Institutional modeling of the management system of regional participants in dual education in the context of neoindustrialization

Alexandr Kokovikhin /PhD in Economics
Associate Professor
Head of the Management
and Information TechnologiesInstitute
Ural State University ofEconomics
Ekaterinburg, Russian Federation
gov66@inbox.ru

Ekaterina Ogorodnikova /PhD in Economics
Associate Professor,
Department of Management
Ural State University ofEconomics
Ekaterinburg, Russian Federation
cmb_8@mail.ru

Andrey Plakhin /PhD in Economics,
Associate Professor,
Deputy Headof the Management and Information
TechnologiesInstitute
Ural State University ofEconomics
Ekaterinburg, Russian Federation
apla@usue.ru

Abstract— **The initial prerequisites for writing this article were the multiple tasks of forming an effective management system for the regional participants of the dual model in the context of new industrialization. The dual model is one of the most effective tools for reducing the "competence gap" caused by neo-industrial transformations. The main purpose of this article is the scientific substantiation of the choice of the institutional model of managing regional participants of the dual model in the context of neo-industrialization, as well as the assessment of its usefulness for individual participants: enterprises, government agencies, students and educational institutions. The methodology for the formation of an institutional model is based on the principles of the theory of utility, so the authors posed and solved the scientific problem of formalizing the utility of participation in the dual education model for individual stakeholders in the form of specific indicators. As a result of the study, the main targets of regional participants in dual education were identified and formalized in the form of specific indicators, two types of models of management of regional participants in dual education were identified: using and without using institutional superstructures, a quantitative study was conducted of the utility indicators of participants in dual education, which resulted in the formation of an institutional model for managing regional participants in dual education in the context of neo-industrialization.**

Keywords — Neoindustrialization, dual education, institutional modeling, integrated indicator, utility, management model, target vector, secondary education, institutional superstructure

I. INTRODUCTION

A systematic look at the phenomenon of new industrialization, taking into account its historically-determined nature, allows to consider the works of J. Galbraith ("New Industrial Society"), D. Bell's ideas about "post-industrial society" as the theoretical basis for the formation of a neo-industrial model of economic development as an independent type of society transformation, also researches of E. Toffler on the "super-industrial civilization", as well as the work of Russian scientists V. Inozemtsev, Y. Yakovets and others [1].

At the level of regions and territories, the timing and socioeconomic effect of the new industrialization is directly determined by the results of the investment policy, as noted in the work of E.G. Animitsa and Ya.P. Silin: "the new industrialization in the economic space of the Sverdlovsk region implies not only a fundamental renewal of fixed assets, it also requires large-scale investments in the creation of new production infrastructure, in resource-saving solutions, in the development of new technologies and the transfer of foreign, the training of new personnel, the formation of a new organizational and production process, and even the emergence of a modernized person — both a producer and consumer of fundamentally new products, goods and services [2].

All researchers of long-term economic development trends are united by the idea of technological conditionality of changes related to human resources. S. Kergroach notes the special influence on the labor market of the fundamental digital transformation of production [3]. A more detailed justification of the connection between the development of regions and the availability of qualified personnel is presented in [4, 5]. Since the mid-2000s, the concept of "gap" has entered the concept of knowledge management in the sense of the "knowledge gap". Analysis of the gap in knowledge and skills, the gap in competencies as a method of systematic assessment of the level of knowledge and skills (competencies) allows not only to quantitatively compare the competence model of a graduate and the competence model of a specialist (job profile), but also to develop and implement an individual program of knowledge and skills development competencies) with the goal of bridging the gap [6].

Assessing the institutions of development of the professional labor market, business representatives highlight the issues of participation of enterprises in the implementation of projects on vocational guidance for schoolchildren - 37.6, and in the second place of the rating with a small margin of 2% is the promotion of the best experience of partnership of industrial enterprises and educational institutions on practice-oriented dual education - 35.6%.

