

Transformation of the human resources regional market under the influence of economy digitalization

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Abstract—Economy digital transformation involves a number of problems associated with great risk for ensuring steady employment of population as development of artificial intelligence promotes replacement of human resources and jobs cuts. On the other hand, in the area of developing innovative digital technologies, there is shortage of highly qualified personnel, and there is the need to retrain staff within the region or for people to move to regions where human resources shortage is observed. The paper presents the research first results, which identify the integrated impact of economy digital transformation on the regional labor market. The main concepts of labor market transformation process are revealed. The research is topical as it allows using its findings for cognitive modeling of possible scenarios of human resources market changes.

Keywords—digital economy, labor market, human resources, employee pool, Ishikawa diagram, cognitive modeling

I. INTRODUCTION

New industrialization of Russia's economy caused by perspective digital industrial technologies growth and implementation as well as large-scale replacement of human labor with robotics will significantly change employment structure of both new and already existing jobs. It will also cause priorities changes in terms of professions, necessary competences, etc.

Quantitative assessment of the number of jobs and professions lost and created due to new "digital professions" is a labor-consuming scientific task, which is difficult to structure. Modern expert estimates of global jobs cuts caused by the digitalization process differ significantly. For example, according to WEF experts supposed jobs cuts by 2030 is in the range from 2 million to nearly 2 billion.

Recently conducted analysis of social effects of technological development new wave carried out by Russian researchers was based on two sources. Russian Federal State Statistics Service provided data on the number of organizations and their demand for employees in different professional groups. Ministry of Education and Science provided information on the number of students majoring in innovative professional fields. The analysis characterizes the social processes caused by new industrialization based on innovative technologies and digitalization of economy [1]. However, this analysis does not deal with the demographic situation caused by demographic waves, population shift, raising the retirement age, and human resources growth triggered by all these factors. Taking into account the demographic situation in the labor market dynamics can reveal the compensatory effect caused by the combination of a demographic gap and unemployment growth due to reduction of jobs and disappearance of some professions. Assessment of the mobilization effects produced by on-line activity transfer to real life (off-line) remains an unresolved task also.

Here is the list of problems encountered during the stages of digital technologies introduction and use in the economy:

1. Artificial intelligence development presents a great risk for ensuring steady employment as it can promote human resources replacement and jobs cuts.

2. There exists the problem of staffing the digital economy: there are not enough both experts in the field of innovative digital technologies development and users capable to use them correctly and efficiently.

3. Regions may face the problem of unequal provision of qualified professionals, which may lead to retraining staff in

the region or their relocating to other regions where human resources shortage is observed.

The relevance of this research is confirmed by its compliance with the priority directions of scientific and technological development of the Russian Federation approved by the Presidential decree of the Russian Federation of December 1, 2016 No. 642 "About the strategy of scientific and technological development of the Russian Federation", namely:

- with the direction a) transition to the advanced digital, intellectual production technologies, robotic systems, new materials and ways of designing, creating systems of large data volumes processing, machine learning and artificial intelligence;
- with the direction g) possibility of the Russian society effective reply to great challenges, taking into account interaction of humanity and nature, humanity and technologies, social institutes at the present stage of global development, including application of humanities and social sciences techniques.

The research novelty lies in the complex analysis of social effects of the technological development new wave. This analysis means systematic approach and takes into account the main internal and external processes, which determine and accompany the transformation of the regional human resources market.

II. LITERATURE REVIEW

Global economy digitalization entered its active phase. Such concepts as "The third industrial revolution" and "Industries 4.0" rather quickly developed from the corporate level to the state programs and business strategies.

To speak about modern society trends researchers use dozens of different terms and concepts. Europeans scholars prefer to use the term "digital economy" in their papers and documents, while Americans (for example, Deloitte, IBM and some other companies) resort to a more technological term of API economy [2; 3].

A number of research papers are devoted to the analysis of different countries economy digitalization and comparison of their development on the national level. Some articles emphasize that digital economy regulation must proceed from extensive dialogue of the commercial and government institutions operating in the digital markets of any country [4-8].

The scientific community pays special attention to issues of digital industrial innovations influence on labor market. Some authors not only measure modern technologies influence on cumulative number of jobs but also consider the issue of how economy digitalization will influence jobs quality and structure [9; 10].

Many papers consider issues of creating new jobs in global economy, which appear due to new digital positions, and to recruiting personnel that must have necessary digital skills. Today the insufficient number of these employees presents a serious problem [11-13].

