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Labor Potential Reproduction Transformation in Digital Economy Conditions

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***Abstract*— The article considers the digital economy as a qualitatively new form of labor relations organization, built on a combination of the principles of dynamism and adaptability to economic processes transformation. The authors` characteristic of labor potential is presented as a set of interconnected and interdependent needs, abilities, opportunities and development conditions, ensuring its reproduction in the context of digitalization. A comparative analysis of labor market condition in Russia and the Krasnoyarsk Territory was carried out, which made it possible to determine the phases and types of labor potential reproduction "narrowed", "expanded", "simple" depending on the age and educational structure. The segment of the "black hole" in specialists with competencies in the digital economy is highlighted. Directions of lifelong learning ecosystem creating are proposed, which allow digital competencies formation and labor potential reproduction support during the life cycle of society.**

Keywords: labor potential, reproduction, phases of reproduction, society life cycle, labor market transformation, digital economy

I. INTRODUCTION

Digitalization today has penetrated into all life areas of any state. The particular sensitivity of digitalization is manifested in changing forms processes of social production aimed at living labor into intellectual one replacement with computer technology and machine learning application. These challenges have identified a number of problems, primarily related to training workforce which is able to adapt to new knowledge, skills, competencies that are in demand on the modern labor market. The high dynamism of the applied technologies for the goods production and services provision set challenges of professional skills continuous perfection.

These reasons require reformatting the labor potential reproduction system organization. An extensive review of domestic and foreign literature fulfillment allowed the authors to highlight the hypothesis of labor potential reproduction development, based on a combination of the principles of socialization, value guidelines and self-affirmation. This task is realized through the educational space formation focused on lifelong professional education. To provide training for specialists capable performing labor functions is based on the digital economy competencies, as well as society self-development possibility throughout the entire life cycle.

II. RESEARCH METHODOLOGY

Reasonable theoretical methodology was applied in the studies. Theoretical principles construction is based on hypotheses creation in the empirical research process of labor

market development data for 2011-2018. The hypotheses are based on the methods of systematizing and structuring the research results on labor potential development and reproduction theory.

Labor potential reproduction model in society life cycle certain stages is based on P. Janet`s theories, S. Buhler's personality core feature model, D. Super's professional development, and emergence. The authors` qualitative changes are highlighted in the model; the stages of vocational training which have unity during the society life are expanded, providing the integral effect to labor potential reproduction.

The result of the study is the ecosystem reproduction construction of society labor potential during the life cycle, based on the systems approach.

III. Labor Potential in Digital Economy

Digitalization of the economy has changed business models, made adjustments to practical activities, contributed to new types goods and services production emergence, the open labor market formation. Kapitsa S.P, Khasen E. [1,2], single out the main reason for economic growth - this is the technology development, which is directly related to the accumulating knowledge process and information. Innovative digital technologies are designed to ensure the competitiveness of all participants in the economic system from individuals to large companies and states [3], by costs reducing and labor productivity increasing.

World experience shows that the labor potential is the main factor in modernizing and increasing the state's competitiveness, allowing it to become a leader and avoid moving to the periphery of the international division of labor [4]. The effective formation and rational use of labor potential is a priority at the mega, macro, meso and micro levels, which are closely interrelated and affect labor relations, personality development.

Despite the technological structures and labor functions change, labor is the most important production factor of modern economy. The digital paradigm requires a labor relations concept revision, when the employee has a constant need to receive a set of competencies that are not characteristic of the profession, caused by business and life platformization. The role of professional adaptation significantly increases in these conditions: the employee's ability to meet new requirements, processes, types of work, to implement theoretical knowledge into practical skills, to analyze the positive and negative dynamics of the organization's business processes [5]. The main element of social and labor relations are people - talented specialists who can use existing digital technologies and adapt quickly to new methods and approaches usage [6].

