METHODOLOGY FOR STAFF MONITORING OF TRADITIONAL AND NEW ECONOMIC SECTORS OF THE REGION

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ABSTRACT

The existing territorial, sectoral and professional-qualitative imbalances in the supply and demand of labor resources in regional markets make it difficult to shape the intellectual potential of the region. The purpose of the study is to justify the parameters for monitoring of staffing needs for making management decisions to eliminate imbalances in supply and demand based on adjustments to long-term and short-term forecasts of the structure and composition of labor resources.

The authors use newly developed methodology for monitoring of staffing needs, considering the specifics of the regional economy development in traditional sectors of regional specialization and new sectors – high-tech, innovative. Traditional and new economic sectors are assessed differently in terms of aims for development, technologies used, and specifics of product and labor markets.

While traditional sectors are aimed at the quantitative growth of existing commodity and labor markets, new economic sectors are oriented at development of professional competencies for the new commodity markets.

The parameters for monitoring in the traditional economic sectors reflect the structure of the number of employed by occupation, vacancies, levels of education and vocational training. In the high-tech and innovative sectors of the economy, the monitoring parameters consider the structure of new professional competencies and priority occupations to ensure the technological leadership in the region on niche, local and international levels as well as the required level of education. The results of monitoring were analyzed by assessing the structural shifts between the current and projected number of employees based on the indices A. Salai and K. Gatev; intersection of a finite set of competences.

The use of the proposed methodology considering the differences in traditional and new economic sectors can eliminate disruptions in the demand and supply in the labor and educational markets; create mechanisms for staff management considering the specifics of the particular economic sectors and create the order for advanced training of highly professional personnel for new sectors of the regional economy. This approach will ensure the reliability of procedures for forecasting staffing needs and objectivity of adjustments to parameters due to changes in target aims.

Keywords: staffing needs, monitoring parameters, traditional economic sectors, new economic sectors, forecasting staffing needs, structure of professional competences

INTRODUCTION

At present, in the Russian regions, the system of staffing needs monitoring in the economy is focused on a selective survey of business representatives on current and medium-term development plans, including the staffing needs of investment projects. As a rule, monitoring indicators make it possible to estimate some quantitative characteristics of the staffing requirement (the total number of qualified specialists with the indication of occupations, the number of employees planned for dismissal, and the number of graduates of vocational education institutions planned for employment, the number of newly created jobs). But the existing monitoring system lacks indicators that allow revealing the specific needs of employers in traditional and new sectors of the economy that can timely reflect the nascent changes in the requirements for the professional competencies of workers, assess the magnitude of territorial, sectoral and professional-skill imbalances between the supply and demand of labor resources and develop management mechanisms personnel of the region. The current situation makes it difficult for the region to develop its intellectual potential, despite the high demand for labor resources from the economy.

The purpose of the article is to justify the parameters of the staffing needs monitoring for making management decisions to eliminate imbalances in supply and demand based on adjustments to long-term and short-term forecasts of the structure and composition of labor resources. The reported study was funded by Krasnoyarsk Region Science and Technology Support Fund according to the research project: KF-597.

METHODS AND MATERIALS

The monitoring methodology proposed by the authors is devised with the consideration the specifics in the development of the regional economic sectors (traditional sectors of regional specialization, new sectors – high-tech, innovative), being a result of the influence of four groups of factors:

– *global challenges* of socio-economic and technological development, in the long term changing quantitative and qualitative characteristics of staffing needs through the formation of priority and new professional competencies;

– *socio-economic* (programs of social and economic development – SED, investment projects – IP, significant for individual business entities) – in the short term, maintain the structure of the personnel requirement unchanged (by industry, levels and areas of training);

– *investment* (large-scale investment projects, including transfer of technologies), changing the structure of the economy and employment in the areas of IP and related industries, focused on the development of existing labor markets through the formation of priority competencies;

– *innovative* (creation, implementation and dissemination of innovation in the economy, including creation of mother technologies), aimed at creating new labor markets by creating new skills, specialties and qualifications.

