyze information, predict development and minimize risks when making decisions, which allows you to build a business on a strictly scientific basis competently and effectively.

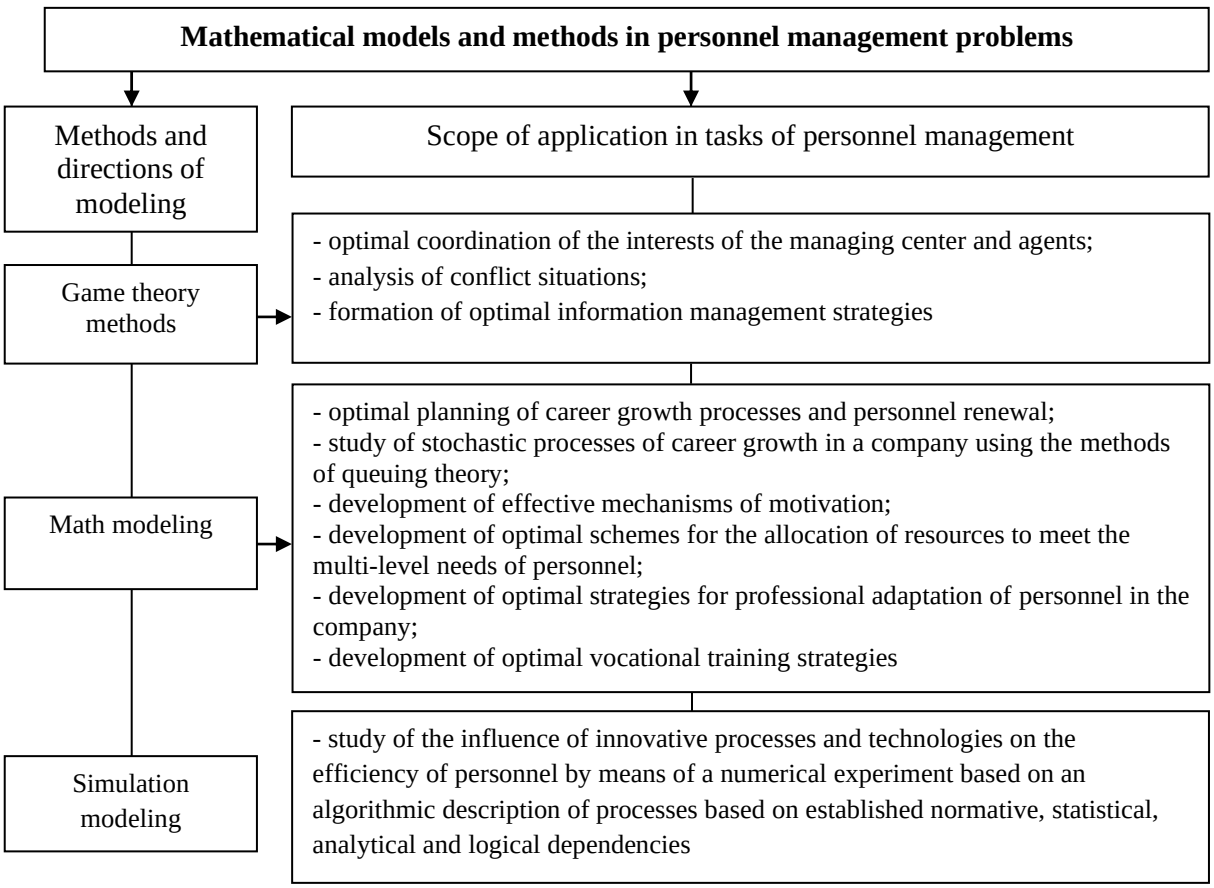
Neural networks are designed similarly to the human nervous system, but in fact they use statistical analysis to recognize patterns from a large amount of information through adaptive learning [8]. Neural networks are a powerful modeling technique that can reproduce extremely complex dependencies. Neural networks learn by example. A neural network user selects representative data and then runs a

learning algorithm that automatically perceives the data structure. Efficiency of work is achieved, firstly, from the parallelization of information processing, and secondly, from the ability to self-learn, i.e. create generalizations [7]. The term generalization refers to the ability to obtain a reasonable result based on data that was not encountered in the learning process. These properties allow neural networks to solve complex problems that are considered intractable today. However, in practice, when working autonomously, neural networks cannot provide ready-made solutions. They need to be integrated into complex systems [5].

