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MANAGEMENT OF COMPETENCE DEVELOPMENT OF THE HIGHER-EDUCATION TEACHING PERSONNEL

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Abstract. *The urgency of the work is determined by the need to develop new approaches to the assessment process and to increase the level of competence of the teaching staff of the institution, which is the most important factor of its competitiveness.*

The object of the study is the management system of the teaching staff of the higher education institution.

The subject of the study are the models and methods of managing the level of competence of the faculty.

Research objective is to increase the level of competence of the higher-education teaching personnel.

The methods of system analysis, mathematical programming, graph theory are used in the paper.

Keywords: *assessment, competence, higher-education teaching personnel, management.*

Introduction

Currently, higher education institutions (institutions of higher learning) are under conditions of serious changes not only of the external, but also of the internal environment. In the external environment, there are increasing demands on the quality of education on the part of the state, applicants and employers, aggravation of competition among universities for ranking in the rankings and applicants with high results of the Unified State Exam (USE). At the same time, the opportunities for applicants (including foreign ones) to expand when choosing an educational institution are being expanded, economic conditions for the activities of higher education institutions are changing (universities are given the right to freely exercise entrepreneurial and other income-generating activities). On the other hand, the consolidation of universities, the emergence of supporting universities poses the task of improving the organizational structure of

educational institutions, the formation of new elements of a corporate culture aimed at creating an effective system of reproduction and development of human resources.

All this raises the problem of finding new sources of increasing the competitiveness of higher education institutions, the most important factor of which is the quality of the educational services provided. As is rightly noted in a number of documents of international organizations, legislative and regulatory acts on education, the most important condition for improving the quality of education is the competence of the teaching staff. At the same time, a number of studies (Barkalov et al., 2010; Nasonova et al., 2017; Tatur, 2009) made it possible to identify certain problems on the part of the higher-teaching staff in improving the quality of education: the lack of unified models, rules and methods for assessing the level of competence of the teaching staff, which impedes the realization open personnel policy and attracting qualified personnel from outside; Inadequate mastering by teachers of methodologies recognized at the world level; low motivation of the higher-teaching staff to participate in the processes of changes and optimization of the activities of educational institutions.

As practice shows, the structural divisions on personnel management that exist in most HEIs usually carry out legal regulation, accounting and staff statistics. The solution of the above mentioned problems requires a new approach to the construction of management systems by the teaching staff of educational institutions, which must also perform the functions of evaluation, motivation and compulsory development of the faculty.

The purpose of this work is to develop a method for a comprehensive assessment of the level of competence of the teaching staff of an educational institution of higher education. Correctly planned, scientifically based and based on methods and mechanisms of management, the personnel assessment system will not only make it more efficient to assess and select teaching staff in the conditions of introducing professional standards at the present time, but also to increase the motivation of teachers to develop existing and acquire new ones competencies, and also to design a trajectory of development of competence of both individual teachers and structural divisions as a whole.

Management system for the development of the competence of the faculty

Competences are stable characteristics of the human personality, predetermining the behavior of a person in a variety of situations and work tasks. At present, a multidimensional (holistic) approach to competence is becoming widespread, which offers more opportunities for integrating business requirements, human resource management technologies and the educational

process. The competency model is the basis for making any personnel decisions regarding hiring, evaluation, upgrading, moving, stimulating and motivating the personnel of the organization.

In this paper, the definition of the competence of the Russian scientist A.V. Chutorskoy (Trishina & Chutorskoy, 2007), according to which, “... competence is the possession, possession of the subject by the relevant competence, including his personal attitude to it and the subject of the activity. Competence is a personal quality (a totality of qualities) that has already taken place and a minimum necessary experience in a given field.” It should be noted that the general definition of the teacher's competence will not differ from the generally accepted one, but will differ in the set of competencies characterizing the level of the teacher and the characteristics of his personality. In Fig. 1 represents the structural model of the competence of the teacher of an educational institution of higher education and its evaluation, developed at the Voronezh State Technical University.

