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Innovations in education and approaches to assessment of regional educational systems

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Abstract: The analysis of the latest innovations in the Russian education and trends in the development of educational regional systems is provided. Approaches to assessing the effectiveness of the operation of the company-university system are discussed by an example of motor engineering training for the oil and gas industry.

1. Introduction

The innovative development of the global and domestic economy has led to an unprecedented rate of knowledge renewal. According to some experts [5], 5% of theoretical and 20% of professional knowledge are updated annually. This means that today it is impossible to train a specialist for professional activities only once.

In response to these challenges, the structure of educational levels, the requirements for the teaching staff, the methodological support, the material and technical base of educational institutions have fundamentally changed in the system of Russian education [9], which is stated in the new Law on Education [10], a series of educational standards "3+" [8].

2. Methodology

Implemented in 2011, the transition of Russian education to a multi-level training system, on the one hand, was to add flexibility in training highly qualified personnel. On the other hand, training of engineering personnel is impossible without the industry participation in the development of educational programs for undergraduate and graduate programs. To do this, the production sector must understand the characteristics of the new training system and realize the possibilities of its use for solving production tasks for training and retraining personnel.

Education has yet to adapt to a two-level system. Standards and educational programs of higher education fall short because bachelor's programs are extremely reduced training programs for engineers of the 2000s. The analysis of the main educational programs for engineering training in several universities (Table 1) shows that there has been a significant decrease in the absolute and relative number of hours allocated to disciplines of humanities, mathematical and natural sciences, as well as disciplines that form the basis of engineering training. (Theoretical Mechanics, Theory of Machines and Mechanisms, Resistance of Materials, Technology of Structural Materials, Machine Parts). At the same time, the load in the disciplines of the professional cycle increased substantially in absolute and relative terms with the same number of practice hours.

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Table 1. Ratio of training load by groups of disciplines

Educational program	Year of approval	Distribution of training load (hour)							Total amount of training load (hour)
		Humanities, Socio-economic	Mathematical and natural sciences	General engineering	Special	Specialization (profilization)	Practice	Others	
Engineer	2002	1796	1715	1834	1990	570	1080	1112	10097
Bachelor	2016	1732	828	1404	2484	1008	1080	1112	8640
Master	2016	504	936	-	1224	-	672	1488	4320

The Law on Education [10] and educational standards of the generation 3+ [8] give ample opportunities for improvisation in the development and implementation of basic educational programs.

New opportunities consist in a reasonable combination of competence-based and socio-cultural approaches, dual educational technologies, project training methods, modular principle of organizing the learning process. All this allows us to maximally individualize the educational process, make it as efficient as possible, including from the point of view of generation and transfer of new knowledge.

Starting from 2011, there has been a serious trend toward the transfer of authority to manage education, including higher education, to the regions. If this policy from the side of federal organizations proves to be long-term, it will entail a number of consequences that will need to be taken into account in the management of regional budgets, economy of the region as a whole and educational system in particular. Regions will need to predict the need for human resources at all levels of training, depending on the prospects for the development of the region [6]. It will be necessary to optimize the development of the infrastructure of educational institutions of all levels in the areas of training [11]. It will be necessary to learn how to evaluate the effectiveness of the regional system to form competences in terms of the effectiveness of the company-educational institution system.

In this system, let us put company first, since it has the task of developing requirements for training and retraining personnel, the goodwill of using high-tech equipment of the company to obtain working professions, and conducting various types of practice.

From this point of view, the region faces another challenge: developing a system of criteria for selecting leading companies, as well as mechanisms for motivating companies to participate in training and retraining programs.

Companies, relevant ministry and independent expert agencies evaluate education and the level of training of specialists. The Ministry of Education and Science of the Russian Federation annually makes adjustments to the scale of assessment of the activities of educational institutions. At the same time, the index of employment of graduates, the level of wages and promotion of a business career remain key, both during accreditation of educational institutions, and evaluation by independent expert agencies, also during certification of quality systems.

All approaches to assessing the quality of education can be divided into 5 groups:

1. Assessment of conditions for the provision of educational services.
2. Assessment of the result (knowledge, abilities, skills - competences of the student, graduate).
3. Assessment of satisfaction (student, graduate, industry).
4. Process approach.
5. Complex assessment including elements of the four previous groups.