The purpose of this article is to substantiate the methodological basis of the institutional modeling of the management of regional participants in dual education. As a key criterion for choosing a model of management of the dual education system in the region, the authors propose the use of a criterion for maximizing the integrated utility indicator for participants in the dual model.

II. Theoretical And Methodological Base Of Research

The basic source of information for studying the institutional model of management is data on the organization of the management system in Germany. According to the work of Thomas F. Remington [7, 8], about 20% of firms offer training in manufacturing, most of which are small and medium-sized businesses. Corporate industrial academics such as Volkswagen, Siemens and Bosch have corporate training academies and workshops, other enterprises are included in the system of dual education through participation in chambers of commerce and industry.

The activities of the Chambers of Commerce and Industry of Germany as the main institution providing management of the dual education system include all the main stages of this process: set standards for the professions, standardize methods and the learning process, train teachers, carry out an independent assessment of students' qualifications in the process and upon completion of training, carry out registration - administrative activities in relation to the organization of practical internships, issue training certificates [9].

Such an institutional model for managing participants in dual education provides significant benefits for the training of personnel. Constant information exchange between employers and educational institutions allows not only to plan a contingent of students based on the staffing needs of enterprises, but also to unify the professions (according to the Agency for Strategic Initiatives in Germany there are about

350 nationally recognized professions, while in the system of Russian primary vocational education and secondary vocational education is being prepared for 600 professions).Also, through the mechanism of membership dues, on the shoulders of employers more than half of the cost of training is transferred.

The same institutional model positively assesses Monika Pogatsnik in [10] denoting the advantages of using the dual education model for companies: eliminating labor shortages, improving the quality of the workforce, reducing costs and forming cooperation based on curriculum development. Also important is the ability to form deep human and professional relationships.

However, even with the borrowing of the German experience in Europe, there are difficulties in managing the dual education system caused by the change in the institutional structure of the management system, in particular Fernando Marhuenda-Fluixa [11] notes significant problems of low controllability in the absence of a unified system of chambers a similar institution, especially affecting the process of teacher retraining. In the works [14,15] the leading role of the state in the institutionalization of the process of public-private partnership in the field of secondary education is indicated, however, no recommendation models are given. The article [16] discusses the experience of organizing a dual scheme within the light industry sector and suggests the formation of relations between the parties on the basis of contracts directly between educational institutions and enterprises.

In the Russian practice, at the moment, the most successful is the system of dual education, formed in accordance with the needs of the largest enterprises, whose resource capabilities make it possible to invest in their own educational production base [17]. Such a model is devoid of additional institutional superstructures and allows integration of the managerial impact of regional governments and big business on the performers of dual education programs: vocational education institutions and the specialized department of the company responsible for personnel training.

III. Methodical Tools For Institutional Modelling Of The Management System Of Regional Participants In Dual Education

The primary objective in building the management system of regional participants in dual education is an objective description of the composition of participants and the identification of target vectors causing interest in the implementation of the dual model.

The entire set of elements of the institutional architecture of management of the dual education system can be divided into groups of permanent participants and institutional superstructures.

The category of permanent participants in the system of dual education includes government bodies in the region, enterprises - employers, educational institutions and students. Depending on the chosen architecture of the institutional model of management, certain participants perform a larger or smaller set of functions, in some cases the functions of permanent participants may be transferred to the institutional superstructure being created. For example, when forming the main educational program in an area where there is a large

number of employers who do not have the resources for industrial training, their functions are usually performed by industry associations.

The participation of state authorities of the region in the dual education model is determined by the following goals: ensuring the balance of supply and demand on the labor market, forming additional positions in the region's investment attractiveness ratings and solving the problems of the vocational education systemeffectiveness [29]. Being the main customer in the system of secondary vocational education, the state authorities are interested in the gradual transfer of this function, and accordingly the cost of employers. The dynamics of this process is quite obvious in the basic industrial sectors, when the participation of corporations allows for the loading of institutions of secondary and primary vocational education. At the same time, without state participation it is impossible to effectively organize the process of transition from general to professional education.

