Dynamic model of the work team composition in the organization

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Abstract. The article presents a dynamic model of the composition of the labour collective in the organization. The model is built, taking into account the following categories of workers: «Executives», «Specialists», «Employees», «Workers» using Powersim Studio. Our model is multidimensional. A model management interface was created, which includes an input interface through which data is entered, as well as an output interface that allows seeing the difference between new employees and experienced ones. During the experiment, a model of the life cycle of an employee in an organization from hiring, adapting, working to experienced employees to the subsequent dismissal was considered. Based on the calculations, it was concluded that the recruitment rate, the speed of dismissals and the total number of employees affect the reception of new employees.

1. Introduction

The personnel management system involves the organization of hiring, the definition of the organizational structure of personnel management, vertical and horizontal relationships of managers and specialists in the process of justification, development, adoption and implementation of management decisions [1].

Also, this system provides continuous improvement of methods of working with personnel based on the use of the achievements of domestic and foreign science and advanced production experience.

The main structural unit for personnel management is the personnel department, which is entrusted with the functions of hiring and dismissing employees, as well as organizing their education and advanced training [2].

Planning staff is one of the most important functions of personnel management. It consists of the quantitative, qualitative, temporal and spatial determination of the need for personnel necessary to achieve the goals of the organization.

The purpose of staff planning is a short-, medium- and long-term determination of its quantitative and qualitative composition, which ensures not only the development of the enterprise but also its economic growth. This goal is achieved through an optimal staff structure. The motivation is the wage (salary) of the employee [3].
Remuneration: on the one hand, it is the main source of income for workers and raising their living standards, on the other hand, it is the main lever for stimulating material growth and increasing production efficiency [4, 5].

Material interest is an objective connection realized by people between the ability to satisfy needs and the need to solve particular economic problems. This category is manifested in human activities. The degree of its manifestation depends on the extent to which stimulus affect a person [6].

There are many formal methods of inventory management. One of such modern and widely used methods today is the dynamic modelling of the composition of the labour collective in the organization [7 - 9]. We will create a simulation of the personnel life cycle that will help the personnel serving in the planning staff process.

2. Model for calculating the composition of the labour collective in an organization. Figure 1 shows a graphic diagram of a dynamic model of the composition of the labour collective in the organization. The model includes one level (drive):

- New employees.

The diagram also shows two streams:

- Reception of new employees.
- Dismissal of new employees.

![Figure 1](image_url)

**Figure 1.** Diagram of flows and levels of calculating the level of personnel management efficiency.
In addition to the listed flows and levels, auxiliary variables are present in the diagram [5]. The interpretation of the variables shown in the diagram is presented in Table 1.

Table 1. Variables used in the diagram of flows and levels of calculating the level of personnel management efficiency.

| №  | Name                                      | Documentation                        |
|----|-------------------------------------------|--------------------------------------|
| 1  | Salary of new employees                   | Salary of new employees              |
| 2  | Salary of experienced employees           | Salary of experienced employees      |
| 3  | Recruitments speed                        | How quickly new employees appear     |
| 4  | Dismissal of new employees                | Dismissal of new employees           |
| 5  | Dismissal of experienced employees        | Dismissal of old employees           |

Since all auxiliary elements have been added, the next logical step will be to describe elements that are calculated by formulas. For this, we need to input the values. Description of variables is presented in Table 2.

Table 2. Description of variables.

| Element name                              | Values                                                                      |
|-------------------------------------------|-----------------------------------------------------------------------------|
| Recruitment speed                         | STEP(‘Exogenous growth pace of the number of employees’; ‘Initial employee growth time’) |
| Total number of employees                 | FOR(i=Staff; c=Experience'|'New employees[i][c]+'Experienced staff[i]). Variable parameters «(Total number of employees» |
| Dismissals of experienced employees       | FOR (c=Staff; i='Experience' | 'Experienced employees[<c>[i] * 'Share of dismissals of experienced employees'[c;i]) |
| Adaptation of newcomers                   | 'New employees'/’Time of assimilation of information'                      |
| Dismissal of new employees                | 'New employees'*’The share of dismissals of newcomers'                     |
| General rate of dismissals                | 'Dismissal of experienced employees' + 'Dismissal of new employees'         |
| Reception of new employees                | FOR (i=Staff; c='Experience' | 'Recruitment speed'[i]*'Total number of employees'[i][c] +'The general speed of dismissals'[i][c]) |
| New employees                             | FOR(i=Staff; c='Experience' | 'Experienced employees[i][c] *'The share of dismissals of experienced employees'[i][c] *'Time of assimilation of information'[i][c]) |
| Salary of new employees/ Salary of       | FOR (i=Staff; c='Experience' | 'New employees[i][c]*'Tariff schedule of salary for new employees'[i][c]*(1+'Extra charge for new employees'[c]) |
| experienced employees                     |                                                                             |
| Total salary of employees                 | 'Salary of new employees'+'Salary of experienced employees'               |

Function STEP (Height, Start), where the height determines the numerical expression that determines the height of the step, and the beginning – the expression that determines the time of appearance of the step signal.