Comprehensive assessment of the level of competence of the organization. Consider an organization consisting of n units. For definiteness, let it be a university consisting of n institutes (faculties), where each employee (teacher) of the university has a certain level of competence. Assume that the level of competence is assessed on a three-point scale: 3 - high level, 2 - elevated level, 1 - normal level.

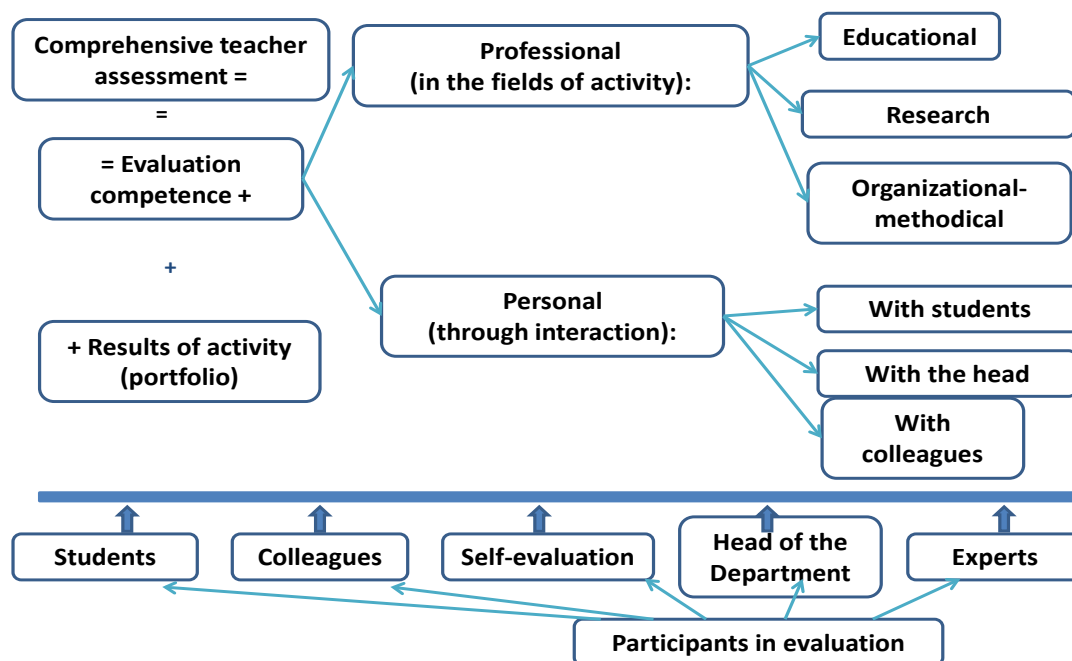


Figure 1. Structural model of the teacher's competence and assessment

The level of competence of the Institute's personnel will be assessed as follows. Let n – number of higher teaching staff; n_1 – number of higher teaching staff, having a normal level of competence; n_2 – number of higher teaching staff, having an increased level of competence; n_3 – number of higher teaching staff, having a high level of competence. We denote by: $Y = n_1 + 2n_2 + 3n_3$ - amount of competence levels higher teaching staff's institute. We introduce the boundary values:

$$A_0 = q_0n, \quad A_1 = q_1n, \quad A_2 = q_2n, \quad \text{where } q_1 < q_2 < 1;$$

Respectively, if $Y \geq A_2$, then this means that the institution has a high level of competence; if $A_1 \leq Y < A_2$ - increased level of competence of the higher teaching staff, if $A_0 \leq Y < A_1$ - normal level of competence, if $Y < A_0$ - low level of competence and organizational measures are required.

To assess the level of competence of PPP as a whole, the matrix convolution apparatus is applicable. We define the dichotomous structure (binary tree) of the pairwise aggregation of the competence levels of higher teaching staff's institutions. There is an example of such a structure is shown for the case of the four institutions in Fig. 2.

First, an integral assessment of the level of competence of institutes 1 and 2, as well as 3 and 4 is determined. Then a comprehensive assessment of the level of competence of the combined institutes I and II is determined. It should be noted that a binary tree can be any.

