Personnel Training System Intersectoral Modeling in the Context of Digitalization

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Abstract: The article reflects the testing the intersectoral modeling methodology results of the regional economy need for highly qualified personnel. Based on the conducted monographic research, the official and scientific-based methods shortcomings are identified, and possible leveling ways are proposed. On the example of the Republic of Crimea, the additional professional education system modeling is carried out, taking into account the possibilities of its digitalization and the specifics of individual sectors of the region's economy seasonal functioning. Based on the data on the gross regional product and the employees average monthly salary, the number of employees calculations in the forecast period were carried out by extrapolation using the dynamics series trend models. Reasonable indicators of the quantitative and qualitative needs of the Republic of Crimea economy for highly qualified personnel can be used for strategic and tactical planning by state and municipal authorities.

1 INTRODUCTION

Digitalization is rapidly changing all spheres of public life. The training system is not only placed at the center of this process, but also produces digital changes itself, being self-taught (Lalitha and Sreeja, 2020). The transformation of educational technologies, the blended learning forms development, the graduates digital competencies formation is not a complete list of the modern training system innovative opportunities. The result of the implementation of these changes should be an increase in the industrial and labor relations efficiency, provided with qualitatively new highly qualified personnel characteristics.

Education, as the basis of the personnel training system, is to a certain extent a public good, as a result of which it occupies an important place in the state social policy. At the same time, the authorities are interested not only in the budgetary, but also in the economic efficiency of the educational process, expressed in the subsequent growth of the gross domestic product. Models of intersectoral balances of the personnel training system and the labor market are developed and applied at various levels of management as an element of strategic planning (Podverbnykh and Samokhvalova, 2019).

The purpose of the article is the scientific substantiation of the personnel training system intersectoral modeling methodology in the conditions of digital industrial and labor relations.

2 METHODS

Modeling the digital economy needs for highly qualified personnel has its own characteristics in each country and region (Leshukov, 2020). In the Russian Federation it is based on the methods of forming the state task for the educational services provision, control figures for the students admission and the needs of employers in personnel (Fridman and Verbetskaia, 2020). A positive trend of the current regulatory framework is the gradual transition from calculating the number of applicants to determining the number of graduates required by the economy. However, in general, the methodology of the personnel training system inter-sectoral balance adopted at the state level does not have adaptability to modern digital relations in the labor market.

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The annual economy staffing needs are covered mainly by educational organizations graduates, as well as partly by retraining the unemployed, interregional and foreign labor migration (Sigova, 2009). At the same time, the potential of personnel professional training and retraining is not taken into account by authors specializing in forecasting the economy need for qualified personnel (Subanakova and Byuraeva, 2018).

Official and scientific-based methods are focused on the offer of educational services that are formed at the higher, secondary and primary levels of professional training. Modern realities dictate the need for education level continuous improvement and competencies expansion throughout the entire career. It requires taking into account the educational services market opportunities to quickly solve these problems within the institute additional professional education framework through the tools of professional retraining and advanced training of both persons with secondary vocational and (or) higher education, and those in the process of obtaining the education. It should also be taken into account that thanks to digital educational technologies and distance learning, the response time of the educational services market to the current economy demands is reduced to several months (Lee and Choi, Cho, 2019).

Another important addition to the training system intersectoral modeling methodology at the regional level is to take into account structural changes in the economy within a single forecast period (in this study – a year). Regional specifics, expressed in the contrasting seasonality of the activities number (in particular, in the agro-industrial and recreational-tourist complexes) (Tsehla and Plugar, 2017), dictate the need for the labor market flexible adaptation to irregular demand, which, to a certain extent, may also be solved within the framework of additional professional education institution.

3 RESULTS

Testing of the methodology for modeling the personnel training system in the digitalization conditions was carried out on the example of the Republic of Crimea, a region that has a pronounced seasonality of the main budget-forming industries development.

As input parameters that determine the overall dynamics of the additional professional education market development in the region, the indicators were considered, the official forecast of which is given in regional and sectoral development programs, as well as the Republic of Crimea Socio-Economic Development Strategy until 2030, i.e. the growth rate of the economy by the activity type, the number of employees for the current period, the average salary (and the index of its growth) by economic sector, the volume of investment, the labor resources use seasonality coefficient by type of economic activity. Forecast indicators of the economy dynamics and investment activity in the context of economic activities are also reflected in the annual forecasts of the Republic of Crimea socio-economic development, officially published by the Ministry of Economic Development of the region.

According to current documents and official statistics, the Republic of Crimea is expected to prioritize the development of health resorts and tourism, healthcare, agro-industrial and fisheries complexes, chemical industry and construction. This is confirmed by the dynamics of the gross regional product of the Republic of Crimea for 2015-2019, presented in Table 1. The largest specific weight is occupied by trade and real estate operations (on average, 16.0% and 11.0%). The share of agriculture, manufacturing and public administration (9.0%), healthcare (8.0%) and construction (7.0%) is a bit lower, but at a fairly high level.

