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FACTS, TRENDS, FORECAST**

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ECONOMIC AND SOCIAL CHANGES: FACTS, TRENDS, FORECAST

A peer-reviewed scientific journal that covers issues of analysis and forecast of changes in the economy and social spheres in various countries, regions, and local territories.

The main purpose of the Journal is to provide the scientific community and practitioners with an opportunity to publish socio-economic research findings, review different viewpoints on the topical issues of economic and social development, and participate in the discussion of these issues. The remit of the Journal comprises development strategies of the territories, regional and sectoral economy, social development, budget revenues, streamlining expenditures, innovative economy, and economic theory.

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The formation of the scientific personnel with an active life position, a great demand for Institute's investigation, academic community's support of the new journal published by ISEDT RAS, which combined efforts of the economic institutes of RAS in the Northwestern Federal District, and furthermore development of international ties have become the main outcomes of the last years.

MAIN RESEARCH DIRECTIONS

Due to the Resolution № 96 by the Presidium of Russian Academy of Sciences dated from March 31, 2009 VoIRC RAS carries out investigations in the following fields:

- problems of economic growth, scientific basis of regional policy, sustainable development of territories and municipalities, and transformations of socio-economic space;
- regional integration into global economic and political processes, problems of economic security and competitiveness of territorial socio-economic systems;
- territorial characteristics of living standards and lifestyle, behavioral strategies and world view of different groups of the Russian society;
- development of regional socio-economic systems, implementation of new forms and methods concerning territorial organization of society and economy, development of territories' recreational area;
- socio-economic problems regarding scientific and innovative transformation activities of territories;
- elaboration of society's informatization problems, development of intellectual technologies in information territorial systems, science and education.

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In order to integrate scientific activities of the Institute's scholars into global research area, international scientific conferences are held on a regular basis; they result in cooperation agreements with different scientific establishments:

2007 – Cooperation agreement is signed with Institute of Sociology, of the National Academy of Sciences of Belarus, Center for Sociological and Marketing Investigations at the “International Institute of Humanities and Economics” (Belarus, 2008).

2008 – Protocol of intentions is signed with Alexander’s Institute at the Helsinki University (Finland, 2008).

2009 – Cooperation agreement is signed with Center for System Analysis of Strategic Investigations of NAS (Belarus, 2009).

2010 – Cooperation agreement is signed with Institute of Economics of the National Academy of Sciences of Belarus (Minsk, 2010).

2011 – Cooperation agreements are signed with National Institute of Oriental Languages and Civilizations (Paris, 2011), Institute of Business Economy at Eszterhazy Karoly College (Hungary, 2011), Republican research and production unitary enterprise “Energy Institute of NAS” (Belarus, 2011). Protocol of intentions are signed with Jiangxi Academy of Social Sciences (China, 2011), Research and Development Center for Evaluation and Socio-Economic Development and the Science Foundation of Abruzzo region (Italy, 2011).

2012 – Cooperation agreement is signed with Center for Social Research at the Dortmund Technical University (Germany, 2012).

2013 – Cooperation agreement is signed with Jiangxi Academy of Social Sciences (China, 2013).

July 2013 – The application for research performance by international consortium involving ISEDT RAS within the 7th Framework Programme of European Community.

2014 – Cooperation agreement is signed with Jiangxi Academy of Social Sciences (China, 2014).

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Shabunova A.A., Guzhavina T.A., Dement’eva I.N., Kozhina T.P., Lastovkina D.A., Afanas’ev D.A. *Regional Civil Society: Development Dynamics: Monograph.*

Global Challenges and Regional Development in the Mirror of Sociological Measurement: Proceedings of the Online Research-to-Practice Conference. Vologda, March 14–18, 2016.

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FROM THE CHIEF EDITOR

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“Crony Capitalism” – a Source of Social Inequality in Modern Russia*



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Social inequality is a phenomenon that exists in any society. Creating deep contradictions between the actual situation and the needs of the individual and social groups, social inequality becomes one of the main mechanisms of social development, and in it lies its positive role. However, when the means of social mobility that allow each specific individual to implement effectively and safely their needs in improving social and economic status stop working, then inequality can become a destructive factor threatening social stability in the country. Almost all major world revolutions (including the Russian Revolution of 1917, the 100th anniversary of which has been celebrated recently) were in some way associated with this process.

The main function of the state as an institution that sets the “rules of the game” in social development through its legislative activities consists in maintaining such a balance in which social inequality provides an evolutionary progressive development of all segments of society. In this sense, a special role is played by the welfare state, the concept of which was formulated in the late 19th – early 20th century¹.

The mission of the welfare state on the level of management, according to L. von Stein, one of the founders of the concept, is expressed in two main objectives: first, to promote the free inter-class movement; second, to help those who suffer deprivation. The welfare state should provide every human being with “not spiritual

* The article was supported by the Russian Foundation for Basic Research in the framework of scientific project No. 16-06-00136.

¹ German scientist L. von Stein (1815–1890) is considered to be the author of the concept of the welfare state. The ideas of the welfare state were considered by Yu Offner, F. Naumann, A. Wagner, G. Hegel, W. von Humboldt, N.I. Danilevsky, V.I. Lenin, K. Marx, F. Engels, etc.

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or economic wealth as such, but with live and free inter-class movement, which makes this wealth attainable for every person”². It seeks to minimize and balance the contradictions that are based on the heterogeneity of the class structure of society. If the state “is unable to perform its social function that consists not in subordinating one interest to another, but in the harmonic resolution of their contradictions, then its place is taken by the elemental authority of physical powers, and civil war destroys, together with the overall well-being, the state itself, which could not understand and maintain this wealth”³.

