

# Modeling of the Process of the Branch Personnel Training

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**Abstract**—Implemented is formalization of the students' training management in the branch university on the basis of competence approach. Elaborated is an algorithm for constructing a model of training in accordance with the requirements of the modern realities. In developing of the model used is the theory of Markov's processes. The results allow to carry out operative and strategic management of the qualitative and quantitative training.

**Keywords**—personnel management training; competence approach; coordination of interests of the parties in the formation of the personnel of the branch university; Markov's processes; modeling of the process of management training.

## I. INTRODUCTION

The estimation of the human resources development due to the formed competences depends on the economic and social interests of the Russian society, in particular, the requirement to increase the competitiveness of graduates and personnel of organizations [1-9]. Our attempt to formalize the process of the university training on the basis of competence approach is implemented in the form of an algorithm for training of specialists in accordance with the requirements of the transport branch (in particular, OAO Russian Railways). The arrangement of this problem leads to the elaboration of the model, on the basis of which operative and strategic management of the quantitative and qualitative components of competitive staff is possible. This task creates the elaboration of the model, which helps fulfilling operative and strategic management of quantitative and qualitative competence of the training of competitive staff.

## II. COMPETENCE MODEL OF A TRANSPORT WORKER

The basis for the creation of the accepted is the effective interaction of educational establishments and organizations (Fig. 1).

Branch requirements are presently worked out for the workers [10], and also requirements of professional and federal state educational standards (see Fig. 1). However, intercommunication of the indicated requirements of the parties to the personnel is absent, which hampers their concordance, modelling and estimation interpretation. In more detail the results of the analysis are presented by us in [11-17]. For providing of competence of leaders and specialists of industry of requirement for their preparation in universities and further activity in the structural railroad subdivisions must be identical and strictly specified by the cooperation parties. The condition for providing of this ac-

cordance is measurement of workers' separate competences [18].

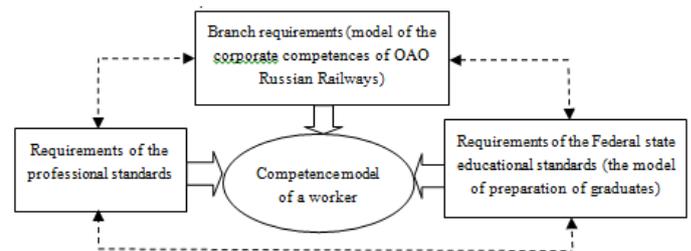


Fig. 1. The employee's competency model which takes into account the requirements of the Federal State Educational Standards, professional standards and corporate competences of OAO Russian Railways.

For determination of the level of the formed competence of university graduates conducted was the analytical review of students' progress as competence formation takes place in the process of concrete disciplines mastering. Analyzing the progress of students on directions of preparation for all period of educating, it is possible to draw a conclusion about the level of their preparation and mastering of one or another competencies.

We will consider on a concrete example, the level of students' competence according to the academic progress. As an object of estimation we choose a preparation direction Management 080200. The standard of preparation of the bachelor [19] supposed mastering of 22 general culture (GC) and 50 professional competencies (PC). Passing on the Federal State Education Standard of the higher education was carried out on the direction Management 38.03.02 [20].

For the reception of the necessary base of evaluation of the formed competences suggested are the results of examinations and tests on educational disciplines, results of the course planning, results of all types of practice and defence of the final qualifying work. For formalization of students' competence mastering success we form the criteria presented in tab. 1.

Further determined was the average score on each discipline of all students in a group, and after that the average score of a group on every cycle and division was calculated. The results of the calculations and generalized estimation of the level of competence formation within the framework of a concrete cycle we will fragmentarily present in table 2.