The first approach assesses the possibility of implementing an educational standard in terms of the quality of the basic educational program, provision of educational facilities, training and research equipment, qualified teaching staff, educational materials. According to this scheme, assessment of

universities is conducted by experts from Rosobrnadzor (Federal Education and Science Supervision Service) during accreditation examination, continuous online monitoring by the Ministry of Education and Science and independent expert organizations during certification and inspection of quality management systems (QMS).

The second group includes the recently introduced system of federal Internet exams, the system of state examinations which presumes the availability of qualified industrial workers in the State Examination Commissions (SEC).

Satisfaction is evaluated in several ways by different methods. The first group of methods is based on an expert survey of a specially selected group of students in the learning process and graduates - immediately after employment, in 5, 10, 15, etc. years after graduating from the educational institution (EI). The second group of methods is based on an expert survey of employers. This method was widely used in the period of planned economy.

The process approach is widely used to assess the focus on improving all EI processes (main and auxiliary). It is used for certification and inspection of the EI QMS for compliance with international quality standards ISO 9000.

Complex assessment of the training quality is a symbiosis of the four previous approaches in various combinations and ratios. It serves as the basis for making managerial decisions when accrediting EI, certifying QMS, evaluating rating agencies.

In the authors’ opinion, from the point of view of the rationale for regional policy, it is more appropriate to assess the joint activity of the university and interested companies in training, employment and career advancement of young professionals. At the same time, the effectiveness of the process of training a specialist in this context should be understood as ensuring maximum compliance of the graduate's competences with the industry requirements. Assessment of this effectiveness can involve a set of indicators, including: the duration of the adaptation period after employment of young specialist T_A in months; the probability of employment of graduate P_T; survival rate (job security) of young professionals V_{Too} over evaluation period T_{Oc} (in months) – the ratio of the number of young professionals who have worked at the enterprise for 5 years or more to the total number of young professionals employed over the estimated period.

It is ideal when a young specialist does not need an adaptation period or this period is combined with the process of obtaining higher education. In times of developed socialism, this period was 3 years. For this period the graduate of the university was given the status of a young specialist. This also involved a system of mentoring, restriction of the specialist's functions, reduction in the level of responsibility for unintentional shortcomings in the work. However, under conditions of competition and intensive innovation development of industries, it is necessary to find a compromise solution that is acceptable both for the education system with its limitations (requirements of the educational standard, the level of financing of the educational process) and the industry requirements, consisting in the desire to accelerate adaptation processes and ensure the fastest use of the university graduate to solve engineering problems.

The second assessment of effectiveness is "Ease ...", a high probability of employment. Dual education involves a significant contribution of the company to the training of a specialist. And in this key, a reasonable combination of the socio-cultural and competence-based approach is important (a person must share the values of the company). Why train if he or she goes elsewhere and causes damage to the enterprise? The real values of this indicator for motor specialties, according to the results of 10-year observations, are in the range of 0.5 to 0.85.

The survival rate (job security) of young professionals in the company depends on many factors, including industry, company personnel policy. For example, large oil companies are characterized by the availability of programs for young professionals, which involve a series of adaptation procedures that make it possible to shorten the period of adaptation as much as possible and reduce the probability of dismissal. The level of wages and prospects for promotion are essential. According to surveys of specialists of the personnel services of large companies engaged in the technical operation of vehicles, this indicator varies between 0.1 and 0.8.

For a comprehensive assessment of the effectiveness of the educational system, it is proposed to use the indicator characterizing the effectiveness of the educational system as the ratio of the effective work time of the graduate over evaluation period $T_{Oц}$ to the value of the evaluation period which is proposed to call the efficiency coefficient of the educational system - $K_Э$. Its physical meaning is the relative duration of the effective period of the graduate's work. One can understand the effective period of the graduate's work as the time from the moment of employment after graduation, except for the adaptation period.

It is related with indicators of the probability of employment, the adaptation period, the evaluation period, the survival rate by the ratio (1):

$$K_э = \frac{P_T V_{Too} (T_{Oc} - T_A)}{T_{Oc}}, \quad (1)$$

where T_A - assessment of the graduate's adaptation time;

P_T - assessment of the probability of employment of the graduate in the specialty within a year after graduation;

V_{Too} - assessment of the survival rate of young professionals in the company.

Depending on the objectives of the research, average values, mathematical expectation, or other valid values may serve as estimates of indicators.

