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System Approach in Professional Retraining of Industrial Production Enterprises Specialists

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ABSTRACT
For the modern industry, where global modernization takes place, professional retraining is carried out on a multi-link, multi-stage trajectory, its quality and costs evaluation being a non-trivial task for both performers and consumers of educational services. The trajectories can be implemented on the basis of corporate and higher education integration. A person should learn and improve his skills all the time, because life itself is now rapidly changing and becoming more complex. The levels, types, and forms of education are increasing and the time frame for learning is expanding. Today it is necessary to study thoroughly, economically, quickly. Inside a professional discipline engineering activity assumes allocation of some "core of knowledge" around which various "applications" are realized. Retraining should be carried out in the operated system providing decrease in expenses and quality control. Optimization of experts retraining system is a difficult problem in connection with dependence nonlinearity of cost-quality and essential restrictions.
Keywords: *system approach, retraining of specialists, training trajectories, resource, cost-quality*

1. INTRODUCTION

The progress of science and technology at the current stage of industrial society development is largely determined by the availability of highly qualified human resources. The experience of industrially developed countries shows that the urgency of personnel training and retraining, its professional development increases significantly especially in the periods of structural transformations of economy and crisis phenomena elimination.

The Cobb-Douglas production function is widely used to model processes characterized by firm, stable production functioning (when involvement of a new resource unit brings an effect proportional to the average productivity of available resources) [1,2,3]. Then the model of production can be presented in the following form:

$$Y = A_0 K^{\alpha K} L^{\beta L} \quad , \qquad (1)$$

where Y- is the result of technology functioning; A_0- is the model proportionality coefficient; K- is the cost of the basic industrial funds concerning technology; αK- is the logarithmic function of elasticity on funds; L- is the expenses for the personnel serving technology; βL- is the logarithmic function of elasticity on labour.

At $\beta_L > \alpha_k$ - the industrial process is labor-intensive, and at $\beta_L < \alpha_k$ - the industrial process is fund-intensive.

Personnel contribution evaluation techniques by means of production functions show high sensitivity of this component in the resulting production, that commensurate with capital expenditures, and in some industries it is even higher. For example, in the electric power industry, especially in the branches with wide application of computers and software there is an identifiable scientific and technical progress, as there is a need in highly qualified personnel in this branch. In the industries involved $\beta_L < \alpha_k$ [4,5,6].

2. RESEARCH METHODOLOGY

Requirements for specialist training are formulated outside the educational system. They are based on general economic and social goals of the state, the needs of private production, personality, etc. The importance of education in a country economy is especially emphasized in the theory of human capital, according to which resources spent on education are considered to be investments into human capital.

The modern personnel retraining can be characterized by the following features:
- multifunctionality of retraining;
- increasing knowledge-intensive production, which leads to a further increase in the requirements for the quality of specialists retraining;
- financial and technical resources of the personnel training system.

The planning level has the following functions:
- quantitative indicators evaluation of engineers retraining;
- determination of retraining majors and branches;

- defining the levels of specialists retraining.

To take decisions the planning system should be supplemented by criteria for the distribution of human, financial and material resources allocated to the system of technical training, retraining and professional development.

Taking into account the world experience in the use of production functions, it can be assumed that the proposed tools can be used as a methodological basis for planning and forecasting the number and structure of specialists and the formation of a new system of training and retraining [6,7,8].

For the formation of the strategic personnel policy it is necessary to define the production development objectives, to develop the system that provides production units with highly qualified personnel, to assess the quality of specialists retraining, and to organize the process of their professional development.

For the modern industry, where global modernization takes place, professional retraining is carried out on a multi-link, multi-stage trajectory, its quality and costs evaluation being a non-trivial task for both performers and consumers of educational services. The trajectories can be implemented on the basis of corporate and higher education integration.

In order to describe the production as a whole and determine its needs in the qualified personnel, we will distinguish three main groups of factors:

- defining quantitative and qualitative indicators of the system of specialists technical training, retraining and advanced training;
- characterizing internal processes in production, interaction of fixed assets and human resources;
- reflecting external processes in the system.