TABLE I. CRITERIA OF COMPETENCES FORMATION

An interval of a students, estimation	The level of competence formation, %
4,5-5,0	More than 90
4,0-4,5	80 – 90
3,5-4,9	70 – 80
3,0-3,4	60 – 70
3,0	Less than 60

TABLE II. ESTIMATION OF THE LEVEL OF STUDENTS' COMPETENCES FORMATION

Training cycles	The average score of students of direction of training Management	Codes of formed competences	The level of competence formation, %
Humanitarian, social and economic cycle	4,15	GC-1 ÷ GC-14	80 - 90
Mathematical and natural science cycle	3,8	GC-15 ÷ GC-18	70 - 80
Professional course	4,22	GC-19 ÷ GC-21 PC-1 ÷ PC-50	80 - 90
Physical culture	4,14	GC -22	80 - 90
Educational and industrial practices	4,68	GC-8; GC-13; GC-19 PC-8; PC-47; PC-49	90 and above
Final state certification	4,24	GC-5; GC-6 PC-1 ÷ PC-50	80 - 90

As follows from table 2, the level of competence formation of students does not fall below 70 %. All cultural competences in the process of training has been mastered. The highest level of development have the following competences (more than 90 %): commitment to personal and professional self-development, ability to critically evaluate personal strengths and weaknesses; ability to perform business communication : public, speaking, negotiations, meeting, business communication, electronics correspondence as well as the ability to consider the consequences of management decisions and actions from the perspective of social responsibility.

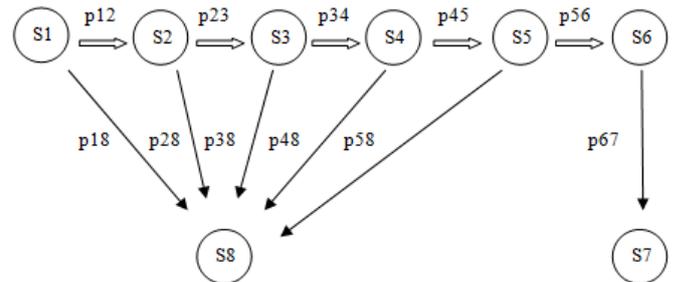
The least mastered are: possession of the culture of thinking, ability to perceive, compilation and analysis of information, goal setting and choice of ways of its achievement.

### III. MATHEMATICAL APPARATUS OF MARKOV PROCESSES

To control the process of formation of competitive graduates we use the mathematical apparatus of Markov processes, which allows to simulate the process of control in their preparation. Based on the obtained in the course of a differentiated analysis of students' progress throughout the training period, the results

of the exam for admission, the number of dropouts for school failure students constructed a homogeneous Markov chain (see Fig. 2). The calculation circuit is made, first of all, the conclusion about the probability of obtaining competent specialists at the end of the learning process, calculated the total retention risk and risk of expelling contributions of students with different high school preparation and performance at all stages of learning.

The object under study over time moves from one state to another, and in our case, from an applicant to a graduate. We will present in general form state graph of the Markov's chain relative to the learning process in the university and let us trace out its transition probabilities.



Here: S1 – freshmen; S2 – sophomores; S3 – third-year students; S4 – fourth year; S5 – fifth-year students; S6 – student, published on the list of the final state certification; S7 – specialist who graduated from the university; S8 – a person who studied at a university, but never finished it.

Fig. 2. General view of the Markov chain to describe the training of students of the specific areas of training.

The symbol “p” is used to describe transition probabilities. So to change the state S1 during a year for the possible transitions to the state S2 with probability p1.

The academic performance of all students over the entire period of study has been analyzed. Let S1I be a student in the first year within the average score of 4,4-5; S12 – a student in the first year within the average score of 3,7-4,3; S13 – a student in they first year within the average score of 3,0-3,6. Similarly presented is the state of the student of other courses (S1I, S1II, S1IV, S1V). The status of S1VI is student who graduated from the university; S1VII is a student expelled from the University.

Further, based on the performed calculations, we find the probability that the students were transferred to n-status in the next year; and also either improve or worsen the condition. The diagram below (see Fig. 3) presents the results. Low performance indicates a lack of training. Basically expelled are the students who had difficulties in mastering of the teaching material. Timely measures (additional classes, appointment of a more qualified teacher, etc.) will allow to save the quantity of students.

