

Regional Industrial Transformation and Educational System Stakeholders Networks

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Abstract—The article analyzed the relationship between the educational system and regional economic development. The rate of regional industry transformation is analyzed using structural shifts coefficients. The low rate of structural changes and the small share of the innovation sector can become a threat to the regional economy development and affect the level of regional competitiveness. The fourth industrial revolution is transforming the factors of regional growth and placing new demands on the workforce quality on the regional labor market. Accordingly, the regional education system is becoming an important driver of economic development. However, there is a significant gap between the supply of workers generated by universities and the demand from the regional economy agents. To remove these contradictions, the main stakeholders of the regional educational system should form a knowledge network to intensify the efficiency of communication as within the universities as between the main stakeholders. The regional policy could play an important role stimulating not only technological but also social innovation and the formation of appropriate regional institutions.

Keywords—*region, regional industry, knowledge-based economy, regional labor market, educational system stakeholders, institutions*

I. INTRODUCTION

The fourth industrial revolution or Industry 4.0 includes automation and data exchange technologies in manufacturing, including cyber-physical systems, the Internet of Things (IoT), and cloud computing. All these modifications change the industrial structure of countries and regions and impose new requirements for training. The specificity of the fourth industrial revolution lies in the fact that it is more related to social factors, in contrast to previous industrial revolutions, which are mainly determined by technical innovations.

A higher education and training system focused on the needs of the regional economy can be an important driver of innovation and economic growth.

The success of the development of the territory is directly related to the formation of its balanced and progressive economic structure, as well as the ability to adapt to the challenges of the external environment. Many Ural scientists prioritize economic development in favor of changing the structure of industrial production towards manufacturing and high-tech industries, although not due to a decrease in physical production volumes in the extractive sectors, but due to faster growth in the manufacturing sector. It is necessary to transform and diversify the old industrial structure of the Ural economic complex, ensure the modernization of obsolete industries, and strive for the accelerated development of high-tech production [16].

II. FACTORS OF REGIONAL INDUSTRIAL TRANSFORMATION

Many studies are devoted to identifying drivers of economic growth and development in the context of globalization at different territorial levels—countries, regions, and individual cities, as well as differences in the models of such development [1]. Recently, special attention has been paid to the fourth industrial revolution (or Industry 4.0), precisely in terms of the influence of social factors [2].

Increasing the share of the innovation component in the regional economy is the most important condition for its competitiveness. That is why regional factors of innovation are explored both theoretically and using the example of various regions [3]. The level of innovation in the region's economy directly affects its adaptability and ability to respond flexibly to external changes (resilience), including crisis phenomena [4]. It is also noted that the structure of the regional economy, its specialization have a significant impact

on the effectiveness of the regional innovation system and on the pace of economic development of the entire region [5].

Since in this paper, we focus on the relationship between the regional educational system (forming a kind of labor supply) and the regional industry (presenting the demand for labor), it was important to study existing research. A number of papers study the overall positive effect of higher education, including economic benefits [6, 7]. Several studies are more focused on identifying the relationship between human capital, which is largely a product of the regional educational system and regional development [8, 9]. Some of the works are aimed at identifying disparities between supply and demand in the labor market, which arises as a result of the inconsistency of the qualifications of graduates with modern requirements [10].

The modern concept of higher education stakeholders and knowledge networks is based on the fact that such network interconnections can remove or at least reduce the contradictions between the interests of different stakeholders and significantly reduce the existing disparities in supply and demand in the regional labor market [11, 12]. An important point is to increase the effectiveness of communications both within educational institutions and between them and the external environment [13].

A significant role in this process is assigned to a reasonable and balanced regional policy aimed at stimulating the innovation process, including through the formation of specific regional institutions [14, 15].

III. METHODOLOGY

Industry represents the basic economic potential of Sverdlovsk Region and includes the power industry, the metallurgical complex, engineering, and metalworking.

Based on the standard indicators of structural changes, the authors calculate a number of coefficients (absolute indicator of structural change, Gallagher index and Gatev coefficient of structural shifts), which allow to reveal the scale of structural changes in the industry of Sverdlovsk Region. Volumes of own-produced goods shipped, work performed, and services on their own in the industry of Sverdlovsk Region for a number of integrated types of economic activity are taken as basic indicators. The main types of economic activity are extraction of minerals, processing, production and distribution of electricity, gas, and water. Thus, the structure of the studied structure includes three elements. The dynamics of own-produced goods shipped, work performed, and services on their own for the specified types of activities in monetary terms are shown in Table I.

