TRAINING OF PERSONNEL FOR THE DEVELOPMENT OF INNOVATIVE ENTREPRENEURSHIP

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ABSTRACT

Aim of the study: The article presents the results of a study that analyzed statistical data on the training of specialists by institutions of secondary professional and higher education who have the necessary competencies to work in the conditions of digitalization of the economy. The purpose of the study was to develop and test indices of personnel support for the digitalization of the economy, as well as to identify socio-economic factors that significantly affect the level of personnel support for the digital transformation of the economy.

Methodology: The study uses data from official statistical reports of the Russian Federation. The proposed staffing indices were modeled as target functions that depend on socio-economic factors that characterize the development of the economy in different dimensions. At the same time, the indices themselves were calculated as values that correlate the parameters of the output of digital specialists and their demand in the economy.

Conclusion: The study compared statistical and neural network methods of data modeling and their generalizing indexes. The analysis of the obtained regression models and sensitivity analysis of trained neural networks allowed us to evaluate their accuracy in predicting trends in the digital economy staffing and to identify factors that significantly affect the achievement of the goal of matching the output of specialists and the requests of economic sectors.

Keywords: Entrepreneurship, Statistical Socio-Economic Data, Institutions of Secondary Vocational Education (SPO) and Higher Education (VPO), Digital Specialist Output by SPO and VPO Institutions, Regression Models, Neural Networks.

INTRODUCTION

In the National program "*Digital economy of the Russian Federation*", one of the most important directions of digitalization of the economy at the present stage is allocated its personnel support. The goal is to increase not only the quantitative indicators of digital specialists' output in a short time, but also to provide a well-formed competence structure that would correspond to end-to-end digital technologies. Also, during the implementation of the program, it is necessary to eliminate imbalances in training (Academic entrepreneurship, 2004). As the results of some studies show, the current structure of training at the regional and Federal levels does not fully correspond to the emerging structure of personnel needs in the new economy. For example, there are imbalances between the relatively low percentage of graduates of universities and vocational education institutions in the areas of training in information and communication technologies (ICT) and the high needs for these specialists in the real sector of the economy, authorities and management (Adeniran, 2017).

The purpose of this study was to scan and interpret the situation with the training of ICT specialists in Russia and to propose and illustrate (examples of monitoring trends) the accuracy of simple indicators (indices) which could in the future be used in studies of the situation of staffing in the processes of digitalization of the economy, and in building scenarios for the development of vocational education adequately to the changing labour market (Chiste, 1996).

The scientific problem was to formalize complex dependencies of indices on a set of socio-economic factors, as well as to identify factors that significantly affect the indices of personnel support for the digital transformation of the economy. This kind of knowledge, according to the authors, will allow more efficient management of complex socio-economic processes to achieve a balance between supply and demand for digital professionals (Entrepreneurship, 2004).

The relevance of this type of research, especially in terms of setting the task, the tools used, is also due to their use as cases in the educational process of training business analysts, whose competence should cover skills in data analysis and automation of internal business processes of companies. In particular, it is important to use new Analytics tools in the educational process of training business analysts, for example, application packages that have the ability to implement machine learning techniques, including the use of neural networks (Evans, 2015).

METHODOLOGY

The research is based on international and Russian legal documents, statistical data from the Federal state statistics service (ROSSTAT), the HSE, data from the Ministry of education and science of the Russian Federation, and published analytical materials in the field of Russian education statistics. The work also used methods of comparative and descriptive analysis, generalization (Geipele, 2010).

The analysis included 18 areas of training at the master's level, 43 areas of specialty training, 26 areas of bachelor's training, 12 programs for training middle-level specialists on the basis of General education, as well as three programs for training qualified workers serving on the basis of basic General education (Goyal, 2020).

Regression models were generated and analyzed in the environment of the IBM SPSS STATISTICS package. The STATISTICA 13 package was used to train neural networks that have a multi-layer perceptron configuration. TIBCO Software Inc.

RESULTS AND DISCUSSION

The Russian Federation has been actively moving towards digital transformation of the economy since December 2016. Under these conditions, the necessary tools are being created and research is being conducted in the field of information and analytical support for managing digital transformation processes at the national, regional and industry levels and creating the necessary indicators, methodologies and tools for this purpose (Gribust, 2018).

In Russia, the regulatory framework for the development of the digital economy is enshrined, in particular, in The strategy for the development of the information society in the Russian Federation for 2017-2030 and the national program "*Digital economy of the Russian Federation*" (Khosrow-Pour, 2018). The first document outlined national priorities in the digital economy, the need to create conditions for the development of the digital economy, and the principles of cooperation with foreign countries in this area. The national program "*Digital*

economy of the Russian Federation" regulated the growth of Russia's internal expenses for the development of the digital economy by at least three times compared to 2017, the creation of stability and security of the Russian communications infrastructure, and the use of mainly domestic software by state authorities, local governments, and other organizations (Kingma, 2011). The national program includes six Federal projects, one of which is the project "*Personnel for the digital economy*". The allocation of training of highly qualified personnel for the digital economy in a separate Federal project is a significant step towards achieving the global goals of the national program. In this case, the rapid response of higher and secondary professional education systems to the challenges of the digital economy is of particular importance (Kruzhilin, 2018). The program provides for the achievement of a number of indicators by 2024.

The World Bank report "*Competition in the digital era: strategic challenges for the Russian Federation*," assessment of countries ' readiness for a digital economy a study of digital transformation in different industries, including education. Its results show that in Russia there are still problems of insufficient financial support for digitalization processes, personnel shortages, and insufficient digital educational content, which often does not meet the necessary quality criteria (Kruzhilin, 2016).