From Fig. 4 it is seen that the probability of transition of all students from the first course to the second is equal to 0,73, the second course to the third – 0,88, the probability of transition from the last year to the final state certification (protection of final qualifying work) approximately is equal to one. The analysis showed that the students of the first course are in a situation of the highest risk of expelling. The probability of a student being expelled from the fifth course is almost zero.

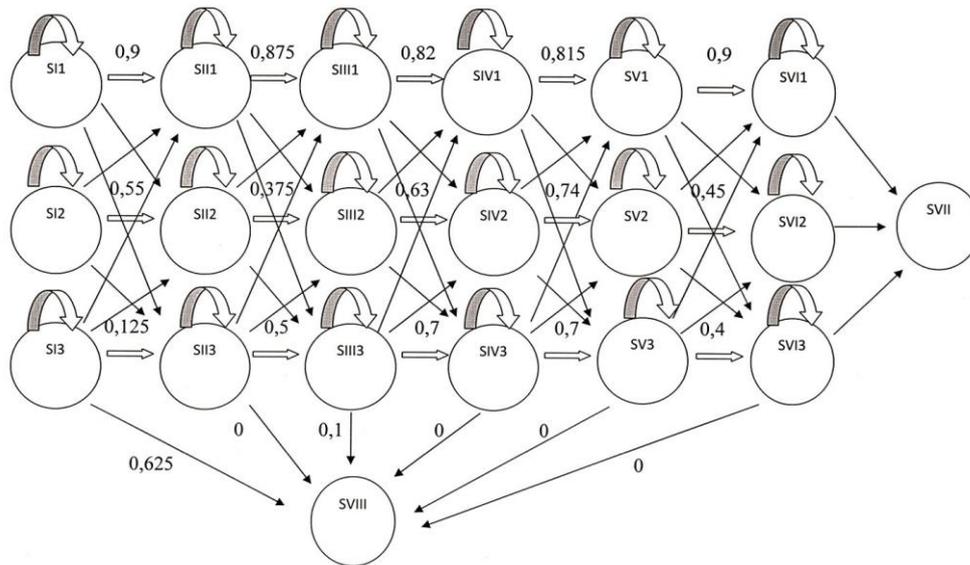


Fig. 3. Model of probabilities of the level of development level of student's competences of specific areas of training.

On the basis of logical addition of risks we calculate the total risk of expelling of the student in the learning process:

$$P = 0,27 \cdot 0,88 \cdot 0,97 \cdot 1 \cdot 1 + 0,12 \cdot 0,73 \cdot 0,97 \cdot 1 \cdot 1 + 0,03 \cdot 0,73 \cdot 0,88 \cdot 1 \cdot 1 + 0 + 0 = 0,32.$$

The overall risk of a student being expelled for 5 year of training was 0.32. Thus, the process of preparation of students in the university is described in terms of the theory of Markov's processes. The simulation of the learning processes, indicating steady states and detection of probabilities of transitions between them has been conducted.

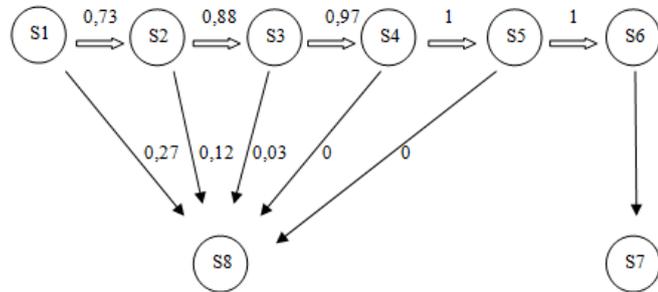


Fig. 4. Generalized values of the matrix of probabilities of students' transition to the next course.

It is proposed to use the obtained data to control the quantitative and qualitative components of the effectiveness of specialists' training. The conclusions can be used by the heads of transport universities to implement operational and strategic actions aimed at optimization of the level of development of competences by the reduction of percentage of expelled students, by students to plan the personal training process and probability of graduation as well as by manager of the transport branch carrying out recruitment of young specialist.

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