Mathematical models and methods allow making decisions both in conditions when the influencing factors are known, and in conditions of limited availability of information, therefore, the possibility of real application of neural networks and their interaction with the company's information system.

Modern mathematical methods and models open up new opportunities for formalization, constructive development and increasing the efficiency of the company's personnel management methods.

The main areas of application of mathematical methods and models in personnel management problems are shown in Fig. 1.



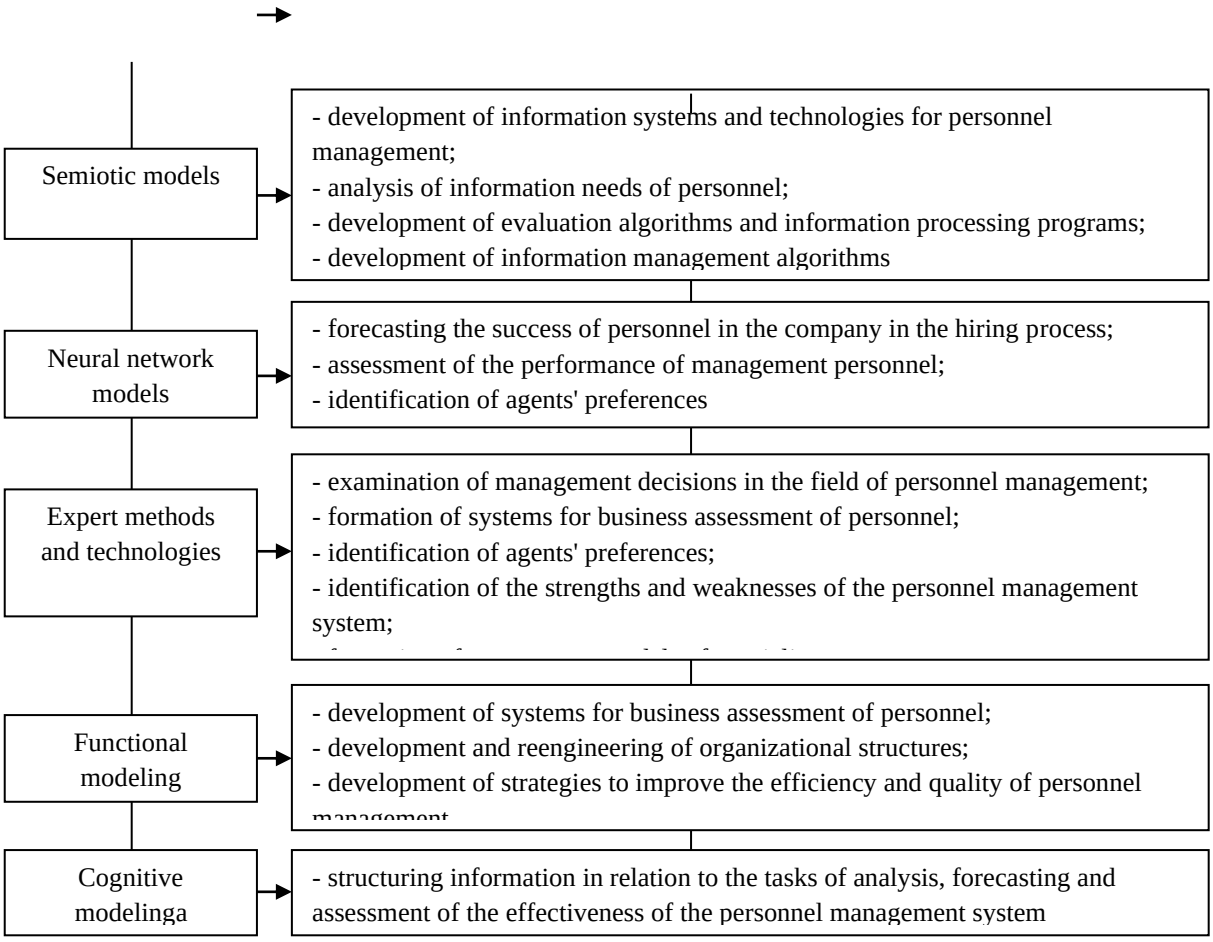


Fig. 1. Spheres of application of mathematical models and methods in tasks of personnel management (Author's development)

The personnel development management system is a complex of organizational structures, methods, organizational and economic measures and resources that serve to fulfill the tasks of training, retraining and advanced training of personnel; organization of inventive and rationalization work; professional adaptation; evaluating candidates for a vacant position; ongoing periodic evaluation of personnel; business career planning; work with the personnel reserve.

Neural network models and methods as applied to the task of predicting the success of new candidates in various areas of professional activity in a company is one of the most urgent tasks of recruiting personnel [1]. The task of forecasting when hiring is set as follows: according to the input characteristics of the candidate used in the standard selection, to obtain an assessment of the special criteria of success in professional activity. Parameters of professional knowledge, skills, and abilities are

used as input characteristics of candidates; autobiography data; characteristics associated with the peculiarities of the psycho-motivational mechanism of professional activity, purposefulness, activity, performance, cultural level, value orientations in life, value orientations in achieving goals, moral qualities; the level of professional flexibility, mobility, sociability, tolerance, computer literacy, proficiency in a foreign language, the employee's attitude to himself, the ability to establish business relationships, efficiency, discipline, confidence in success.

The general scheme of a neural network algorithm that solves the problem of predicting the success of candidates is shown in Fig. 2 [3, p. 123].

Along with neural network algorithms, fuzzy expert technologies can be used to predict the success of a person in a company [4]. This article proposes one such technology. It is assumed that the company assesses a set of specific competencies in the recruitment process. All competencies are represented as linguistic variables. Three models based on the competence database are introduced into consideration: the employer model, the applicant model and the evaluation model. The models of the employer and the applicant are sets of assessments of the linguistic importance of the analyzed competencies, and the assessment model is the level of expression (term) of each competence in the applicant.