The main reasons for social and labor relations transformation in the context of economy digitalization are [7]:

- strengthening the social component in social and labor relations;
- non-standard forms of labor relations development;
- blurring the boundaries between work and leisure;
- value preference differences of generations X, Y, Z;
- education orientation on the labor market.

Education orientation on the labor market and professional environment creation where an employee realizes his professional competencies [8] is a priority. Organization processes improving, labor relations regulation and stimulation contributes to workers` labor potential development, highly consumer valuable goods and services production.

The concept of "labor potential" as an economic category appeared in the scientific literature in the 70-80s XX century. However, among researchers there is no single approach to its definition.

Analyzing scientific researches in this field showed that the issues of assessment, formation, reproduction, development and effective use of labor potential are being actively studied. Initially, it is necessary to determine the concept of "labor potential" and its transformation in the digital economy conditions.

The study of the works of domestic and foreign researchers in various fields of economic science, allows us to identify the main approaches that determine labor potential essence: resource, factor, integral.

Resource approach to labor potential adhere to L.I. Abalkin, I.S. Volokhin, V.K. Vrublevsky, B.M. Genkin, N.V. Korovyakovskaya, V.G. Kostakov, L.E. Kunelsky, A.A. Popov, E.S. Rusanov, G.P. Sergeeva, M.I. Skarzhinsky, L.S. Chizhova, N.I. Shatalova et al. According to them labor potential is a type of economic resources that characterizes the possibility of participation of a person, employees of an enterprise, the country's population in the production and goods exchange [9,10].

Factor approach to understanding labor potential essence of is adhered to by K. L. Andreev, V. B. Bychin, M. I. Goldin, A.I. Kibanov, Yu.P. Kokin, R.P. Kolosova, Yu. G. Odegov, A.S. Pankratov, P.E. Shlender et al. From their point of view, labor potential is the most important generalizing indicator of development level of human factor creative activity [11], summarizing the final indicator of the personal factor of production [12].

Some researchers (V.S. Bulanov, N.A. Volgin, I.S. K.A. Gulin, Maslova, E.A. Chekmareva, A.A. Shabunova, etc.), combining resource and factor approaches (integral approach), understand labor potential as a generalizing characteristic of measure and quality of aggregate abilities for socially useful activity, which determine the capabilities of an individual person, groups of people, the entire able-bodied population for their participation in labor [13].

There are 3 types of labor potential in theory [14]:

- aggregate (full) - a general measure of all opportunities necessary for work and incorporated in a labor-active population;

- productive - the greatest return in creating any values necessary for society as a whole, and for each individual person;
- private (selective) - determines the opportunities for particular population activities (individual (age, gender)), territory, labor collective.

The indicated types of labor potential in the conditions technological structures change, in our opinion, should be considered on the integrative approach basis. Based on the foregoing and the integrative approach using, the author offers labor potential definition interpretation as a set of interconnected and interdependent needs, abilities, opportunities and conditions for the society development, ensuring its reproduction in digitalization conditions.

IV. Analysis of the Regional Labor Market

The labor potential reproduction is characterized by natural and migration growth indicators, which affect the population dynamics and structure. Let us consider the birth and death rates for the population of Russia and the Krasnoyarsk Territory over a number of years (Table I).

TABLE I. Natural and migration movement population indicators dynamics in Russia and the Krasnoyarsk Territory for 2011-2018 [15, 16]