Corporate participants exist in the harsh conditions of global competition [18] and the transformation of governance structures and labor organization. As a rule, dual education schemes fall into the general target vector of increasing labor productivity and reducing production costs, namely, training costs. Financing of secondary vocational education remains a state prerogative, while the participation of companies at certain stages of designing a dual education system is not capital-intensive and allows to getan employee with a clearly higher competence. The main goals of participation of corporate structures in the dual education model include targeted training for specific workplaces with specified competence characteristics, reduction of terms and costs for the adaptation of new employees and costs for additional training.

The interest of students in participation in dual education programs is due, above all, to job security at partner enterprises, which allows them to overcome the risks of structural changes in the labor market that may arise during the training period. However, the absence of a wider universal education can adversely affect the life prospects of a graduate, in many ways putting him at risk if the employer can be closed.

The interest of educational organizations in the implementation of dual education programs is due, above all, to receiving assignments for students to learn from the region's employers and to update the material base. The situation in the markets related to the field of education is described in more detail in [19], which shows that the sphere of activity of the institutions of primary and secondary vocational education is quite competitive. Accordingly, the formation of long-term strategies should include a system of dual education, allowing the moving to receive resources directly from partner employers.

Identifying the goals of the main participants in the dual education system in the region allows us to form a comprehensive indicator of the participants' utility, table 1.

Next, we consider the types of institutional superstructures found in the management systems of the dual model of education. The purpose of the formation of institutional superstructures is to simplify the process of interaction of the basic participants, to address issues of coordination in

industries with a multi-segment structure and to perform the function of an independent assessment of the qualifications of graduates. Types of institutional superstructures responsible for coordinating the activities of the regional dual education system: chambers of commerce, business interaction centers and secondary vocational education systems, development agencies, coordination councils, etc.

TABLE I. CALCULATION METHOD OF UTILITY INDICATORS FOR REGIONAL PARTICIPANTS OF THE DUAL EDUCATION SYSTEM

Category of participants	Characteristics of the participant's objective function	Calculation formulas	Evaluation procedure
Utility for employer companiesTUec	Increase productivity	$K_1 = \dfrac{\sum q_1}{\sum T_1}$ q0,1 – volume of production T0,1 – time spent on production	Evaluation characterizes the percentage of productivity growth costs of training personnel
	Reducing the cost of training	$K_2 = \dfrac{\sum s_1}{\sum h_1}$ s0,1 – training costs h0,1 – number of trained workers	Evaluation characterizes the percentage reduction in the cost of training personnel
Utility for educational institutionsTUed	The volume of orders for training by employers partners	$K_3 = \dfrac{Z_1}{Z_0}$ Z0,1 – number of training places financed by the employer	Evaluation is formed according to the reporting of educational institutions.
	Improving the material and technical base at the expense of partner employers	$K_4 = \dfrac{G_1}{G_0}$ G0,1 – valuation of the formed material and technical base at the expense of employers	Evaluation is formed according to the reporting of educational institutions.
Usefulness for state authorities TUsa	Balance of supply in the labor market	$K_5 = \dfrac{\sum d_1}{\sum s_1}$ s0,1 – supply in the labor market for workers of given qualifications d0,1 – demand in the labor market for workers of a given qualification	Evaluation describes the dynamics of the ratio of supply and demand.
	Formation of additional positions in national rankings	$K_6 = \dfrac{R_1}{R_0}$ R0,1 – position	Evaluation characterizes the growth of the region's

Category of participants	Characteristics of the participant's objective function	Calculation formulas	Evaluation procedure
		of the region in the ranking «Doing business»	position in the ranking «Doing business».
Utility for students TUst	Employment in the company partners in the framework of the dual education model	$K_7 = \dfrac{W_\square}{V_\square}$ W – number of partners employed by employers V – number of graduates within the dual model	Evaluation is formed according to the reporting of educational institutions.

