Microeconomic dynamic model of an enterprise

E.A.Borloeva[*], K.O. Konushevskaya[†]

, O.A. Kosorukov[‡]

Plekhanov Russian University of Economics

[*] elvira.elfik@mail.ru

[†]xenychka@gmail.com

[‡]Kosorukovoa@mail.ru

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Labor is the main resource of each company, which defines the performance of the company and its competitiveness due to the quality and effectiveness of them.

Labor relations - perhaps the most complicated problem within the business, especially when the collective of an enterprise has dozens, hundreds and thousands of people. Labor relations cover a wide range of issues related to the organization of the labor process, training and recruitment, preference of the optimal remuneration system, the establishment of social partnership in an enterprise.

Need for staff, as well as in other types of resources depends on many conditions. To plan and meet the need for staff is much more difficult than to do it for the physical and financial resources. The need for staff is affected by the circumstances connected with the characteristic of the reached rate of development of a company and the expected state after the next stage of development. These circumstances may include dynamics and the forecast of the market, which the organization operates in, its internal resources, including human and their development; production, personnel, and the economy policy, the state of the labor market of required professions, etc. The real possibilities of human resource planning systems have determined mainly by the character of the information database, containing data bank. Where by planning staff operate with a wide range of tasks, an extensive database, describing the details of every employee, especially its vocational qualification ability have to be created.

Thus, we were faced with the following objectives:

- Planning and forecasting needs of the enterprise in the labor force;
- Forecasting of the actual state of the labor force as a result of their movement;
- Optimization of personnel decisions to achieve the balance of labor resources.

The planning and forecasting of human resources in the enterprise in today's economic conditions are not inferior in importance and responsibility of the tasks of production planning. Applying of mathematical methods and models to optimize resource management and forecasting the need for staff can most effectively use human resources in the enterprise. To achieve this goal there was created the model of the forecasting of the overall staffing needs for enterprises in Russia. The developing forecasting system of the need for the labor for enterprises of Russia solves the problems of both quantitative (numbers required) and quality (specialty and level of skills) prediction of the staffing needs[3]. The purpose of constructing the model was forecasting the needs of enterprises of the Russian Federation in the workforce, taking into account the professional and qualification structure of staff and staff groups, with the

possibility of implementation of various development scenarios of the business, depending on its core activities, production and staffing plans. The results of the model have its practical reflection on the anticipated completion of each year in the form of tables with data about the needs of this enterprise in the labor force, in the context of specialties and skill levels required of personnel, with the main groups of staff for each direction of the company[2]. To obtain predictive values of staffing needs have been using various methods, including the aggregate method, the calculation of the number of service standards, methods of multiple regression, time series regression. The model provides a scenario analysis, which is a useful tool for management decision-making, as it allows you to track the direct influence of the parameters such as investment, gross output, productivity, technological level, on the need for enterprise personnel to achieve its goals. As the created model shows just the companys need for the labor force, it was developed "The Dynamic model of the state and movement of labor on the enterprises of Russia", which characterizes the time variation of the personnel of large enterprises in the Russian Federation as a result of the processes of motion in the enterprise[1]: the dismissal (voluntary redundancy and dismissal due to a reduction), hiring, re-training, aging, death, retirement. It was conducted the research of the difference in the construction of this projection to separate skill groups and levels of workers and for managers, professionals, employees and unskilled staff. The model allows to make a quite accurate forecast of the long-term labor state at 10 years. The results of the two models are the forecasts of personnel needs of enterprises of Russia up to 2020 and the actual state of personnel in the companies in the Russian Federation. Comparing the results of the two models appears a question of labor imbalances, i.e., lack of or over at certain positions in certain companies. To solve this problem, we can use The Dynamic decision-making model for Russian enterprises to make decision on hiring, dismissal and re-training of staff, where we seek an optimal plan for hiring, dismissal, qualifications or demotion. The model runs separately for the main staff, support and control personnel. Actually, these flows, describe human behavior in the labor market conditions and competition for jobs, and therefore the following methods have developed:

- Recruitment. There is estimated the possibility that a potential employee of a certain age and specialty will agree to get a certain position in the enterprise. Parameters affecting the output:
  - Salary;
  - Social benefits.
- Retraining. There is estimated the probability with which a worker of a certain age and specialty agree to improve skills or to be lowered into position.
- Dismissal. There is estimated probability of voluntary redundancy of an employee of a certain age and certain specialty. Quantitative indicators that affect the output of the model:
  - The salary of the employee;
  - The cost of social services for this category of staff;

The model finds a solution that would minimize the costs of removal, hiring and training. We solve the optimization problem with a number of limitations. A distinctive feature of the model is an indicator of complexity that characterizes the difficulties of the company in connection with the proposed optimal personnel policy.

This indicator is affected by the following factors:

- The presence of specialists with the requisite skills and qualifications in the forecast time in the labor market of the region;
- The competitiveness of a company;
- The presence of educational institutions, graduating experts with the required skills in the current region;

- The average regional cost of training ;
- The cost of paying severance package.