Under the influence of various groups of factors sectors of different technological types (traditional technologies, high-tech, innovative) coexist in the economy of the region, their functioning requires staff different in number and vocational qualifications, as well as levels and programs for their preparation in vocational education [2, 17, 19-20].

Traditional technologies sector comprises the types of economic activity where the modernization processes are the weakest. It is characterized by a steady demand for traditional professions and qualifications within the existing levels of education (VO, ACT) and training directions (EGS – enlarged groups of specialties).

The high-tech sector includes economic activities with active technological development. Used technologies have novelty, technical and economic advantages over traditional analog technologies. They are characterized by the growing demand for traditional and new qualifications in the framework of existing training areas (ETA).

The *innovative* sector includes economic activities with active introduction of innovative technologies, novel and unique, which do not have analogs. The peculiarity of the need for intellectual and staff provision of promising commodity markets and labor markets is lack of contractors from business at present time (time of the forecast formation). It is characterized by a qualitative change in demand for professional staff and new labor markets [18].

The revealed peculiarities of the staff need formation in different sectors of the economy made it possible to make the conclusion about the need to apply various methods and indicators of the staffing needs monitoring in traditional and new sectors of the economy.

Unlike new sectors of the economy (high-tech, innovative) focused on professional competencies for the development of new commodity markets, traditional sectors of the economy are based on the quantitative growth of existing commodity markets and labor markets. The existing monitoring system in the regions of Russia is focused on monitoring the staffing needs of business for the *traditional technology* sectors. Monitoring parameters in traditional sectors of the economy reflect the structure of the number of employed by occupation, vacant jobs, and levels of education and areas of training [2].

In the high-tech and innovative sectors of the economy, the monitoring parameters are determined by the structure of new professional competencies and priority occupations to ensure technological leadership of the region (niche, local, international), the required level of education (higher, secondary vocational) [5].

The differentiation of methods for monitoring the staffing requirement, the data collected and the frequency of monitoring by sector of the economy are presented in Table 1.

The monitoring results could increase the reliability of the forecast of the personnel requirements of the economy on the basis of an analysis of the collected data:

– short-term forecasts – due to making timely adjustments to the staffing needs for training (existing professional standards and educational programs for 2-3 years);

– medium-term forecasts – due to the formation of clusters of priority competencies and a list of priority occupations for high-technology sectors of the economy within the existing regional system of vocational training (updated professional standards and educational programs for a period of up to 5 years);

– long-term forecasts – on the basis of creating clusters of new competencies, new professions for innovative sectors of the economy and a list of new educational

programs for the training of professional staff (lists of new professional standards and new educational programs for up to 10 years).

Table 1 – Main characteristics of monitoring the staffing needs in the economic sectors of the region

Methods of monitoring	Collected data	Periodicity
Traditional Technologies Sector		
Questioning of employers about actual employment. Audit workplaces in the economy of the region. Content analysis of applications from enterprises and organizations on the current staffing needs and staffing of investment projects. Content-analysis of investment projects included in the Strategy of the SED * regions.	Short-term need: the current need of enterprises and organizations in professional personnel by levels of training and occupations to "update" the composition of the workforce. Medium-term need: a prospective staffing need of business for the implementation of investment projects	As vacancies open, for the current staffing need; Annually before the development and refinement of forecasts – for the long-term personnel needs of the SED * and the formation of the orders for vocational education institutions
High-tech Sector		
Questioning of employers on the target training of young professionals. Expert sessions with representatives of high-tech business, education and science to identify priority competencies. Content analysis of applications from enterprises and organizations on the staffing of investment projects. Content analysis of investment projects in the Strategies of technological development of regions.	Medium-term need: – quantitative and qualitative parameters of the staffing needs of business for large-scale investment projects, projects for introducing technologies that have advantages over analogues, including technology transfer projects; – list of priority professional competencies for technological development of business / industry	Annually before specifying the scenarios of technological development of the region and the formation of tasks for vocational education institutions
Sector "Innovation"		
Content analysis of innovative projects in the strategies of technological and innovative development of regions. Expert sessions with representatives of innovative business, education and science to identify new professional competencies, new professions	Long-term need: – a list of new professional competencies for innovative business / industry development (long-term staffing needs); – a list of new professions	Annually before clarifying the scenarios of innovative development of the region and the formation of tasks for vocational education institutions