One more aspect of the analysis is the problem of very rapid growth of the market of so-called on-demand employment, i.e. the number of freelancers. First, this growth was promoted by digital technologies and second, by the rise

of different online job boards and specialized online temporary recruitment platforms such as Upwork and AmazonMechanicalTurk (AMT), for example. Some contributors also consider the problems of labor shift growth [14, 15].

Constantly growing production automation and use of different robotic technologies and equipment, their influence on labor market and, as a result, unemployment growth are a subject of a separate study. A number of papers deal with this problem [16, 17].

Digitalization of Russia's economy, its features and problems are analyzed in research papers of both certain scientists and scientific communities [18-25].

III. METHODOLOGY AND RESULTS

The present research took into account many factors and contradictory effects of the economy digitalization influence on the labor market. These factors and effects are characterized by difficult semi structured interrelations, so the research requires a systematic approach and cognitive modeling methodology. Fuzzy cognitive maps by Silovwere chosen as the basis for the cognitive modeling of the labor market. This type of cognitive maps provides higher adequacy of the developed models in comparison with sign cognitive maps as they allow to use qualitative and quantitative characteristics and then on their basis to carry out dynamic modeling. The first step in the technique of Silov's fuzzy cognitive maps building is identification of the main concepts and definition of cause and effect relationships between them. PEST-analysis and SWOT –analysis of the human resources market were applied to identify the main concepts. Ishikawa diagram was used to specify the main concepts list and determine cause and effect relationships between them. Integrated application of the listed techniques (approaches) will allow gaining the greatest effect while creating a cognitive model of human resources market.

At the first stage of the research, the authors selected the main concepts with the help of PEST analysis. It helped analyze the influence of the external environment factors on the human resources market. The results are presented in table 1.

TABLE I. *PEST-ANALYSIS OF HUMAN RESOURCES MARKET*

Political (P)	Economic (E)
The current legislation in the field of labor market state regulation. Foreign policy, adequate response to the arising threats. Domestic policy of the state. State regulation of the human resources market. Personnel policy in industries. Maintaining the government power among citizens and in a business community.	Economic climate, separate industries directly connected with new industrialization. Digitalization of economy. Average salary in regions and the whole country. Inflation rate. Investment climate in the sphere of new industrialization and development of digital economy. Sanctions against Russia. Import substitution. Labor market and employers' requirements. Demand for educational institutions graduates and trends of change.
Social (S)	Technological (T)
The legislation determining social factors. Demographic factors. Migration policy. Basic values of society. Ethnic, cultural, religious factors. Lifestyle trends, quality of life. Stratification of society, low social mobility.	Development of innovative technologies in Russia and in the world. Conditions and trends of information technology development. Innovative capacity of regions and the whole country.