Table 1: The gross regional product of the Republic of Crimea structure, on average for 2015-2019, %.

Type of activity	Specific weight, %
Agriculture, forestry, hunting, fishing and fish farming	9
Mining operations	3
Manufacturing industries	9
Electricity, gas and steam provision; air conditioning	5
Water supply; water disposal, waste collection and disposal organization, pollution elimination activities	1
Construction	7
Wholesale and retail trade; motor vehicles and motorcycles repair	16
Transportation and storage	6
Hotels and catering establishments activities	3
Information and communication activities	3
Financial and insurance activities	1
Activities related to real estate transactions	10
Professional, scientific and technical activities	2
Administrative activities and related additional services	2
Public administration and military security; social security	9
Education	4
Health and social services activities	8
Activities in the field of culture, sports, leisure and entertainment	1
Other types of services provision	1
Total for the surveyed types of economic activity	100

The main trigger for both employed persons who are able to master new professions or move to a qualitatively new level of professional training, and for applicants who choose the direction of their future professional activity, is the absolute value and the average salary growth rate, which causes an increase in the supply of higher-paid professions and positions. The average level enterprises employees and organizations nominal wages of the Republic of Crimea for 2017-2019 is presented in Table 2:

Table 2: Average monthly nominal salary of the 1st employee in the Republic of Crimea, on average for 2017-2019, RUB.

Type of activity	rub.
Managers	56,505
Specialists of the highest level of qualification	35,944
Mid-level specialists	29,886
Employees engaged in the preparation and execution of documentation, accounting and maintenance	25,973
Employees of the service and trade sector, protection of citizens and property	22,289
Qualified personnel in agriculture, forestry, fish farming and fishing	27,512
Qualified personnel in industry, construction, transport, and related occupations	32,346
Operators of production plants and machines, assemblers and drivers	31,807
Unqualified personnel	18,723

From the data given in Table 2, it follows that the highest level of average wages in the Republic of Crimea is offered by the construction and mining industries. In second place in terms of remuneration are the categories of workers in the region electricity and water supply industries. The average level of wages is observed in the sectors of trade, transportation and storage, information and communication, and healthcare. The agricultural workers remuneration is comparable to the real estate transactions activities. The least attractive activity, from the point of view of remuneration, is the activity in the field of culture, sports, leisure and entertainment of the Republic of Crimea.

The number of employees calculation in the forecast period was carried out by extrapolation from trend models of the dynamics series, taking into account official information on the trends in the development of the region economy and expert adjustments (Antyukhova and Kasatkin, 2021). All trend models constructed for each main type of economic activity are statistically significant and have a determination coefficient higher than 0.7. The calculation data are summarized in Table 3.

Table 3: Forecast of the number of people employed in the economy of the Republic of Crimea, 2022.

Type of activity	people
Agriculture, forestry, hunting, fishing and fish farming	8,237
Mining operations	2,863
Manufacturing industries	35,043
Electricity, gas and steam provision; air conditioning	11,096
Water supply; water disposal, waste collection and disposal organization, pollution elimination activities	10,450
Construction	11,874
Wholesale and retail trade; motor vehicles and motorcycles repair	13,430
Transportation and storage	31,040
Hotels and catering establishments activities	12,876
Information and communication activities	2,105
Financial and insurance activities	4,110
Activities related to real estate transactions	3,860
Professional, scientific and technical activities	6,120
Administrative activities and related additional services	14,730
Public administration and military security; social security	40,056
Education	56,034
Health and social services activities	70,901
Activities in the field of culture, sports, leisure and entertainment	7,050
Other types of services provision	4,785
Total for the surveyed types of economic activity	8,237

Based on the calculations, the growth of the demand for highly qualified personnel in the region is expected in the following industries: manufacturing, water supply, construction, transportation and storage, hotels and catering enterprises, administrative activities and public administration, health care.

The reducing the number of people employed in the Republic of Crimea trend will be typical for agriculture, mining, electricity supply, trade, information and communication activities, finance and insurance, real estate transactions, science and education, culture and sports.

In general, it should be noted that by 2022, in relation to the level of 2019, the total expected increase in employment (by 56,416 people) will exceed the reduction (by -29,938 people) in the number of jobs in industries with a negative trend in the development of the labor market by 26,478 jobs. Of course, the upcoming changes will require the working-age population to improve their skills, expand their competencies, change their occupation, and adapt flexibly to the new digital industrial and labor relations (Oberländer et al., 2020).

The calculations results are the basis for determining the potential market capacity of additional professional education programs in the region. Since it was found that the proportion of students studying simultaneously in the programs of higher, secondary and additional professional education in the region over the past five years was less than 1.0%, this number was not taken into account by us among the persons potentially focused on professional retraining and advanced training.

In general, in the framework of the proposed methodology for predicting the number of students enrolled in secondary professional education programs, higher professional education and at the same time mastering additional professional education programs, it is necessary to calculate the trend equations in the context of enlarged groups of training areas/specialties on the retrospective data basis.