In order to ensure visibility and form an integrated approach, it is customary to use radar charts in assessments. They show how the values of factors correlate in different companies Fig. 1.

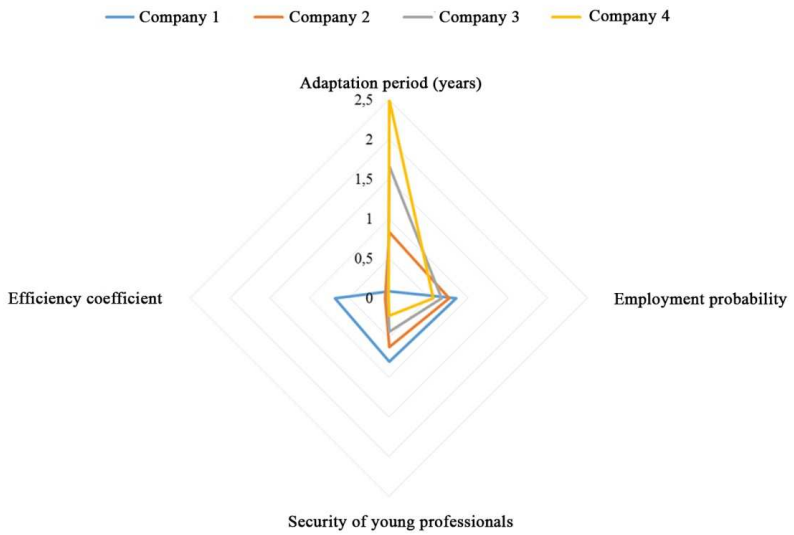


Figure 1. A radar chart of the efficiency of the company-university system

The proposed indicator assesses the joint activity of the company and the university in training. As can be seen from the above mentioned data, the greatest effect of the system is achieved where the company and the university carry out a complex of activities for transferring the adaptation period to the period of studying at the university (company 1). The worst result is when a young specialist begins to get acquainted with the company after graduating from the university. This acquaintance often involves obtaining a working profession, an internship, and a long-term job in a working

position at once. The adaptation period is 2.5 years; low survival rate is typical for companies with such personnel policy (enterprise 4).

There are also companies on the market that implement a completely different personnel strategy. They do not work with young specialists, they do not recruit students from universities and colleges, and they do not spend resources on these "useless" activities. Often these enterprises are at a very good technological level. The essence of their personnel policy is the selection and re-purchase of specialists with the necessary core competencies in the labor market [3]. Such companies receive certain competitive advantages. From the point of view of the law - no complaints. From the point of view of state care for personnel training - there should be a system of preferences for companies that care about training young people, creating training centers, actively interacting with universities and colleges for training and retraining programs. And here the economic evaluation of the system becomes urgent, which will show how effective the personnel policy of the company is, where it gains, and where it loses. Issues of social and economic efficiency of investment in education have been discussed over many years in a huge number of publications by domestic and foreign authors [1, 2, 4, 5, 7, 8, 12]. According to studies conducted in the United States, every $35,000 invested in the training system brings $1,000,000 in profits [5]. What is the situation in Russia?

The economic model for assessing the investment of enterprises in education is given in [1]. The model is based on the rules for calculating the investment in the student, as well as calculating the additional profit and the payback period of investments in education. In the authors' opinion, this model describes well the closed corporate educational systems, not taking into account the options for involving young specialists from outside, which is typical for motor service and transport companies.

$$EFF = \frac{EF}{RC}, \tag{2}$$

where EFF – economic efficiency of investment in education;
EF – value of the received economic benefit;
RC – amount of resources, or costs on the part of the company.

To use this well-known formula for assessing the economic efficiency of the company-university system, it is necessary to modernize expression (2) by presenting the *EF* and *RC* indicators as functions of indicators T_A, P_T and V_{Too}, or the efficiency coefficient of educational system K_E.

Knowing the financial investments of the company in one student and the achieved efficiency coefficient, one can evaluate the efficiency of investments in educational programs.

3. Conclusion

The calculations conducted using the above mentioned approach for a number of companies in different sectors of the economy made it possible to estimate the payback period for company investments into educational projects (on tripartite contracts for training by the basic educational programs of higher education). They are from 5 to 0.5 years without taking into account K_E and from 10 years to 1 year, taking into account K_E.

Further research in this area can be aimed at typing educational systems, development of a system of criteria for selecting partner companies, as well as a system of preferences to motivate employers.

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