Indicators		***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
Number of permanent population, thousand people	RF[1]	142961	143202	143507	146091	146406	146675	146842	146831
	KT[2]	2833.8	2842.4	2849.6	2855.8	2862.6	2870.9	2875.9	2875.3
The number of births, thousand people	RF[1]	1796.6	1902.1	1895.8	1942.7	1940.6	1888.7	1690.3	1604.3
	KT[2]	38.3	41.2	41.1	41.2	41.2	39.8	35.6	33.5
The number of deaths, thousand people	RF[1]	1925.7	1906.3	1871.8	1912.3	1908.5	1891.0	1826.1	1828.9
	KT[2]	37.0	36.9	36.2	36.2	36.2	35.8	35.3	35.7
Natural increase (decrease) in the population, thousand people	RF[1]	-129.1	-4.3	24.0	30.3	32.0	-2.3	-135.8	-224.6
	KT[2]	1.3	4.3	4.9	5.0	5.0	4.0	0.3	-2.2
The number of arrivals, thousand people	RF[1]	3415.1	4196.1	4496.9	4624.9	4734.5	4706.4	*	*
	KT[2]	90.9	102.6	110.3	113.5	117.1	124.5	125.0	131.0
The number of departures, thousand people	RF[1]	3095.3	3901.2	4201.0	4354.8	4489.1	4444.5	4561.6	4786.7
	KT[2]	82.9	98.7	109.0	112.6	114.3	119.7	124.1	131.3
Migration growth	RF[1]	319.8	294.9	295.9	270.1	245.4	261.9	*	*
	KT[2]	7.9	3.8	1.4	0.9	2.8	4.8	0.9	-0.3
Total population growth	RF[1]	190.7	290.6	319.9	300.4	277.4	259.6	*	*
	KT[2]	9.3	8.1	6.3	6.0	7.7	8.8	1.2	-2.5

* - no data; 1 - The Russian Federation; 2 - The Krasnoyarsk Territory

The analysis showed that there is a constant increase in the number of resident population in the Krasnoyarsk Territory and Russia as a whole, but the situation radically changed in the opposite direction last year. In 2018, the population of the country decreased compared to 2017 by 11.8 thousand people, and in the Krasnoyarsk Territory by 0.6 thousand people. The number of deaths exceeds the number of births in 2011-2012 and 2016-2018. The natural population decline was 224.6 thousand people in 2018. There was a natural population growth in the Krasnoyarsk Territory during 2011-2017, but the trend changed in 2018, and a natural decrease was formed as 2.2 thousand people.

In connection with the population decrease number, the official labor force level of the indigenous population, and respectively, of the labor potential, is reducing. Replenishment is due to migration flows, mainly low-skilled labor.

To assess the labor potential and identify this process existing problems, an analysis of the labor market of the Krasnoyarsk Territory was carried out (Table II).

TABLE II. ANALYSIS OF THE LABOR MARKET OF THE KRASNOYARSK TERRITORY [15,16]