These groups of factors are in complex interaction. The second and third group determine the tasks formation for the retraining system; at the same time, the quality of the retraining system has a direct impact on production efficiency. This mutual influence is dynamic and its consideration is necessary to solve the system optimization problems of personnel training and retraining.

Knowledge as a way of skill formation is designed to form various skills: basic, substantive, interdisciplinary, methodological. Higher education should, first of all, form the subject and interdisciplinary skills, which are the basis for specialist training. It is necessary to pay attention to the formation of methodological skills, because they form the ways and methods of self-organization and self-education. Since these forms of training are used for a qualified specialist to some extent, his further training and retraining is more targeted. The customer is interested in training a specialist of a certain level, with specific knowledge and skills, and it is the customer who forms a list of necessary disciplines.

Today, personnel training is not just the latest fashion, but an effective tool for motivating the personnel (as a result - growth of their productivity) and a means of the company increasing competitiveness. Introduction of new production or customer service technologies is unthinkable without staff training. It is not easy to attract a good specialist to your company without giving him/her an opportunity for further professional growth. It becomes only possible owing to corporate training.

Intra-company educational structures appear more and more often in universities, and this fact confirms trend involved, i.e. the demand for education is changing towards its greater professionalization.

The search for innovative forms of educational and scientific activity of a classical university, as well as mutually beneficial forms of its interaction with business, seems to be the most relevant. One of these forms, as evidenced by the international practice of developing effective systems of educational structures, may be an alliance between a corporate university and traditional educational institutions.

An important characteristic of corporate education is that, according to some experts, it is a system of continuous corporate professional education.

There is also a narrow understanding of a corporate university - first of all, as a system of training young specialists in specialized universities at the third or fourth year of their studies on specially designed training programs taking into account the specific features and corporate culture of the company.

Thus, despite some differences in the interpretation of corporate education, mainly due to the specific features of corporate forms of education in a particular company, all experts agreed with the definition of "corporate university" as a system of intra-company education, united by a single concept within the framework of the organization's development strategy and developed for all levels of managers and specialists.

Most companies today strive to hire already experienced, well-trained employees who do not need additional courses for adaptation in the workplace. In such cases, the focus is made on the personnel training directly at higher education institutions. Most of all it concerns technical and engineering professions. Many companies actively cooperate with higher education institutions and already in their final courses form the personnel reserve for their production, organizing student internships and preparing diploma projects at their own enterprises. This fills a gap that is a characteristic of modern Russian higher education - the lack of a practical training component.

Requirements for specialist training are formulated outside the education system. They are based on general economic and social goals of the state, needs of private production, personality, etc. The importance of education in a country's economy is especially emphasized in the theory of human capital, according to which resources spent on education are an investment in human capital [5,6,7,9].

The human being must learn and improve throughout life, as life itself is rapidly changing and becoming more complex. The levels, types, forms of education are increasing and the time frame for learning is expanding. Today it is necessary to study thoroughly, economically, quickly.

A great number of scientific and analytical reviews have been published on this issue, summarizing and systematizing methods and approaches to the definition of

the personnel need [5,6,7,8], some of them being devoted to mathematical methods of modeling personnel processes [5,6,7,10].
The orientation to the systematic approach formation in education as one of the most important requirements of modern life, and its results give an answer to the question: what and how to teach in modern conditions [5,6,7,8,9,10].