As a rule, such organizations should manage the process of implementing the dual model, provide support in government bodies, prepare normative documents, it is possible to perform the functions of personnel needs assessment and some aspects of vocational guidance activities.

The second category of institutional superstructures is organizations that reflect the interests of regular participants, such as industry councils, associations, business associations, etc. These organizations perform a set of tasks related to the prerogative of employers in the dual process: participation in the formation of educational programs, the coordination of an order for training, the organization of industrial training, the formation of industry standards of qualifications.

In addition to the above types of institutional superstructures in the system of dual education, organizations are created that responsible for the independent assessment of qualifications in accordance with industry standards.

Summarizing the domestic and foreign experience of managing the dual model of education at the regional level, we can single out the two most common models differing in the number of institutional superstructures that implement the functions of the main participants in the dual model. When creating a regional management system for the dual education model consisting only of the categories of permanent participants, it assumes a high workload when performing the functions assumed by partner companies and educational institutions. This scheme of interaction assumes that both parties will invest significant time and material resources, respectively, such a scheme of work is expedient if it is possible to fully use the results. Within the framework of this interaction scheme, the company partners provide equipment, conduct training for industrial education masters, actively participate in the formation of professional educational standards and curricula, and evaluate the training of graduates. In turn, educational institutions conduct large-scale work on the adaptation of curricula to industry-specific professional standards, and retraining of teaching staff. The paper [21] presents the management system of the dual model, covering a variety of corporate participants and educational institutions. In this model, there are institutional superstructures organized according to a sectoral principle, covering the functions of streamlining the activities of educational institutions in accordance with the competence and qualification needs of the industry.

When implementing this scheme, partner employers do not incur significant costs in the creation of a training base and, as a rule, are limited to work on adapting curricula and organizing work practices.

The central role in coordinating the activities of regular participants is played by the formed institutional superstructures in the form of industry associations, chambers of commerce, etc., there is low cooperation between partner companies and educational institutions, the role of government bodies being the main customer in training. As noted in Helmer M., Conway M. (2014) [22], participants in the dual scheme make relatively modest investments of time and resources. The scope of their activity mainly affects the harmonization of standards required for the preparation of industry workers, the formation of industry councils, which later work with educational institutions in the field of adapting curricula to the needs of the industry [23]. It is also necessary to note the complexity of the institutional implementation of such a scheme, the preparation of the necessary regulatory framework governing the behavior of participants. Therefore, most of the workload is redistributed to educational institutions that adapt educational programs with the involvement of several companies-employers.

IV. RECOMMENDATION PART

In accordance with the presented methodology, we will evaluate the institutional models for managing regional participants in dual education.

TABLE II. RESULTS OF COMPARATIVE EVALUATION OF INSTITUTIONAL MODELS OF MANAGING REGIONAL PARTICIPANTS OF DUAL EDUCATION

Category of participants	Characteristics of the participant's objective function	Model without institutional settings	Model with institutional add-ins
Utility for employer companiesTUec	Increase productivity	1	0,56
	Reducing the cost of training	1	0,89
Utility for educational institutionsTUed	The volume of orders for training by employers partners	1	0,9
	Improving the material and technical base at the expense of partner employers	0	0
Usefulness for state authorities TUsa	Balance of supply in the labor market	1	1
	Formation of additional positions in national rankings	0,9	1
Utility for students TUst	Employment in the company partners in the framework of the dual education model	1	0,8

Category of participants	Characteristics of the participant's objective function	Model without institutional settings	Model with institutional add-ins
Final evaluation		5,9	5,15

As can be seen from the table, the institutional model without institutional superstructures has the greatest utility for regional participants in dual education in the context of neo-industrialization. In our opinion, this is due to the narrow-industry specificity of the formation of this model, which is common, as a rule, in metallurgy, the fuel and energy complex and unites key employers and specialized educational organizations.

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