Title		2011	2012	2013	2014	2015	2016	2017	2018
The num-ber of labor force (15-72 years), thousand people.	RF[1]	75779	75676	75529	75428	76588	76636	76109	76011
	KT[2]	1511.3	1512.7	1516.0	1524.3	1500.8	1482	1494.2	1491.1
Labor force participation rate,%	RF[1]	68.3	68.7	68.5	68.9	69.1	69.5	69.1	68.9
	KT[2]	68.3	68.6	68.8	69.6	68.9	68.4	69.1	68.8
Number of employed, thousand people Total	RF[1]	7056.6	7145.4	7191.5	7139	7223.6	7292.6	7242	7254.4
	KT[2]	1420.8	1428.8	1429.9	1448.0	1407.4	1391.8	1408.9	1417.9
including									
higher education	KT[2]	362.2	380.9	377.7	407.5	403.3	405.0	412.8	416.5
secondary vocational education	KT[2]	695.4	624.1	624.6	619.3	609.8	565.7	592.5	590.1
general secondary - education	KT[2]	278.5	329.7	337.5	339.1	308.8	337.5	311.6	317.8
a basic secondary education	KT[2]	78.4	89.3	85.4	76.2	81.7	74.9	84.1	88.2
do not have a basic general education	KT[2]	6.3	4.8	4.7	5.9	3.9	5.8	7.9	5.4
the number of unem-ployed (according to the ILO methodolo-gy), thou-sand people Total	RF[1]	4922.4	4130.7	4137.4	3889.4	4263.9	4243.5	3966.5	3657
	KT[2]	90.4	84.0	86.1	76.3	93.3	90.2	85.2	73.2
including									
higher education	KT[2]	12.9	13.0	15.8	11.4	13.5	14.1	10.6	11.5
secondary vocational education	KT[2]	44.3	35.5	29.3	27.4	29.2	31.4	31.8	28.0
general secondary - education	KT[2]	21.9	23.9	26.1	26.5	33.9	27.6	25.5	22.8
a basic secondary education	KT[2]	10.6	11.0	13.5	10.5	15.4	15.9	15.7	9.8
do not have a basic general education	KT[2]	0.6	0.6	1.3	0.4	1.3	1.1	1.7	1.1
Unemployment rate (according to ILO methodology),%	RF[1]	6.5	5.5	5.5	5.2	5.6	5.5	5.2	4.8
	KT[2]	6.	5.5	5.7	5.0	6.2	6.1	5.7	4.9
The number of officially registered unemployed, thousand people	KT[2]	34.973	30.513	24.371	20.461	18.390	20.255	17.705	14.591
The officially registered unemployment rate (in% of the labor force)	KT[2]	2.2	2.0	1.6	1.3	1.2	1.3	1.2	1.0
Graduates from higher educational institutions, thousand people	RF[1]	1443	1397	1291	1226	1300	1161	1555	1157
	KT[2]	111.9	110	102.5	96.1	89.7	85.2	81.1	81.3
Graduates of specialists from secondary specialized educational institutions, thousand people	RF[1]	572	518	486	439	451	446	469	473
	KT[2]	49.5	47	46.2	40.7	46.5	45.3	41.4	40.9

The labor force at the age of 15-72 years in the dynamics of 2011-2016 shows a growth trend in Russia and a decline in 2017-2018. In the Krasnoyarsk Territory, the same trend can be traced, but the reduction in the number of labor force begins in 2016(0.21% or 3.1 thousand people). At the same time, the level of participation in the workforce amounted to 68.8%, which coincides with the national average. In the structure of employment by main types of economic activity, the main share (more than 50%) is in material production, which indicates a slow economy transition to an information society based on knowledge, high technology and high-tech production. However, the share of the employed population in activities related to the use of computers and information technologies over the past decade has increased from 0.4 to 1.7%, but not at a sufficient pace for the digital economy development. In the Krasnoyarsk Territory, there is a decrease in the number of employed people in agriculture (by 38%), manufacturing (by 22%), and construction (by 14%). The number of people employed in the social and intellectual services provision, as well as other activities, is below the average.

The structure of the employed population according to the level of education was distributed as follows: more than 40% with secondary vocational education, more than 25% with higher education, more than 20% with full secondary education, 5-7% with basic secondary education. At the same time, there was an increase in the number of employed workers with higher education, which indicates the potential for adaptation to environmental conditions. Nevertheless, it is necessary to state the lack of specialists with higher education in a number of high-tech specialties, as well as the shortage of qualified personnel in workers who have the competencies of additive technologies.

Constraining factor of labor potential development is unemployment. Recently, there has been a positive trend in the Krasnoyarsk Territory, as the number of unemployed is reduced (from 90.4 to 73.2 thousand people) and the unemployment rate calculated according to the ILO methodology (from 6 to 4.9%). In the structure of the unemployed population by the level of education in 2018, the largest share is held by unemployed with secondary vocational education (38%) and higher education (16%), which confirms the insufficient demand for certain areas of training of certified specialists in the labor market. The reasons for the low competitiveness of the existing workforce are the acquired competencies that do not allow society to carry out labor activities using digital technologies.

The number of graduates of higher and secondary professional educational institutions is reduced during the analysis period by 30.6 and 8.6 thousand people accordingly, including young qualified personnel. These trends indicate a quantitative and qualitative reduction in the parameters of labor potential; negatively affect the process of its development. This argument allows us to determine the type of reproduction of labor potential as “narrowed” and to distinguish the segment of the “black hole” [17] in specialists with digital economy competencies.