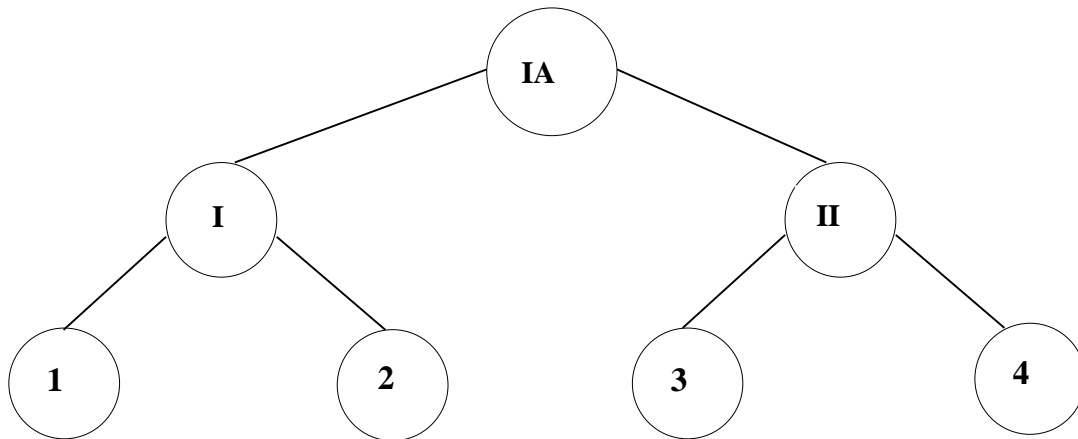


Figure 2. **Binary tree of pairwise aggregation of competence levels**

The definition of aggregated estimates is made on the basis of matrices 3×3 . There is an example of such an aggregation matrix for estimating institutions 1 and 2 is shown in Fig. 3.

3	2	3	3
2	1	2	3
1	1	2	2
2 1	1	2	3

Figure 3. **Matrix of aggregation of competency assessments**

The choice of matrices is determined by the priorities of institutions. Thus, from the matrix in Fig. 2.2 it can be seen that the Institute 1 has a certain priority before the institute 2. Indeed, in the estimation of the second institute and the second one, the integral score is 2, and in the reverse picture (the score of 1 from the first institution and the estimate of 2 from the second) the integral estimate is 1. Having method of assessing the level of competence of the institution as a whole, it is possible to solve the problem of increasing this assessment.

Strategies to improve the level of staff competence. There are various strategies to increase the level of competence of the organization's staff. Consider three of them. The first is a training strategy in which the organization spends certain funds to increase the level of competence of employees in a particular field of activity. The second is a hiring and firing strategy in which an organization employs an employee with a high level of competence in a particular field of activity, dismissing an appropriate employee who does not have a high level of competence. And the third is a strategy of reassignment, in which the organization swaps employees. Consider these strategies.

Consider the *training strategy*, which consists in identifying the set of employees whose level of competence is desirable to be improved, and in identifying those areas in which it is desirable to increase the level of competence of their employees. Assume that the structure of the distribution of workloads does not change with the growth of the level of competence of employees. In this case, increasing the level of competence of the employee in the field of work assigned to him, will increase the level of performance of these works. For the formal statement of the problem, we denote K_{ij} - costs for training an employee j (to increase the level of his competence) in the field of work of the i -th type. Obviously, this will increase the amount of work performed by employees with a high level of competence by the amount x_{ij} . We denote by $y_{ij} = 1$, if associate i , to whom works are assigned of the j -th type in volume x_{ij} , aims at learning, $y_{ij} = 0$ otherwise; $T(x)$ - set of pairs (i, j) , such that $x_{ij} > 0$ and employee j has a normal level of competence in the field of activity j .

A task. Identify y_{ij} , $(i, j) \in T(x)$, maximizing $\Delta(x, y) = \sum_{(i, j) \in T(x)} x_{ij} y_{ij}$ under

restriction $\sum_{(i, j) \in T(x)} K_{ij} y_{ij} \leq H$, where H – funds allocated for training.