4 DISCUSSION

In order to characterize the prospective situation on the labor market of the Republic of Crimea more fully, the annual additional demand of the economy for personnel by type of economic activity was calculated.

In the framework of modeling the interaction of the additional professional education market and the regional labor market, the additional annual demand of the economy for personnel was considered, due to both the economy growth and investment activity in the region, and the replacement due to natural-age retirement.

The values of these parameters were calculated according to the method of V.A. Gurtov and E.A. Pitukhin (Gurtov and Pitukhin, 2017):

$$\Delta L_{e,t} = L_{e,t} - L_{e,t-1} \quad (1)$$

where $\Delta L_{e,t}$is the additional demand of the regional economy for personnel caused by the development of industries (the need for "growth");

$L_{e,t}$ - the number of people employed in the economy by type of economic activity (e) in the year (t).

$$L^{-}_{e,t} = k_{e,t-1} * L_{e,t-1}$$

$L^{-}_{e,t}$ - additional demand of the regional economy for personnel caused by the working population aging (the need for "replacement");

$k_{e,t-1}$ - the coefficient of natural and age-related attrition of employees in the economic sector (e).

In addition, an important methodological addition, from our point of view, is to take into account the seasonal factor and calculate the additional seasonal demand for personnel$L'_{e,t}$.

Thus, the total annual additional demand includes three growth factors, they are economic development, natural-age retirement, seasonality, which is mathematically expressed by the formula:

$$\Delta D_{e,t} = \Delta L_{e,t} + \bar{L_{e,t}} + L'_{e,t} \quad (2)$$

The parameter $L'_{e,t}$is proposed to be calculated as an absolute indicator of seasonality for (e) type of activity, which is equal to the maximum value of the difference between the actual level of the series and the average annual value smoothed along the trend line for the forecast period (t). Its final value is subject to expert adjustment, taking into account the industry development scale:

$$L'_{e,t} = \max (y_t - \widetilde{y_t}) \quad (3)$$

$L'_{e,t}$ - additional seasonal demand for personnel (e) type of activity in the period (t);

y_t – the actual level of the series for period (j);

$\widetilde{y_t}$ – the average annual value of the aligned (theoretical) level.

We propose to forecast the seasonality of the labor resources use with the help of an additive model in the context of economic activities. This procedure was carried out according to official statistics for 2015-2019, with a preliminary alignment of the series according to the trend equation.

The calculation data is presented in Table 4.

Table 4: Forecast of the total additional personnel needs of the Republic of Crimea economy, 2022.

Type of activity	people
Agriculture, forestry, hunting, fishing and fish farming	110
Mining operations	-644
Manufacturing industries	4,694
Electricity, gas and steam provision; air conditioning	71
Water supply; water disposal, waste collection and disposal organization, pollution elimination activities	1,242
Construction	2,611
Wholesale and retail trade; motor vehicles and motorcycles repair	-337
Transportation and storage	4,693
Hotels and catering establishments activities	4,223
Information and communication activities	-829
Financial and insurance activities	-586
Activities related to real estate transactions	-237
Professional, scientific and technical activities	-890
Administrative activities and related additional services	2,375
Public administration and military security; social security	3,111
Education	1,804
Health and social services activities	9,639
Activities in the field of culture, sports, leisure and entertainment	-1,293
Other types of services provision	2,759
Total for the surveyed types of economic activity	32,516

The proposed approach allows us to take into account the actual employment dynamics during the year, to track industries with high seasonal fluctuations in the level of employment, and also to take into account structural shifts in personnel needs caused by changes in the proportions in the economy of the region.

As a result of the calculations, by 2022 the total additional need for personnel in all sectors of the economy will amount to 32,516 people, including due to growth it will ammount 12,832 people, due to retirement it will ammount 13,283 people, due to seasonality it will ammount 6,400 people. At the same time, due to the seasonal factor, the greatest demand is observed in agriculture, electricity supply, hotel and restaurant business, education, as well as in health care. At the expense of retirement it is observed in education and health care, as well as in manufacturing and public service. Due to the growth it can be seen in manufacturing, transport and communications, hotel and restaurant business, administrative and public services, health care of the Republic of Crimea.

5 CONCLUSION

Summing up the results of the conducted research, it can be stated that intersectoral modeling of the

personnel training system in the digitalization conditions requires the adaptation of the applied methods at all levels of management. The opportunities for self-education provided by the digital economy throughout the entire period of an individual's working life open up broad prospects for the additional professional education system development. The approbation of the methodology for modeling the number of labor resources for the needs of the regional economy of the Republic of Crimea, taking into account the peculiarities of its seasonal nature, indicates the possibility of its application by the regional authorities. The prospective nature of the intersectoral planning model allows us to predict the effectiveness of both the region education system and its economy as a whole.

The area of further research of the personnel training organization methodology in the digital industrial and labor relations system is in the plane of scientific substantiation of indicators and criteria for measuring digital labor.

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