In addition to the indicated trends, a radical transformation of the labor market has taken place over the past five years due to the platformization of the world economy [18], the development of the economy "on demand" [19], and, as a result, the emergence of platform employment, self-employment, and employment "on demand". Structural changes in the labor market and the identified problems require new approaches to the workforce reproduction in constantly transforming ways of world community economic development.

V. Ecosystem of Labor Potential Reproduction

The problems of labor potential reproduction are in direct interaction with the population reproduction, in the process of which the parameters of the quantity and quality of the able-bodied population are formed.

The system of reproduction and development of labor potential in a classical form [20] includes creation (production), distribution, exchange and use (consumption) of labor resources, ensuring conditions of effective employment and reducing unemployment, the formation of a social structure (Table III).

TABLE III. Phases of Labor Potential Reproduction [composed by the authors]

	Phases of labor potential reproduction			
	production	***exchange***	***distribution***	***usage (consumption)***
Characteristic	labor potential formation; consistent generational change of the working population; personality life cycle stages	the individuals` activities in recreation the physical carriers of labor potential, its qualitative and quantitative parameters	labor potential adaptation to various types of activity and a specific workplace	subject labor activity in the process of using labor potential
Conditions	systematic maintenance, restoration based on consumed material and spiritual goods	labor potential reproduction mechanism is being implemented		

The stages of labor potential reproduction differ in various qualities and properties. The labor potential production occurs in the process of its consumption, but its production cannot be carried out without specific consumption, and therefore, the reproduction process the population's ability to work as a total working capacity is renewed at certain stages of the labor potential reproduction [21].

For the reproductive process, the type of socio-economic system in which the demographic potential passes into labor resources, acquiring the labor potential properties, is crucial.

The labor potential of a person gradually increases with the acquisition of social experience, professional competencies, reaching its peak in adulthood. Then physical abilities fade away, but the intellectual component that is driving in digitalization is preserved, where the individual is able to carry out professional labor activity and continuing professional education, professional training and retraining.

At the heart of the labor potential reproduction, a staged model is proposed that integrates many approaches to the study of human development and his professional growth. P. Janet [22] puts forward the personality as a set of operations that serve the individual to create, maintain and improve his integrity. The model of the core property of the personality by S. Bueller [23] determines the phases of the working age of life and professional development according to D. Super theory [24]. The theory of emergence [25] is as a result of the emergence of new competencies based on artificial intelligence technologies, for example, the ability to process large amounts of data [26], to use software products to solve practical problems [27], which became widespread in the era of the digital economy.

The scheme of the society life cycle in the labor potential reproduction process of the digital economy, in our opinion, consists of 4 main stages (Fig. 1):

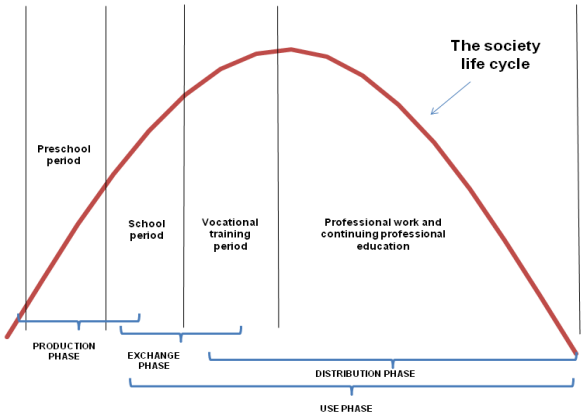

Fig. 1. The society life cycle in the labor potential reproduction process

I. Pre-school period - from the moment of birth to school admission - up to 6-8 years;

II. School period - from 7 to 18 years;

III. The period of vocational training for work - from 15-17 to 18-21 years;

IV. Professional work and continuing professional education, professional training and retraining - the time of all labor activity from 15 years to the end of the life cycle.