This is a classical knapsack problem, effectively solved for integral parameter values by the method of dichotomous programming. We note that the results of the investigations carried out (Burkov et al., 2009; Burkova, 2009; Nasonova et al., 2017) suggested a simple heuristic rule: when solving the problem of determining the optimal flow, one should consider the increase in flows along arcs in the order of increasing value h_{ij} , that is, the costs of training. We note, however, that the task of determining the optimal training strategy, taking into account the possibility of redistribution of the amount of work, is waiting for its solution.

Let's pass to the analysis of *strategy of hiring-dismissal*, which feature is growth of intensity in collective, connected with dismissals. Realizing this, the head limits the operation of this strategy. We denote by d_{ij} increase in the level of tension in the team, caused by the dismissal of an employee j . We denote below $z_j = 1$, if an employee j resigns, and instead of him a specialist from outside, $z_j = 0$ otherwise, r_j – increase in the amount of work performed with a high level of competence in hiring an external specialist instead of an employee j . Finally, we denote by L – a lot of employees who have jobs performed with a level of competence below the high.

A task. Identify z_j , $j \in L$, maximizing $\sum_{j \in L} r_j z_j$ under restriction

$\sum_{j \in L} z_j d_j \leq D$, where D – an acceptable level of tension from the point of view of the manager.

If the hired specialist goes to a higher salary, then one more restriction on the payment fund should be taken into account.

Consider the *reassignment strategy*. The need for this strategy is due to the fact that over time the levels of competence of employees vary. Thus, young employees actively increase their level of competence, and older employees, on the contrary, can reduce their level of competence, as they are more difficult to keep up with changes and learning becomes more difficult. If you do not apply training strategies or hiring-firing, you can try to apply the strategy of reassigning employees to posts. Undoubtedly, the reassignment strategy raises the level of tension in the team, as well as the hiring-firing strategy. Therefore, the manager should limit the number of reassignment operations.

Let's explain the strategy of reassignment using a simple example. There are four jobs (posts) and four employees (Fig. 4). Employee i holds the position of i with experience x_i (indicated at the corresponding vertices). It is assumed that all employees can hold any position. Dotted pairs (i, j) , in which the employee j has a high level of competence.

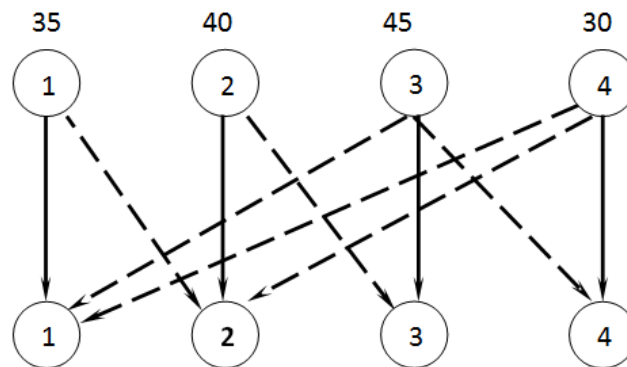


Figure 4. **Illustration of the reassignment strategy**

Note that in the initial distribution of work, the level of competence is 0.

There are 6 elementary reassignments. Consider these:

1. Reassignment (1, 2). Level of competence 35;
2. Reassignment (1, 3). Level of competence 45;
3. Reassignment (1, 4). Level of competence 30;
4. Reassignment (2, 3). Level of competence 40;
5. Reassignment (2, 4). Level of competence 30;
6. Reassignment (3, 4). Level of competence 45.

Define m - vertex graph. Tops i, j of graph edge if possible reassignment of relevant staff. Edge length l_{ij} is equal to an increase in the amount of work performed by employees with a high level of competence. This graph is called the reassignment graph.

Suppose the manager considers admissible k of elementary reassignments. The problem reduces to determining k edges that do not have common vertices, so that the sum of the lengths is maximal. A set of edges that do not have common vertices is called a match.