TABLE I. DYNAMICS OF OWN-PRODUCED GOODS SHIPPED, WORK PERFORMED, AND SERVICES ON THEIR OWN FOR TYPES OF ACTIVITIES IN SVERDLOVSK REGION, MILLION RUBLES

Economics Activity	Year				
	2005	2010	2011	2015	2017
Extraction of minerals	34,106	61,206	70,638	56,178	66,980
Manufacturing	470,694	902,605	109,4825	165,9144	1,750,788
Production and distribution of electricity, gas, and water	61,591	141,380	170,797	170,375	296,064

Economics Activity	Year				
	2005	2010	2011	2015	2017
distribution of electricity, gas, and water					

^a http://sverdl.gks.ru/wps/wcm/connect/rosstat_ts/sverdl/ru/statistics/sverdlStat/

In addition to cost indicators, it makes sense to analyze the structural shifts in the number of operating organizations by economic activity (Table II).

TABLE II. DYNAMICS OF THE NUMBER OF OPERATING ORGANIZATIONS BY ECONOMIC ACTIVITY (AT THE END OF THE YEAR), UNITS

Economics Activity	Year				
	2005	2010	2011	2016	2018
Extraction of minerals	187	279	314	595	572
Manufacturing	5,660	8,172	8,722	14,914	11,875
Production and distribution of electricity, gas, and water	1,242	1,276	1,301	1,086	1,686

^b http://sverdl.gks.ru/wps/wcm/connect/rosstat_ts/sverdl/ru/statistics/sverdlStat/

The structure is not frozen; it changes over time, so the problem arises of studying the changes occurring in it, i.e. structural shifts. The coefficients of structural shifts for the number of operating organizations do not take significant values, although their value exceeds the similar values for the volumes of own-produced goods shipped, work performed, and services on their own for the analyzed activities. Note that the most intensive structural changes for the number of operating organizations had occurred in the period from 2005 to 2011, although they were not significant.

The results of the calculations show the inertia of the regional industry structure, which confirms the previously made conclusions about the low rates of change in structural changes for at least 13 years (Table III).

TABLE III. INDICATORS OF STRUCTURAL CHANGES IN THE INDUSTRY OF SVERDLOVSK REGION, %.

Economics Activity	Period	Absolute indicator of structural change (SD1)	Gallagher index (SD2)	Gatev coefficient of structural shifts (SD3)
Volumes of own-produced goods shipped, work performed, and services on their own	2005 – 2011	3.81	1.67	1.41
	2011 – 2017	4.24	1.84	1.56
	2005 – 2017	6.26	3.0	2.53
Number of active organizations by type of activity	2005 – 2011	9.87	4.75	4.02
	2011 – 2018	2.02	0.89	0.74
	2005 – 2018	11.18	5.04	4.27

The results show that when comparing 2005 and 2018, the total change in shares in the distribution of the number of operating organizations in extraction of minerals, manufacturing, production and distribution of electricity, gas, and water was 11.18%, and the average difference in shares in the structure of the number of operating organizations reaches a value of 16.45%.

Despite the progressive development of Russian industry in recent years, it is necessary to recognize the need to intensify the innovation vector of development, which can be provided by reconstruction and modernization.

Some actions in this direction were taken back in 2010, when Sverdlovsk Region ranked first in Russia in terms of technological innovation costs and the number of advanced production technologies created, second place—in the number of world-class scientific clusters, and fourth place—in the volume of innovative products shipped¹. At the same time, science tends to reduce the effectiveness of the use of the innovation potential.

IV. RESULTS

Among a number of factors constraining the innovation activity of the industry of Sverdlovsk Region, the inefficiency of the institutional organization of investments in industry can be mentioned, which is why Sverdlovsk Region attracts relatively small amounts of investment. It should be noted that if investments in large and small industrial facilities are mediated by a fairly well-developed infrastructure of regional and federal financial institutions, then an investment in an average industrial business is practically absent. Most organizations finance innovation through their own resources in the context of insufficient credit attractiveness. Thus, for the growth of the innovation potential of the region, it is necessary, among other things, to increase the investment attractiveness of Sverdlovsk Region.

The second most important factor in the implementation of the task of improving the sectoral structure of production in the region is to increase the effectiveness of the potential of higher education and research activities. In the current period, the acceleration of structural changes in the education system is required due to the need to increase the share of the high-tech sector in the structure of the gross regional product.