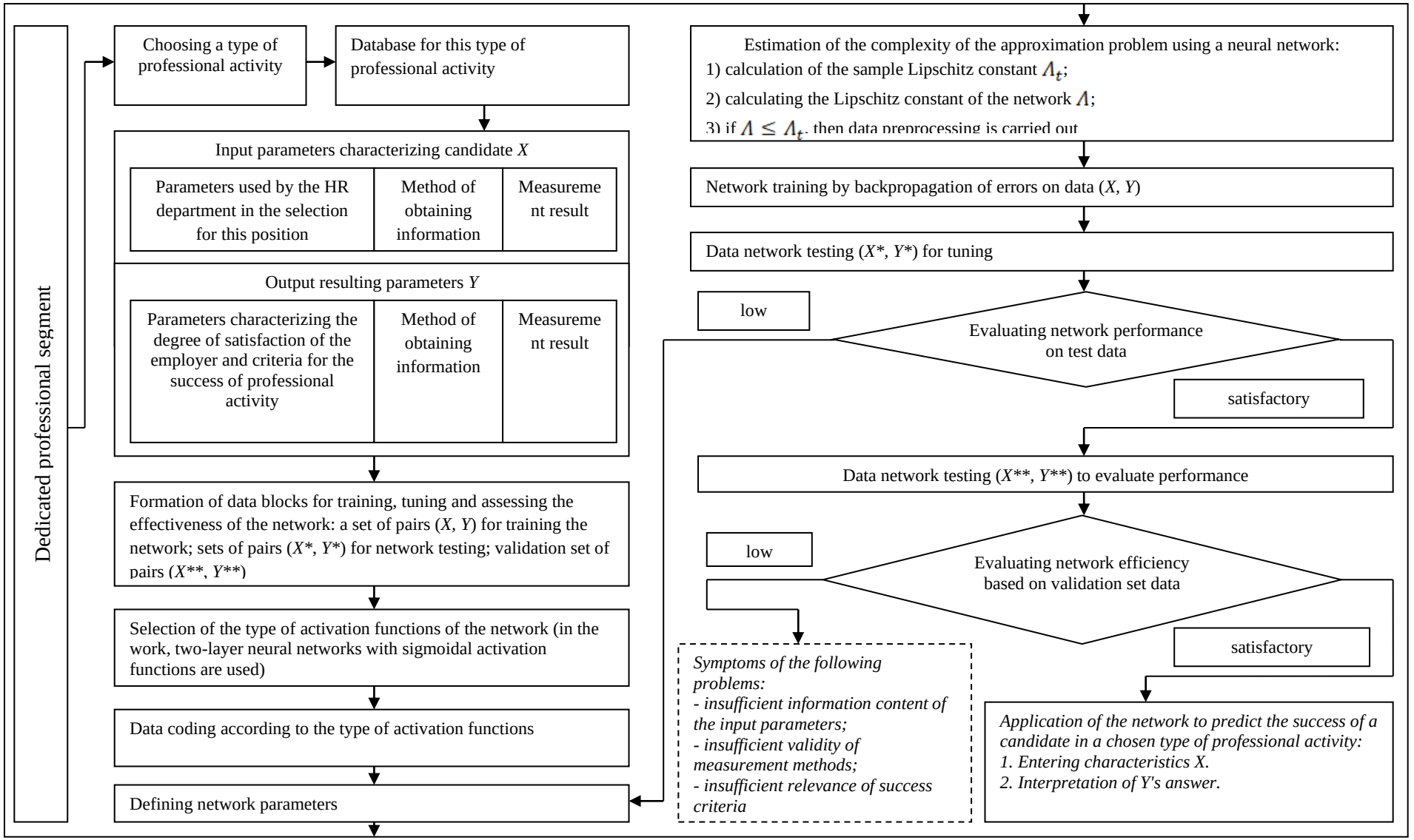


Fig. 2. General scheme of the neural network mechanism

The structure of models for the manager profession is shown in Fig. 3 [3, p. 126].