A task. Identify a matching of k edges with a maximum sum of lengths.

For a small number k this problem can be solved by a simple listing. However, a more targeted approach is more efficient, to which, in particular, the branch and boundary method applies. Let's illustrate the method using the example (Fig. 5.).

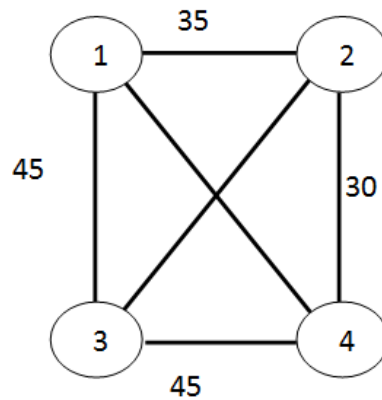


Figure 5. Graph of reassignments

Consider the following algorithm.

1 step. Take the edge with the maximum length - this is an edge (4, 3). We divide the set of all solutions into two subsets. In the first subset, the edge (4, 3) enters the solution, and in the second - does not enter.

Evaluation of the first subset

Because the $k = 2$, then we add one edge of maximal length from the remaining edges that have no common vertices with edges (4, 3) to the edge (4, 3), this edge (1, 2). The estimate of this subset is $45+35 = 80$.

Evaluation of the second subset

We take two edges with maximum lengths, not taking into account the edge (4, 3). The score is $45 + 40 = 85$. Choose the second subset.

2 step. We take the following edge of maximum length. This is an edge (1, 3). We divide the subset in which the edge (4, 3) does not enter into the solution into two. In the first edge (1, 3) enters the solution, but in the second one does not enter. The evaluation of the first subset is $45 + 30 = 75$. The evaluation of the second subset is $40 + 3 = 70$. We choose the subset (3, 4), that is, the solution includes the edge (3, 4) and the edge (1, 2) with the increase in the level of competence 80.

This solution is optimal. The branch tree is shown in Fig. 6.

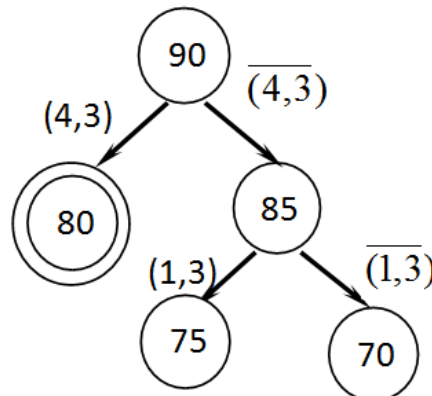


Figure 6. Example of a branch tree

The described algorithm can be generalized to the case of any k and any graph of assignments.

The management system for the development of the competence of the teaching staff. Creation of a competence management system for personnel of any organization, including an educational institution, begins with the development of competency models that represent the standards of professional and business qualities that correspond to posts or groups of posts. In practice, competence is usually described as the ability to solve work tasks, and competence - as the standards of behavior that provide this ability. In order to be competent, the employee must demonstrate certain behaviors that enable him to be competent. The model of competencies is the main tool for making managerial decisions regarding the personnel of the organization.

The structure of the personnel management system based on the competency approach was developed at the Voronezh State Technical University (Nasonova et al., 2017).