The higher education system, located at the crossroads of the real sector of the economy and the social sphere, is not fully capable of following the contemporary challenges of the development of the region owing to the low efficiency of the institutional environment. It should be noted that a number of problems at the regional level are systemic in nature and are common to the entire Russian education system:

- the lack of formalized qualitative and quantitative indicators that can provide information about the graduate to a future employer, both at the level of the entire education system and of a single institution of higher education;

- the existing contradiction between the structure of training and the real needs of the market, due to the fact that the demand for training areas is still formed by the non-professional stakeholder of the educational market—households;
- the lack of an established channel for supplying universities with statistical information on the successful career of their graduates, thus, educational service providers do not have feedback from employers, which reduces the possibility of improving business satisfaction with the human resources from universities;
- extremely low level of transparency of information and institutional communications for better coordination between education stakeholders (employers and applicants);
- budgets of regional and local levels practically do not participate in the diversification of the order for training;
- lack of interest of regional and local authorities in establishing a process of balancing labor and education markets;
- lack of flexibility of the higher education market, which does not allow for prompt response to the personnel needs of regional economies.

These problems necessitate the use of regional tools for harmonizing demand and supply for human resources. The relevance of taking into account the regional specifics of Sverdlovsk Region is explained by the high proportion of people employed in industry. The problem of the imbalance between supply and demand in the labor market of the workforce is noted as one of the main problems of the region.

Evaluation of employees by level of education allows us to conclude about the cumulative higher level of education of workers in the economy as a whole, in comparison with workers in Russian industry (Figure 1).

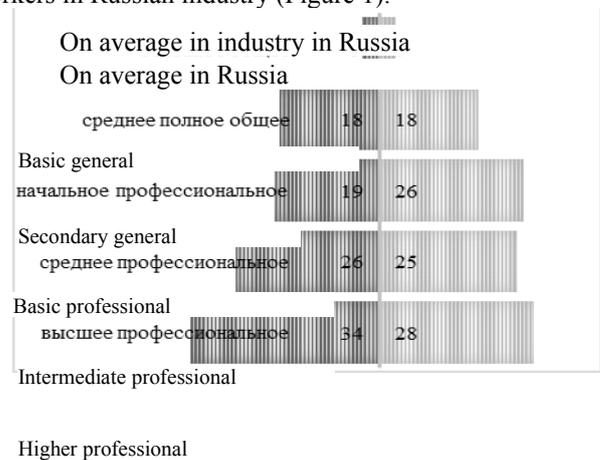


Fig. 1 – The structure of employment by level of education at the end of 2017 in the Russian economy as a whole and in industry in particular, %

According to the analyzed data, modern Russian industry is a less technological sector than other types of economic activity on average in Russia. Retrospectively, one can observe a gradual increase in the level of education of those employed in the industry, which indicates an increase in the innovativeness of jobs, but this trend is rather low.

¹ On Approval of the Strategy of Innovative Development of Sverdlovsk Region for the Period up to 2020 [Electronic source]: Decree of May 22, 2013, No. 646-PP. Access mode: docs.cntd.ru

An analysis of regional statistics illustrates the lower level of education employed in the industry of Sverdlovsk Region than in Russia as a whole, but the general trend characteristic of Russia shows the lack of obvious regional specifics.

It should also be noted that a massive influx of low-skilled workers from abroad has a significant impact on the quality of the workforce, which complicates the implementation of the strategic objectives of the development of Sverdlovsk Region. In particular, a number of problems of regional development include a low level of labor productivity².

It should be noted that foreign labor is employed in industries far from the industry, and in comparison with the Russian Federation, there is a lack of adequate migration and labor policies in Sverdlovsk Region, able to redistribute the flow of migrants in the right direction for industry in the region. The Social and Economic Development Strategy of Sverdlovsk Region for the Period up to 2020 specifies the marginal migration capacity of the labor market in Sverdlovsk Region, which does not have a negative impact on the socioeconomic situation—4%³, while in 2011, this figure for the region was 5.1%⁴; meanwhile, the current situation has not changed significantly. We also note that the share of highly qualified specialists in the total number of foreign citizens engaged in labor activities in Sverdlovsk Region was 1.7%⁵ from 2014 to the present.

Thus, balancing supply and demand in the labor market of Sverdlovsk Region in the industry should be done through its own infrastructural capabilities, the main one being the education system.