*KEY: SED is social and economic development

Methods for analyzing the results of monitoring make the assessment of the structural correspondence between the current and projected number of employees; intersection of a finite set of competences.

Assessment of the structural correspondence between the parameters of the forecast of staffing requirements and the structure of labor resources in traditional sectors of the economy makes it possible to determine the probability of occurrence of "risk points" in the labor markets of the region, and provides the basis for the development of management decisions regarding the elimination of supply and demand gaps in labor and education markets [1]. For these purposes, it is advisable to use the indices of A. Salai and K. Gatev [3-4, 16], which assess the levels of differences between the structures studied:

$$I_s = \sqrt{\frac{1}{n} \cdot \sum \left(\frac{d_2 - d_1}{d_2 + d_1} \right)^2}, \tag{1}$$

$$I_g = \sqrt{\frac{\sum (d_2 - d_1)^2}{\sum d_2^2 + \sum d_1^2}} \tag{2}$$

where d_1, d_2 are compared structures (labor and staffing needs), characterized by the same number of elements. In this study, such elements are the levels of vocational education (secondary, higher – bachelor, master). If the value of the indices exceeds the value "0.1", the differences between the structures are considered to be significant.

The resulting calculations of the indices and the subsequent carrying out of factor analysis make it possible to identify the levels of professional training of labor resources for which the maximum discrepancies in the personnel requirements of the economy are fixed. In order to reduce the level of these discontinuities, it was suggested to use the modeling tool on the basis of the "matrix for changing the structure of the labor force structure by education levels" (Figure 1):

– the rows of the matrix present elements of the existing educational structure of labor resources (according to the levels of vocational education) in the period t_1;

–the columns of the matrix show the elements of the planned educational structure of labor resources (by levels of vocational education) in period t_2;

– cells of the matrix contain information on the share of labor resources that increase the level of professional training for the period under study. In other words, the value in the cell of matrix a_{ij} is the probability of changing the level of education (i) by (j) for labor resources for the period $[t_1; t_2]$. In this case, the total sum of the values of matrix elements in rows is 1 (100%). Indices i and j denote different levels of education: he (m) – higher education (master); he (b) – higher education (bachelor's degree); sv – secondary vocational; at – the average total; bg – the basic general, we – without education). Index i is used to denote quantities at time t_1, and index j is used to denote quantities in moment t_2.

For example, the first and third rows of the matrix (Figure 1) contain information that the workforce having a professional education of the *master degree* and *secondary special* degree at the beginning of the studied period (t_1) will not change it by the end of the period (t_2). At the same time, a certain proportion of the workforce with a *bachelor* degree at time t1 will change their level of vocational training by the time t_2 (10% enter master courses). As a result, by the end of the period (t_2) the change in the structure of the workforce according to the levels of education occurs in accordance with the formula:

$$d_j^{t2} = \sum_{i=1}^{6} d_i^{t1} \cdot a_{ij}. \tag{3}$$

The structure of labor resources in the region is optimized provided that the gaps between the staffing needs of the economy and the existing structure of labor resources are minimized. The optimization criterion is calculated on the basis of formulas 1 and 2. The period for optimization is 3 years.