3. RESEARCH RESULT

For the modern industry, where global modernization takes place, professional retraining is carried out on a multi-link, multi-stage trajectory, its quality and costs evaluation being a non-trivial task for both performers and consumers of educational services. The trajectories can be implemented on the basis of corporate and higher education integration.
The multilevel education system is one of the promising means of conscious management of educational reforms. The main advantages of the multilevel structure of higher education are the following: implementation of a new education paradigm, which consists in fundamentality, integrity and focus on the personality of the student; significant diversification and response to the intellectual labor market; increased education of graduates prepared for "lifelong learning" as opposed to "lifelong education"; freedom to choose "trajectories of learning" and the absence of a dead-end educational situation; wide opportunities for the development of education in the field of "lifelong learning". The multi-level education system consists of separate blocks. To organize these blocks it is necessary to systematically assess the effectiveness of resources spent on a particular trajectory.
As for the improvement of the retraining process for specialists, it should be noted that the creative development of a specialist requires not only the inclusion in the retraining process of the system of some established knowledge, but also the methodology of new knowledge analysis.
Predicting the development of an enterprise, it is necessary to simultaneously predict the appropriate organizational and technological structure of personnel, as well as programs for the systems development of specialists retraining and professional development, because the purpose of such systems actively affects the development of production itself. Thus, the specialization of skilled labor, and in relation to the conditions and tasks of engineering activities - engineering specialization, develops into an important component of the development of production forecasts, as well as the system of training, retraining and professional development of engineering personnel. In connection with the complex nature of many engineering tasks and the need to ensure professional mobility of specialists, a special role is given to the issue of the volumes ratio of general scientific, general professional and special training of engineers.
Functional engineering specialization is provided by more complex methodological means and organizational and methodical methods of the educational process, flexible modular system of curricula, multi-variant composition and differentiated content of the disciplines module of functional specialization [6,9].
The transition to an upgraded model should be carried out in stages and in several directions. One of them may be the introduction into the practice structured training courses for specialists retraining, which means integrated systems that include a course of lectures, a system of laboratory and practical classes, training design, having an interdisciplinary character, and a set of integrative tests, as well as special tools for computer support of the educational process.
Within a professional discipline, engineering activity assumes a certain "core of knowledge" around which various "applications" are implemented. This procedure is also multi-stage and multilayered [5,6,7,9].
Retraining should be carried out in a managed system providing cost reduction, fast adjustment, and quality control.
Optimization of the retraining system is a complex problem due to the non-linearity of cost-quality dependence and the presence of significant limitations.

4. DISCUSSION

Therefore the up to date area of research is the system analysis of retraining specialists models in industrial production, taking into account the functional features and used training trajectories cost.
Integration of multilevel higher technical and professional engineering education in a single structure of a technical university is beneficial for the state and society from the point of view of education economics. It is known that the cost of training a specialist with higher education in an integrated educational system by minimizing the total amount of educational services is 25-30% lower than in the case of consecutive training of a specialist of the same profile in two autonomous higher education institutions [5].
Flexible curricula, on the one hand, should ensure strict compliance of basic and complete higher education with the state educational standards, as well as the requirements of specialists qualification characteristics for their professional, humanitarian, socio-economic and fundamental training, their coordination at all levels and stages of education, on the other hand, they should create conditions for the realization of opportunities for students to change the "trajectory" of their educational route.
Thus, the integration of multi-level higher technical (by directions) and professional engineering (by professions) education in a single structure is the optimal strategy for the formation and development of technical universities in Russia.
The main objective of designing advanced qualification requirements is to ensure compliance between changes in personal and social needs and the prospects of science, technology, economics, culture and their reflection in the objectives and content of training.

Speaking about the issues of improving the process of training specialists, it should be noted that the creative formation of a specialist requires not only the inclusion of some established knowledge in the process of system preparation, but first of all, the methodology of obtaining new knowledge analysis.

The questions of functional engineering specializations quantity and their depth are very important for the organization of educational process and for specialists training cost.

Domestic and foreign higher technical schools have developed and tested numerous training systems and technologies for training engineering personnel [5,6,7,8,9,10]. The most effective and promising were such systems of wide profile specialists training, that orient students to perform specific engineering functions (designer, researcher, engineer, technologist, etc.), predetermined by the customer enterprises.

The methodological core of the targeted functional training system is the idea of three-component structure of engineering work content and the corresponding three-component structure of engineering training. In this case, the content of specialists professional training is presented in the form of three logically and structurally interconnected components (subsystems): basic (fundamental) engineering training in the profile of the major, functional and subject-branch specialization, taking into account changes in the labor market.

The necessity of wide fundamental training of specialists at the university is conditioned by the increasing requirements of the labor market, while the necessity of professional knowledge, skills and abilities specialization acquired by students is conditioned by specific and differentiated requirements of target training and continuously increasing differentiation of engineering activity.