In fairness, we note that in the region, a number of regulatory legal acts have been adopted to change the described situation. In particular, amendments were made to the Strategy for Socioeconomic Development of Sverdlovsk Region for 2016-2030, where the creation of competitive conditions for the accumulation and preservation of human potential is indicated as priorities for the socioeconomic policy of the region. Among the main accents, the need to create conditions for the implementation of educational programs in the most popular and promising professions and specialties is pointed out⁶.

In the current period, the institutional construction of the mechanism for balancing the labor market and education has entered an active phase at both the regional and federal levels. In particular, the National Council under the President of the Russian Federation on Vocational Qualifications, created in accordance with Presidential Decree No. 249 of April 16, 2014, coordinates work to bring federal state standards of vocational education in line with professional

² On the Strategy of Social and Economic Development of Sverdlovsk Region for 2016-2030 [Electronic source]: Law of Sverdlovsk Region. Access mode: <http://zssso.ru/upload/site1/document>

³ The Strategy of Socioeconomic Development of Sverdlovsk Region for the Period up to 2020 (updated version). Approved by the Government of Sverdlovsk Region of December 29, 2010, No. 1910-PP. Access mode:

⁴ Overview of the migration situation in Sverdlovsk Region in 2011 / UFMS of Russia in Sverdlovsk Region / ufms-ural.ru/storage/files/Migracionnaja_situacija_2011_god.doc

⁵ State program of Sverdlovsk Region *Promotion of Employment of the Population of Sverdlovsk Region until 2024* [Electronic source]: Decree of the Government of Sverdlovsk Region of October 21, 2013, No. 1272-PP. Access mode: <http://adm-severouralsk.ru>

⁶ About the Strategy of Socioeconomic Development of Sverdlovsk Region for 2016-2030 [Electronic source]: Law of Sverdlovsk Region. Access mode: <http://zssso.ru/upload/site1/document>

standards to create a regulatory framework for training in demand on the market labor cadres.

At the regional level, there is the Program of Creating High-Performance Workplaces in the Industry of Sverdlovsk Region up to 2020⁷, the purpose of which is to ensure the functioning of 700 thousand modernized and new jobs at existing and newly created enterprises and organizations in the economy of Sverdlovsk Region by 2020.

However, despite attempts to intensify legal regulation in this area, the demand for human resources in the studied area is still high, and the dynamics of the emergence of vacancies in the industry of the region is positive. Today, the labor market is characterized by low-skilled demand. More than 80% of applicants have a non-advising qualification level, while 7% have no qualifications, and 39% have no professional education⁸. This state of affairs in the labor market is taking shape in the context of a progressive increase in the technological effectiveness and innovativeness of workplaces that require highly specialized high qualifications.

The problems are exacerbated by the high disparities in the spatial distribution of the regional industry, since more than 90% of industrial enterprises are located in seven key territories of the region. Given the low migration mobility of the population, as well as the ability of households to invest in education, these imbalances lead to an almost universal shortage of personnel in the industry of the region. According to the Government of Sverdlovsk Region, the demand for both qualified and low-skilled personnel still exceeds supply, primarily in the industry of the region.

V. CONCLUSIONS

Thus, the industry of Sverdlovsk Region is mainly focused on the development of production, not technology.

A comprehensive assessment of the identified regional and sectoral factors of the labor market and personnel potential allows us to determine the architecture of the problem field in the area of balancing demand and supply in the labor market industry of Sverdlovsk Region. In particular,

- a significant systemic problem for the economy of Sverdlovsk Region is the disproportion in the structure of labor resources in the territorial, professional, age, and migration context;
- the inertia of the industrial structure of Sverdlovsk Region leads to low manufacturability and innovation of jobs;
- the lack of an adequate migration policy both at the national, interregional, regional, and international levels;
- practical absence of relations between industrial enterprises (as an employer) and the regional education system (as a producer of human resources);
- the lack of effective interaction between the federal center and regional authorities in the field of formation of a targeted policy, taking into account the interests of the leading industries of the regions.

⁷ The Program of Creating High-Performance Workplaces in the Industry of Sverdlovsk Region up to 2020 // <http://mpr.midural.ru/UPLOAD/user/file/new/vprm.pdf>

⁸ On the Program of Modernization and Creation of New Jobs in the Territory of Sverdlovsk Region for the Period up to 2020 (with changes as of January 19, 2017) [Electronic source]: Resolution of the Government of Sverdlovsk region of July 11, 2014, No. 591-PP. Access mode: <http://docs.cntd.ru>

Thus, in spite of the attempts made to resolve these problems, the balance of the labor market and education is still not optimal.

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