These days the situation in the Russian labor market has changed considerably in favor of applicants. In many cases, it is difficult to employers to find experts with the required level of training. The desire to get qualified professionals leads to the competition for them by using different methods. The increase of salaries is still one of the most important ways to attract and retain professionals, but it is not decisive. Therefore personality-oriented social policies of firms are becoming increasingly important: the use of so-called social packages and profit-sharing system. To calculate the competitiveness of a company, it was derived a factor of prestige of the enterprise, depending on the benefits package provided to and from salaries compared with average regional wages the for the current profession / job. Optimization problem was solved separately for the main, unskilled staff and managers[4][5]. An example of an optimization problem for the main staff. As the variables in the model were considered the numbers of main staff, retired, transferred to a higher level of qualifications, translated into a lower position, gleaning in the enterprise, as well as cost parameters. We used six criteria, which are linear functions of variable costs of the enterprise: hiring staff, firing staff, training personnel, costs of the company for arrears, paid salary and benefits package. From a mathematical point of view, the problem is a linear programming problem with six criteria of quality, more than 3,400 variables and over 2100 constraints. The following optimization problem was posed: find the parameter values, variables, and the costs that minimize the objective function F for a number of limitations. F is a generalized cost function:

$$F = \sum_{i,m}(Apr(t+n) * x_i^m(t+n)) + \sum_{i,m}(Ayv(t+n) * y_i^m(t+n)) + \sum_{i,m}(Apk(t+n) * z1_i^m(t+n)) + \sum_{i,m}(An(t+n) * n_i^m(t+n)) + \sum_{i,m}(ZP_i^m(t+n)) + \sum_{i,m}(FCh_i^m(t+n-1) * b(t+n)) \to \min(1)$$

where Apr - the matrix of the cost of a hiring for main workers employees;

Auv - matrix of costs for the dismissal of main workers employees;

Apk - matrix of costs for the training of main workers employees;

An - the matrix of costs for the shortage of required number of main workers employees;

X - the number of hiring by the company;

Y - the number of firing from the enterprise;

Z1 the number of those who has improved skills;

N- the number of gleaning staff;

ZP - the size of gross wages and salaries;

b - the size of the benefits;

FN - the actual number of main workers;

t + n - forecast year;

t - the beginning of Forecasting (2010).

The optimization problem is easier for support staff because it does not consider the level of qualification. We consider only dismissal, and recruiting of staff, which reduces the number of constraints more than 4 times, and therefore reduces the computation time.

The model was based on the following equation:

- the probability of the consent of an employee's i-th m-th professional skills to work in the enterprise depends on the ratio of wages in the enterprise i-th m-th professional qualifications to average salary in the region of this profession and the qualifications, on the company's prestige factor and the number of proposals in the region on the i-th m-th professional qualifications;
- The number of workers who agree to go to a demotion depends on the state of the labor market in the region; if the demand of the labor market of the current profession and qualification is very small, the probability of the employee's consent to work at lower position increases;

- the probability of dismissal on their own - is a function that depends on wages in the enterprise when compared to the average wage in the region of the profession and the qualifications, on the prestige factor of the enterprise (provided social benefits), the number of proposals in the labor market of this specialty and qualification in the region.

Also, the model shows a chart of the complexity of recruitment from the labor market.

Table 1: Complexity of hiring on a projected year

Prof./ Qual.	1st level	...	Mst level
P1	...	...	...
...	...	...	...
Pr	...	...	...

The complexity is calculated from the following conditions:

1. How many employees are there in the labor market in the region of the current profession and qualification;

2. Coefficient of prestige of the enterprise

3. Remuneration in the company of the certain profession and qualification (compared to the average wage in the region according to the profession and qualification).

As a result of research there have proposed statements of the handling the problem of the labor movement, based on management factors affecting it. There were considered some variants of multifactor models used to estimate the intensity of labor flows, a feature of which is a functional conception of the parameters intensity with the measures of similarity or difference between the groups of enterprises in terms of life or work, respectively.

There was proposed the finding of several solution scenarios.

1. Finding the optimal solution

2. Find a solution by changing the control parameters, such as salaries or the size of the benefits package. At this stage, the decision-maker decides himself how many people to dismiss, recruit or retrain. After that, the costs are counted, and if the results of the program are satisfied, the result is stored. The model allows you to save the results of changes and their impact on traffic flows and in the future to compare results and choose the most suitable.

The models are realized in an environment of AnyLogic , that is characterized with a high comfort of design simulation models and a complete range of mathematical methods.

For decision-making model there is developed the code in the Java language to solve the optimization problem. Standard optimizer, a built-in AnyLogic does not have the resources to meet the challenges of this complexity.

The models are universal for all economic activities of enterprises, as well as allow them to apply for such units, as a research department, staff training, back office.

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