The method of intersection of finite sets of competences allows revealing the structural composition of professional personnel for new sectors of the economy (highly-technical, innovative) in conditions when there are no customers on the part of business during the forecasting process [6]. Therefore, to identify profitable occupations, it is advisable to use existing sources of information both in Russia in general and in the regions [5-13]. Criteria for the demand for a profession are:

– promising occupations listed in the priority areas of the Strategy for socio-economic, technological or innovative development of the regions for the period up to 2030 (section on staff);

– the demand for professions at the federal level, approved by the executive authorities in the sphere of labor and employment;

– the forecast of the annual additional demand for staff in terms of profession for the leading big employers of RF regions by;

– the availability of priority competencies (occupations) for the regional economy of the championship "Wordlskills Russia".

Based on the results of the collection of listed data, a comparative analysis of the lists of professions that are in demand is based on the intersection of the listed sets of popular professions in accordance with various sources of information and the criteria for relevance. Thus, with the help of various sources of information, a list of prospective or new professions for priority areas of socio-economic, technological or innovative development of the region is being formed.

RESULTS

Calculations of indices (1) and (2) for the Krasnoyarsk Krai as a whole for the period until 2020 and for the municipal entities of the province in the period 2014-2017 have shown a high level of imbalance between the studied labor force structures and the staffing needs according the levels of vocational training. So, for example, for the city of Krasnoyarsk in 2017, these indices assumed values: $Is = 0.743$; $Ig = 0.616$.

Modeling of structural shifts based on the matrix of changing the composition of elements in the structure of labor resources by education levels (Figure 1) allowed substantiating the necessary condition for narrowing the gaps between the structures of labor resources and the staffing needs of the economy by 2020 ($Is = 0.051$, $Ig = 0.059$). The structure of the necessary changes in the professional training of labor resources for the regional economy is shown in Figure 1.

Thus, the results of monitoring the compliance of the parameters of the forecast to the size and structure of the staffing needs of economic entities in the economic segments of the region made it possible to determine the probability of a "risk point" in the regional labor market and to justify the need to change the structure of the training of labor resources by 2020.

The results of applying the method of intersection of finite sets of competences formed on the basis of content analysis of the Krasnoyarsk Krai Strategies (socio-economic development, innovation development, industrial policy), the Strategy of scientific and technological development of the Russian Federation until 2035, Atlas of new professions [5, 13-15] allowed establishing the priority list of professions in the new sectors of the economy of the region. For example, for the high-tech sector of the

economy in the Robotics, Radio Engineering, Instrument-Making and Mechanical Engineering sector, the following priority professions were identified for 2020: the designer of industrial robotics; operator of multifunctional robotic complexes; designer-ergonomist; engineer-composer; designer of children's robotics; designer of neurointerfaces for robot control.

period t_2 / period t_1	$d_{he(m)}$	$d_{he(b)}$	d_{sv}	d_{at}	d_{bg}	d_{we}	Total
$d_{he(m)}$	1.00	–	–	–	–	–	1.0
$d_{he(m)}$	0.10	0.90	–	–	–	–	1.0
$d_{he(m)}$	–	–	1.00	–	–	–	1.0
$d_{he(m)}$		0.45	0.50	0.05	–	–	1.0
$d_{he(m)}$	–	–	0.95	–	0.05	–	1.0
$d_{he(m)}$	–	–	0.95	–	–	0.05	1.0

Figure 1 – Coefficients of change in the composition of groups in the structure of labor resources by education levels

CONCLUSION

Thus, the present study, using the example of the Krasnoyarsk Krai, justified the selection of monitoring methods and indicators that reflect the quality of the procedures used to forecast personnel requirements, taking into account adjustments related to changes in the development target parameters in the regional economy segments. The authors proposed a monitoring methodology that allows to form an information space for the decision making by the regional authorities to make managerial decisions regarding the advancing training of professional personnel in the regional vocational education system, to use scientifically grounded approaches to adjusting medium- and long-term forecasts of personnel requirements in the sectors of the economy, taking into account the implementation of priority areas Socio-economic, technological and investment development of economics.

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