The staged model allows studying comprehensively the society development and solving the problems of lifelong professional education.

By the reproduction of labor potential it is necessary to understand the constantly repeating process of the formation and development of knowledge, skills, physical, intellectual, creative abilities of people, their ability to work.

Each economic formation, country, region, industry has its own peculiarity of the labor potential reproduction. An

increase in the volume of information [28] requires digitalization of the process of reproducing the society labor potential at all stages of its life cycle and leads to the need to create a lifelong learning ecosystem to form digital competencies in order to support the labor potential reproduction that meets modern requirements and ensures positive economic dynamics [29] at all levels. Based on these features, an ecosystem of the labor potential reproduction is formed during the society life cycle, which is determined by external and internal factors in the region.

The conceptual model of the reproduction of the labor potential of the region in the digital economy suggests that the individual potential of society is a structural unit and lies in the ability to perceive, analyze, and generate innovative ideas and practical solutions, increasing the personal, educational and professional level in the process of work and the entire life cycle.

The core of the labor potential reproduction ecosystem is a society with a set of needs, motives, opportunities, initiative and other qualities (Fig. 2).

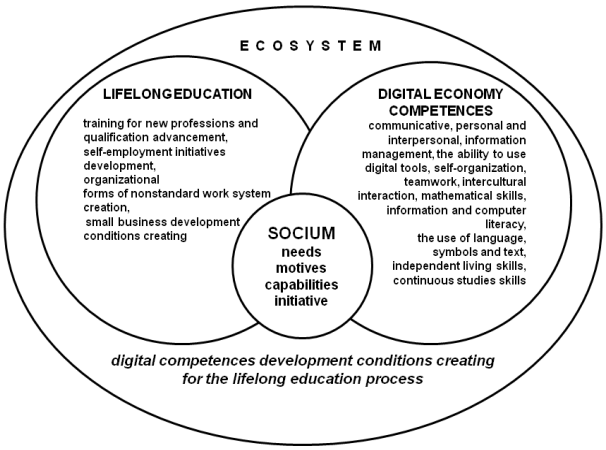

Fig. 2. Lifelong learning ecosystem of labor potential reproduction during the society life cycle

To switch from a “narrowed” to an “expanded” type of labor potential reproduction and a “black hole” in qualified specialists leveling, it is necessary to create conditions that allow getting continuous education during the society life cycle. The role of lifelong education in the ecosystem is leading. The educational process, especially in the training of highly qualified personnel, should be built on the basis of the use of project training methods, education informatization, the implementation of individual educational trajectories [30]. Professional competencies should be formed as a result of the integration of education, science, business on the basis of collaborations of teachers, students, scientists, employers that meet the trends of the digital economy.

The viability of the proposed ecosystem should be based on principles that provide an expanded type of labor potential reproduction:

- individual behavior of society;
- quantitative and qualitative parameters unity of labor potential;
- adaptability to changes in external and internal factors.

The implementation of these principles will ensure the processes of lifelong education in each phase of the labor potential reproduction of during the society life cycle.

VI. Conclusion

The proposed staged model allows comprehensively studying the professional development of society throughout life. The identified problems of professional evolution at each phase of the life cycle: the formation, distribution and use of labor potential are the directions for lifelong professional education improving in the context of platformization and digitalization of the economy.

The ecosystem of lifelong learning of the labor potential reproduction during the society life cycle is designed taking into account individual motives, needs, and capabilities for professional development. It is necessary to create conditions for vocational training, adaptation to new requirements, processes, types of work, development of self-employment organization initiatives. The dynamism and unity of the ecosystem will allow reproducing the demand for labor potential at the regional level that meets the needs of society, science, technology, education and business, and society will integrate harmoniously into the processes of the digital economic paradigm.

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