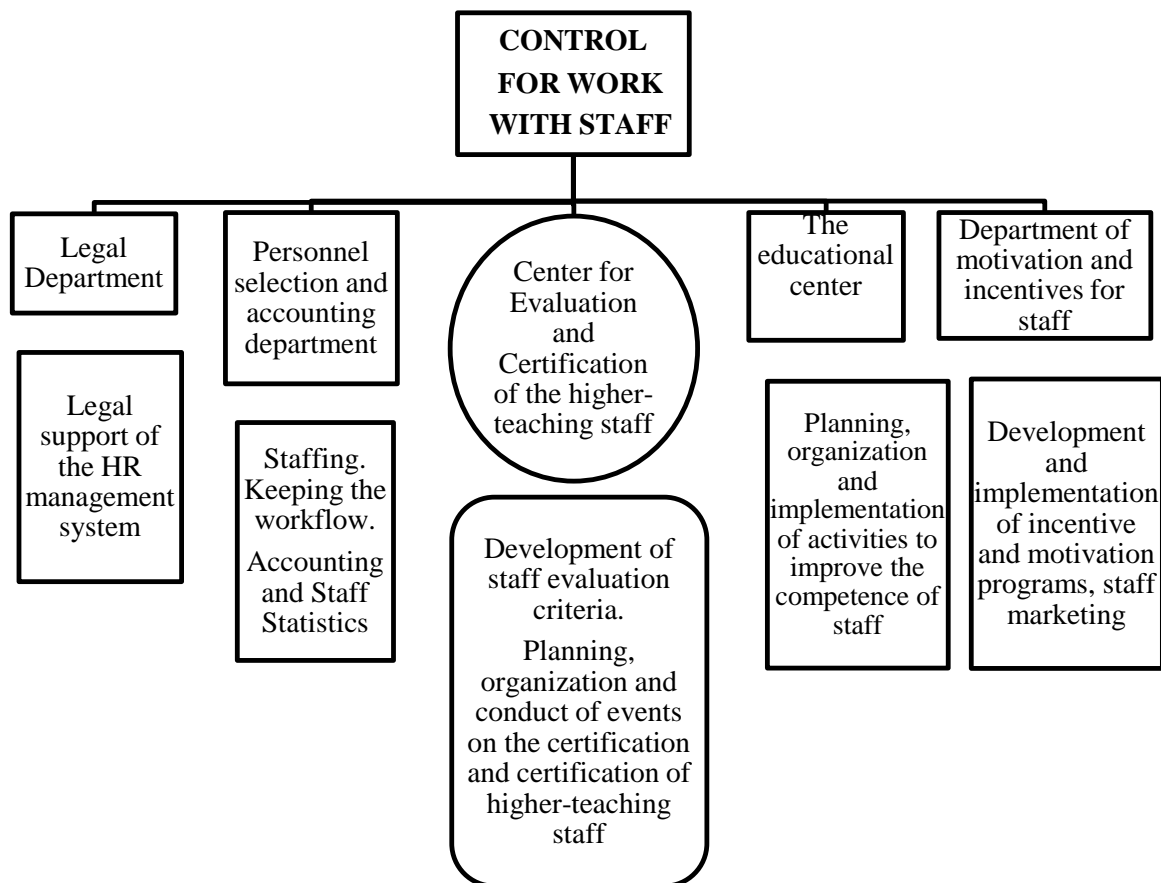


Figure 7. Structure of the personnel management system

The key division of this system is the Center for Evaluation and Certification of the higher-teaching staff, as it is the evaluation results that allow making

objective decisions on the selection and hiring of personnel; Identify gaps in the knowledge and skills of staff and develop training programs; to determine measures to improve the technology of activities and the distribution of work; make adjustments to the system of motivation and stimulation of personnel; to develop career plans for employees and to form a personnel reserve. Increasing the level of competence of the faculty provides the training center.

Conclusions. The solution of the problem of increasing the competitiveness of any educational institution includes the task of developing the competence of the teaching staff, which can be solved on the basis of an integrated approach to the management system of the faculty. Such a system must necessarily implement interrelated functions of evaluation, development, motivation and stimulation of the teaching staff.

The result of the work is the method of comprehensive assessment of the competence level of the teaching staff of the higher education institution, taking into account the priority of the units in the integrated assessment system. Also, to solve the task of forming a program to increase the level of competence of the faculty, a modification of the method of branches and boundaries is proposed, the distinguishing feature of which is the inclusion in the branching scheme of the procedure for improving the lower estimate obtained on the basis of the network programming method. As shown by computational experiments, such a modification reduces the number of branches by an order of magnitude.

The practical importance of the work lies in the fact that its results can be applied in developing methods for increasing the level of competence of the teaching staff of the institution.

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