The results of monitoring indices calculated by the number of ICT graduates lead to the following conclusions. The share of graduates of higher education organizations in ICT areas has been decreasing in the total number of employed digital specialists since 2013, which indicates a decrease in the growth rate of graduates in the number of employed ICT specialists by economic activity. The share of graduates in ICT training areas has increased slightly (since 2014) in the total number of graduates in all training areas (Rumińska, 2004). However, despite the measures taken by the state, there is a shortage of specialists, since 2015, the balance between the number of graduates and the total need for them has been violated. At the same time, business has not yet shown a strong interest in training personnel for the target set.

The results show that in recent years the state has taken measures to increase enrollment in higher education institutions in ICT areas. However, there is a gap between the number of people accepted for ICT courses and the number of graduates. The reasons for this imbalance require additional research. Probably one of the reasons is the low interest or low activity of business in training ICT specialists for the target set (Stachowicz-Stanusch, 2018).

An important stage of the study was to identify socio-economic factors that have a significant impact on the size and dynamics of the indices I1, I2, I3 and I4.

Consider, for example, the socio-economic factors that influence the I3 index. It is obvious that in an ideal situation, the value of I3 should approach one, fixing the balance between the number of graduates who are expected to be employed in the business and the need for specialists that the business claims. Based on the results of the analysis of the obtained regression models, it was found that the greatest impact on the value of the index I3, i.e. achieving a balance between graduates and their needs is influenced by the following socio-economic factors: the number of employed it professionals (professional, scientific activities); migration growth; and the number of families who have received housing or improved housing conditions (Szopa, 2013).

It can be assumed that, on the one hand, the number of employees reduces the need for it specialists (i.e., the denominator of the formula I3 decreases), but on the other hand, the positive dynamics of employment with a certain time lag increases the flow of those who want to get ICT education. As a result, the numerator of the formula for calculating I3 increases. This effect of

the first factor on increasing the numerator and decreasing the denominator leads to an increase in the index I3.

Similarly, we can consider the impact of the migration growth factor on the change in the I3 index (Vakil, 1966). On the one hand, migration growth creates prerequisites for increasing recruitment to HPE institutions (the numerator of the formula is growing), but on the other hand, it increases competition in the labor market in a group of specialists with relatively low qualifications and reduces the number of vacancies. As a result, the need for specialists is reduced, i.e. the denominator in the formula I3 is reduced. As a result, the value of the I3 index increases.

The increase in the number of families who have improved their living conditions indirectly affects the growth of those who want to enter universities and SPO institutions, but at the same time can affect the reduction in the need for personnel, since specialists are assigned to work at enterprises that have contributed to obtaining housing for specialists (Van Wart, 2008).

Knowledge about significant factors was also extracted during the study from trained neural network models using the so-called sensitivity analysis.

The analysis shows that the index also increases the value of socio-economic indicators (living wage, salary, per capita income), which simultaneously create prerequisites for increasing the flow of applicants to universities and colleges, and indirectly signal the development of the economy, increasing the need for it specialists (Wong, 2011). One of the drivers of the increase in I3 is the growth of recruitment and at the same time the growth of the need for it specialists-graduates of SPO (information, communication, education).

On the other hand, high values of the number of employed it specialists in the fields of professional activity, education, information, communications, Finance, and insurance signal an imbalance the lag in the output of these specialists from the need for them. As a consequence of the I3 is reduced.

Attention is drawn to the fact that the neural network, in contrast to the regression model, identified the factor "*Number of employed it specialists in HPE (professional, scientific and technical activities)*" as a factor that affects the I3 index with a minus sign. According to the authors, this result is trustworthy, since the trained neural network, in contrast to the regression model, provided better convergence and approximated the observed values of the I3 index with greater accuracy (Wright, 2007).

In order to assess the movement of students from the moment of admission to the moment of graduation from higher education institutions, as well as to monitor changes in the structure of admission in the period preceding the adoption of the National program and after its adoption, the trends of the I1, I2 and I3 indices were studied (Wright, 2018). The formulas for calculating these indices used not only statistical data on the number of graduate students enrolled in ICT programs, but also data on the number of applicants accepted to higher education institutions for training in these educational programs.

CONCLUSION

In the course of the study, indexes describing the processes of personnel support for the digital transformation of the economy in Russia are proposed.

The trends of indices from 2000 to 2018 are determined. It is established that at present the state needs to take further measures to increase the output of ICT specialists in order to consolidate the trends of digital transformation of the Russian economy. Imbalances between the

number of applicants to higher education institutions and the number of graduates in different areas of training were revealed.

In the process of forming models describing functional dependencies between the corresponding index and a group of socio-economic factors, the influence of such groups of indicators as the structure of the gross domestic product, the number of employees by industry, the average monthly salary as a % of the previous year, the need of enterprises for employees, declared to the employment service, the population and other groups of indicators was studied. In total, the simulation involved

Research and computational experiments were performed to model indices depending on socio-economic factors using multiple linear regression and artificial neural networks (the model is a multi - layer perceptron). A comparative analysis of regression and neural network models is performed. It was found that neural networks provide higher accuracy and convergence with the observed values of indicators.

Based on the results of computational experiments, the socio-economic factors that have the greatest positive and negative impact on the proposed indices of personnel support for the digital economy are determined.

The performed validation of models and the identified significant socio-economic factors not only create prerequisites for making proactive management decisions in the field of professional education planning, but also in the future will allow us to move to the formation of scenarios based on the identification, grouping and analysis of the impact of various socio-economic factors on key factors of change.

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