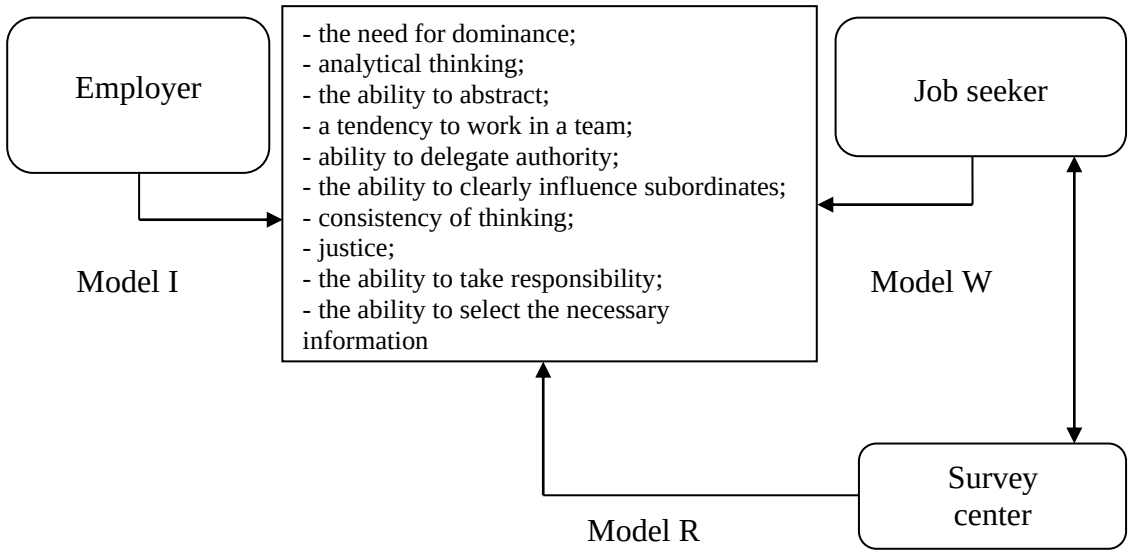


Fig. 3. The structure of the model for predicting the success of a person in a company

Linguistic correlations between different models are calculated, for this the components of the models are ranked in a special way. On the basis of the obtained linguistic correlations, the rules of fuzzy inference are built and the success of a person in the company is assessed [3, p. 126].

Evaluation models in personnel management are the certification and business assessment of personnel, which can be further used in personnel development tasks. The task of using highly qualified personnel is especially important in the formation of the staff of innovative companies [9].

Consider an expert mechanism for the formation of models of competencies of specialists, which allows taking into account the opinion of the head of the company and a group of experts regarding the importance of various general and nuclear competencies, assessing the consistency within the expert group and consistency with the opinion of the head, building a hierarchical model of competencies and a mechanism for obtaining a comprehensive assessment of competence [2].

Suppose there is some hierarchical model of competencies [3, p. 128]. To obtain a comprehensive assessment of competence in accordance with the hierarchical model, it is necessary to expertly determine the relationship of preference between different competencies. To identify preference relationships, a formalized algorithm for the activities of an expert group headed by the head of the company is used. All experts fill in the matrices of the preference relationship between the competencies of the lower level of the hierarchy in the linguistic scale. Various aspects of the consistency of the opinion of experts are assessed, a group of experts is singled out, coordinated with each other and with the opinion of the head. For this group, a group preference relation is built between the competencies of the lower level, and the preference relation between the competences of higher levels is built according to special rules. Linguistic logical convolution matrices are formed in relation to the preference relation between the competencies, and using the complex assessment mechanism, an assessment of the upper level of the hierarchy is obtained - the employee's competence.

There is a set of competencies $X = \{x_1, x_2, ..., x_n\}$.

Each competence corresponds to the degree of significance of the inclusion of this competence in the analysis from the position of the leader $W = \{w_1, w_2, ..., w_n\}$, expressed in a linguistic scale. In this case, the $V = \{V_1, V_2, ..., V_7\}$ scale will be used to assess the importance of including competencies in the analysis from a manager's perspective. Competencies are assessed according to their importance by a group of experts $E = \{e_1, e_2, ...e_p\}$,each of which is characterized by their competence g_k, also expressed in the linguistic scale V. The head of the company is considered as an e1 expert, he is assigned a special role in the examination.

Each expert e_k forms his opinion in the form of a linguistic preference relation P_k, according to which any pair of competencies (x_i, x_j) is associated with a term of a linguistic variable C (term-set $S = \{S_1, S_2, ..., S_9\}$), reflecting superiority in importance from the point of view of an expert of competence x_i in comparison with competence x_j. The preference relationships compiled by different experts may differ. To assess the closeness of the opinions of two experts, a special table of proximity

D,is used, the elements of which $d(S_i, S_j)$, given in the linguistic scale *V*, show how close the terms S_i and S_j of the *S* scale are.

The main stages of the considered algorithm are given in [3, p. 127-129]. The algorithm partially uses the approach of assessing the consistency of expert judgments proposed by domestic researchers [6]. The competency model, built in accordance with the approach described above, allows long-term planning and forecasting of the necessary human resources, quickly and efficiently forming a personnel reserve. Training planning is also systematized and becomes more focused, a transition is made from solving individual problems to real human resource management.

Thus, the introduction of the latest intelligent systems in personnel management allows us to make a qualitative leap in management and increase the efficiency of personnel selection for productive work in the company.

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