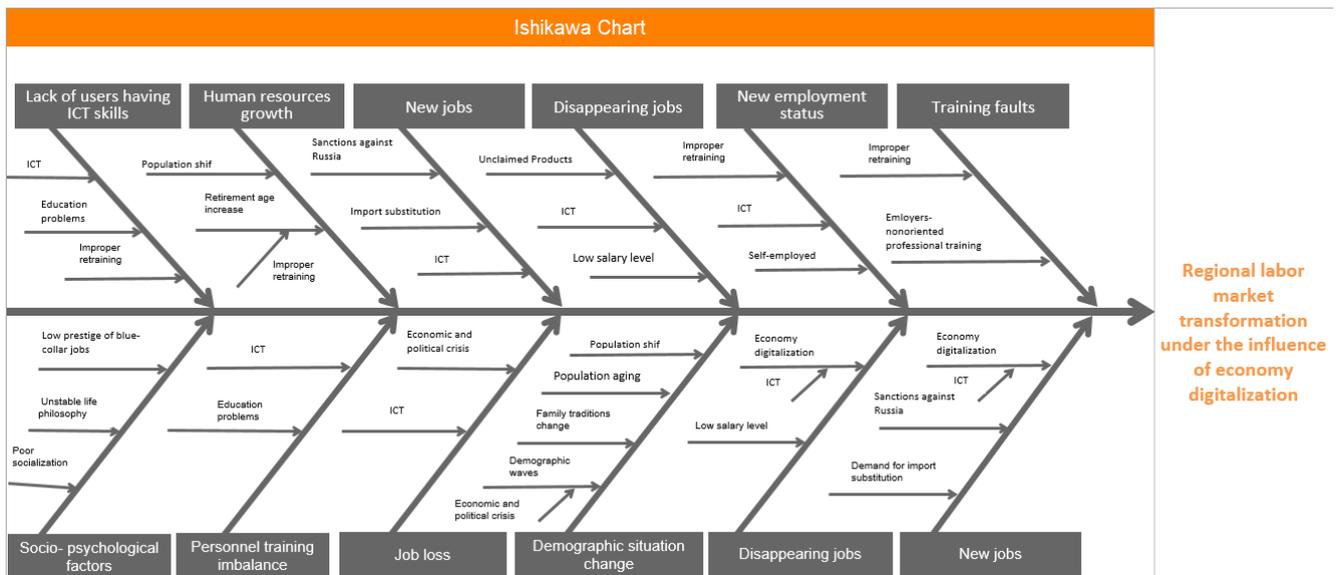


Fig. 1 Ishikawa diagram of human resources market

The authors used SWOT analysis to make conclusions on the internal and external environment of the labor market. The purpose of this analysis was to identify the main concepts by systematization of the available information about strengths and weaknesses of the human resources market and about potential opportunities and threats of the external environment. Table 2 presents the aggregate of significant factors and conditions influencing development of the human resources market.

Ishikawa diagram was used to specify the main concepts list and to determine cause and effect relationships between them. This diagram was developed during team discussion of the problem of labor market transformation under the influence of economy digitalization. Brainstorming technique used for the diagram construction allowed choosing the following main concepts: new employment status, new professions, new jobs, disappearing jobs, the demographic situation change, human resources growth, loss of jobs, training imbalance, shortage of users having proper information and communication technology (ICT) skills, faults in professionals training, social and psychological factors.

TABLE II. SWOT-ANALYSIS OF HUMAN RESOURCES MARKET

Strengths(S)	Weaknesses (W)
New high-tech clusters development. The growth of regions investment attractiveness. Economy digitalization. Additional jobs. Better level of employers' social responsibility.	Lack of employees with proper ICT skills in the economy. The activities of educational institutions are not sufficiently coordinated with the labor market demand. Preservation of informal employment, non-settlement of legal relations with self-employed. Insufficient level of remuneration.
Opportunities (O)	Threats (T)

Favorable geo-economic position of the country, potentially ensuring the emergence of new markets and the labor market development. The development of science and education in the field of health care contributes to the preservation and development of human resources. The growth of labor resources due to raising the retirement age. Improvement of control and supervisory activities in the field of labor relations. Preservation of social stability.	Negative demographic trends. Shift of qualified personnel beyond certain regions. Population aging. Laying off employees and jobs cuts due to the economy digitalization. Changing family traditions. Negative socio-psychological factors: poor socialization, unstable life philosophy, lowering the prestige of blue-collar jobs.
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The developed Ishikawa diagram is presented in Fig. 1.

During the further research, it is supposed to perform the following tasks:

- to create the problem field of the human resources market based on the analysis of various possible combinations of both strengths and weaknesses with threats and opportunities;
- to determine Pareto-efficient set of the revealed concepts.

Availability of this information will form the basis for determining the goals (directions) of the development and ways of their achievement as well as labor market development strategy in the course of cognitive modeling.

IV. CONCLUSION AND DISCUSSION OF RESULTS

Thus, the combination of several techniques and methods was used in the study, including PEST analysis, SWOT-analysis of the human resources market and Ishikawa diagram as the first step to create fuzzy cognitive maps by Silov. These methods allow revealing the concepts, which determine regional labor market processes resulting from new industrialization, and explain interrelations between them.

While selecting concepts for cognitive maps construction, the authors took into account the features of regional labor market transformation in the conditions of national economy digitalization. As a result, three groups of concepts (factors) are determined:

- the set of concepts corresponding to the initial data on the regional labor market; (disappearing jobs and professions, the demographic situation change, socio-psychological factors);
- the set of concepts reflecting the positive impact on the labor market; (new professions, new jobs, human resources growth);
- the set of concepts characterizing the main destabilizing impacts on the labor market; (jobs loss, personnel training faults, training imbalance, shortage of users with ICT skills).

Practical results can be used for possible scenarios cognitive modeling of the regional human resources market change. The concepts intercorrelation at the research initial stage was determined by experts. However, further development of the model supposes econometric interrelations creation.

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