The target orientation of future specialists to perform engineering functions predetermined by the customer requires to acquire a functional engineering specialization during their studies. This type of specialization should be provided by industry profiling of general professional and special engineering disciplines, tasks and content of production practices at the enterprise, focused on a particular production theme of course and diploma design [5].

In order to define the main directions of higher professional school developmemnt, it is necessary to analyze the problem-oriented state of the school and its prospects.

In the conditions of rapidly changing knowledge content, its constant increasing rates, all countries are reforming higher education. Here are its main directions [5,6,7,9]:

- continuity;
- increasing fundamentality;
- integration;
- integration with science and industry;
- computerisation.

A specialist today is a person with broad general and special knowledge, able to react quickly to changes in technology and science, corresponding to the requirements of new technologies, which will inevitably be introduced; he needs basic knowledge, problem, analytical thinking.

The basis for theoretical and then practical development of the lifelong learning concept was the research of R. Dave, who defined the principles of lifelong learning [5]. He defines the attributes that characterize continuing education. These attributes can be considered as the result of the first fundamental phase of scientific research in this field. Their list includes the following principles:

- education coverage of all human life;
- understanding of the educational system as holistic, including basic, sequential, recurrent, parallel education, uniting and integrating all its levels and forms;
- inclusion of formal, non-formal and extra-institutional forms of education into education system, in addition to educational institutions and centres of additional training;
- horizontal integration: home - neighbours - local social sphere - society - world of work, etc.; between studied subjects;
- vertical integration: between different stages of education, between different levels and subjects within individual stages;
- the universality and democracy of education;
- creation of alternative educational structures;
- linking general and vocational education;
- emphasis on self-education, self-training and self-esteem;
- emphasis on self-governance;
- individualization of teaching;
- teaching under conditions of different generations in the family and society;
- broadening one's horizons;
- interdisciplinarity of knowledge, its qualities;
- flexibility and diversity of content, learning tools;
- the ability to assimilate new scientific advances;
- improved learning skills;
- stimulating motivation to learn;
- creating appropriate learning environments;
- implementation of creative and innovative approaches;
- development of nurturing and learning society: learning to "be" and "become" someone;
- systemic principles of the educational process.

The elements of the system have both common and distinctive features. All of them solve a common task of preparing students for work and social activities on the basis of standard curricula, while solving close problems of educational material structuring and selection. Distinctive features are obvious: different volumes, terms, levels of training. Among the significant shortcomings of the system should be attributed to the weak interaction of its elements in the implementation of the cross-cutting educational process.

5. CONCLUSION

The solution to the problem of forming a creative attitude of a specialist is possible only through the implementation of the continuous education, which is carried out through a combination of self-education with the provision of an opportunity to use the help of highly qualified teachers and

specialists at any time. In this connection, the model of education in general is changing. There is a transition from a mono-model oriented at training specialists and functionaries to a multifunctional model based on the free development of each individual's personality and the formation of his or her ability for self-development. One of the most realistic means of implementing the idea of continuing education is the so-called "periodically renewable education".

The main advantages of the multilevel structure of higher education are the following [5,6,7,9,11,12]:

- implementation of a new education paradigm, which consists of fundamentality, integrity and focus on the learner's personality;
- significant diversification and response to the situation on the intellectual labour market;
- improvement in the education of graduates prepared for "lifelong learning" as opposed to "lifelong education";
- freedom of "learning trajectory" choice and absence of educational deadlock;
- the possibility of effective integration with secondary general education and secondary special education institutions;
- the stimulation of significant differentiation in secondary education;
- wide opportunities for postgraduate education;
- The possibility of integration into the global educational system.

The problem of ensuring the competitive ability of products manufactured by the higher education institution, to which its graduates belong, has become particularly important in view of the deepening market transformations in the country's economy. If the main goal is the quality of specialists training, then the expected result, i.e. quality, should be included in the educational process already at the design level. Therefore, the design of the educational process, its management, quality evaluation and its results are the main tasks of each higher education institution.

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