Function FOF: FOR («Dimensions»|«Expression»), where Dimensions – measurements (ranges) and Expression – function expression.
The management interface of a dynamic model of the collective labour composition in the organization is shown in Figure 2. It shows the «Block of graphic windows», which consists of the following parts: a frame with a name, a graph. It is an input interface where the user can independently change the data that he considers necessary for a more accurate display. In turn, the graphs represent the output interface.

![Figure 2. Block of graphic windows.](image)

3. Experimental results

Experiment 1. During the experiment, calculations were made of the level of personnel management efficiency. Figure 4 shows the dynamics of changes in the number of new and experienced employees. The numbers of experienced and new employees increase gradually, i.e. after a certain amount of time, new employees undergo adaptation and become experienced employees. However, experienced employees gradually quit, and other employees take their jobs [3].

Also, we will display the input interface of the experiment at the time of modelling the system (Fig 5). In this table, only the zero period values are initially filled in, and the remaining data is filled in after the model is launched.

![Figure 3. Graphs reflecting the dynamics of changes in the number of each category of workers in our model.](image)

Experiment 2. We will conduct the second experiment, for this, we will increase the size of the “Shares of dismissals of new employees”, “The time for assimilation of information” and the number of “Experienced employees”, and reduce the “Share of dismissals of experienced employees”.

Figures 5 and 6 show the output interface of the second experiment is shown in the form of graphs and tables. The number of new employees has tripled. Adaptation of beginners has increased two to three times. Dismissal of experienced employees quadrupled. Salaries of employees and dismissals of new employees also increased.
Experiment 3. In the third experiment, we will reduce the «Share of dismissals of new employees», «The share of dismissals of experienced employees» and «Time of assimilation of information», as well as the level of «Experienced employees».
The output interface of the third experiment is shown in the form of graphs and tables in figures 7 and 8. The number of new employees was reduced by half. Adaptation of beginners was reduced by almost two to three times. The layoffs of experienced and new employees also decreased, and as a result, the wages of employees also decreased.

![Figure 7](image7.png)

**Figure 7.** Graphic image of the output interface of experiment 3.

| Period | Nimble adaptation | Incumbent adaptation | Incumbent adaptation | Incumbent adaptation |
|--------|-------------------|----------------------|----------------------|----------------------|
| 0      | (0.30;0.20;0.10)  | (0.53;0.35;0.18)     | (0.68;0.45;0.23)     | (0.15;0.20;0.15)     |
| 50     | (0.96;0.91;0.91)  | (1.76;1.66;1.64)     | (2.17;2.04;2.01)     | (0.47;0.47;0.47)     |
| 100    | (2.80;2.35;2.37)  | (4.24;4.18;4.22)     | (5.27;5.19;5.24)     | (1.15;1.15;1.15)     |
| 150    | (5.56;5.55;5.60)  | (8.69;8.69;8.79)     | (12.29;12.27;12.28)  | (2.69;2.69;2.69)     |
| 200    | (12.96;12.99;13.10)| (23.05;23.12;23.12) | (28.66;28.75;28.98) | (44.65;45.39;45.39) |

![Figure 8](image8.png)

**Figure 8.** Tabular image of the output interface of experiment 3.

Figures 9 and 10 show the output interface of the model itself after all experiments are presented in the form of graphs and tables.

![Figure 9](image9.png)

**Figure 9.** The output interface in the form of graphs.
4. Conclusion
The experiments show that the recruitment rate, the speed of dismissals and the total number of employees affect the reception of new employees. The number of people who are hired depends on the category and work experience. So, often people who have work experience of 10 years or over are hiring, but there are much fewer people like this than people with work experience of up to 3 years. The number of managers required by the company is much less than the number of employees and specialists [4].

New employees leave more often than experienced employees. For example, people with work experience of more than ten years are less likely to leave, while people with work experience of fewer than three years are more likely to be fired.

Adaptation time also varies for new employees with different work experience because assimilation time varies from 80 to 120 weeks for employees with different work experience. People with extensive work experience learn the necessary information faster, and people who do not have the work experience need much more time to study the information.

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