Overcoming social inequality and smoothing its subsequent contradictions should be one of the main missions of the public administration system in Russia as a social state in the full sense of the word, as reflected in Article 7 of the Constitution⁴.

The problem of social inequality is particularly relevant for our country because it is the basis of public understanding of social justice – the category that occupies an important place in the structure of the outlook values of the Russian mentality and acts as the main driving force of mass popular unrest (including the Revolution of 1917). “According to experts, the Russian thought most often used justice to measure the world people lived in, and knowledge was linked to action in the world”⁵.

² Stein L. von. *Uchenie ob upravlenii i pravo upravleniya sravneniem literatury i zakonodatel'stv Frantsii, Anglii i Germanii* [The teaching of management and the right to management with the comparison of the literature and legislation of France, England, and Germany]. Saint Petersburg: A.S. Gieroglifov, 1874. P. 524.

³ *Ibidem*. P. 525.

⁴ Item 1 of Article 7 of the Constitution of the Russian Federation states that “The Russian Federation is a social State whose policy is aimed at creating conditions for a worthy life and a free development of man”.

⁵ Epikhina Yu.B., Zotov A.A., Sapov V.V., Popova I.P., Chernysh M.F. *Sotsial'naya spravedlivost' v russkoi obshchestvennoi mysli: monografiya* [Social justice in the Russian social thought: monograph]. Moscow: Institut sotsiologii RAN, 2016. P. 7.

The Soviet government was successful in applying effective methods of dealing with social inequality. For example, for the period from 1905 to 1990, the share of incomes of the richest 10% decreased by 10 p.p. (approximately from 45 to 25%), and the share of incomes of 50% of those with a low level of well-being increased twofold (by 15 p.p.; from 15 to 30%; *Tab. 1; see Insert 1, Fig. 1*).

Table 1. Change in the share of expenditures in Russia*

Income group	1905	1990	2015
Top 10%	45	25	45
Middle 40%	35	45	40
Bottom 50%	15	30	18

Note. The table shows the distribution of income (before taxes and transfers, except pensions and unemployment insurance) among adults. Adjusted estimates combine survey, fiscal, wealth and national accounts data. Approximate estimates solely use self-reported survey data. Income of married couples is divided by two.
* Compiled by the authors with the use of the source: Novokmet F., Piketty T., Zucman G. *From Soviets to Oligarchs: Inequality and Property in Russia, 1905–2016*. National Bureau of economic research. Cambridge: MA, August 2017. P. 4.

After the collapse of the USSR the “new” old elite rushed into the maelstrom of the market economy, and the tools available to tackle inequality were lost. As a result, between 1990 and 2015, the proportion of incomes of the richest 10% of Russians increased by 20 p.p. (approximately from 25 to 45%), and the share of incomes of 50% of the poorest social strata fell by 13 p.p. (from 31 to 18%; *Tab. 2; see Insert 1, Fig. 2*).

Table 2. Dynamics of wealth concentration in Russia*

Income group	1995	2015
Top 10%	53	70
Middle 40%	40	25
Bottom 50%	10	5

Note. Distribution of personal wealth among adults. Estimates obtained by combining Forbes billionaire data for Russia, generalized Pareto interpolation techniques and normalized WID (world wealth distributions).
* Compiled by the authors with the use of the source: Novokmet F., Piketty T., Zucman G. *From Soviets to Oligarchs: Inequality and Property in Russia, 1905–2016*. National Bureau of economic research. Cambridge: MA, August 2017. P. 4.

According to the dynamics of the data presented in Table 2, over the past 20 years (1995 to 2015), the concentration of wealth in the hands of 10% of the wealthiest Russians increased by 17 p.p. (from 53 to 70%). The figure in the rest of the population declined: in 40% of Russians with a medium level of incomes – by 15 p.p. (from 40 to 25%), in 50% of the poorest – by 5 p.p. (from 10 to 5%), i.e. twofold. **The gap in income concentration among the richest 10% and the poorest 50% in Russia in the last 20 years increased from 10 to 14 times** (see *Insert 1, Fig. 3 and 4*).

Thus, the Russian government and Russian society, having embarked on the way toward a market economy, had to face new and previously unknown challenges, to which the ruling elite had to find adequate answers in the interest of national security. However, in the history of our country, everything turned out different. The collapse of the Soviet Union was initiated and organized by people who planned to get personal benefit it. The very fact of signing the Belovezhye Accords contrary to the national will⁶ suggests that the ruling elites of the time were not interested in the implementation of national interests, but were guided by their private motives, in which (as it is now known) an important role was played by Western countries that sought to remove a powerful competitor from the geopolitical race.

For this reason, instead of taking all the necessary effort to adapt the people to new economic conditions and ideological principles of existence as painlessly as possible, the ruling elites of the 1990s created a system of “oligarchic capitalism”. It has other names that are well-known (which in itself speaks about the scope of the phenomenon), but their essence is the same: “crony capitalism”, “capitalism for the few”, etc. All these terms describe a system

⁶ The agreement on the dissolution of the USSR was signed on December 8, 1991 in the Belovezhye Forest, despite the fact that on March 17, 1991, 76% of citizens of the Soviet Union (with a voter turnout of 80%) voted against the dissolution of the Soviet Union.

S.Yu. Glazyev: “We cannot do without the target credit emission of the growth of investments required for extended reproduction of the economy at least to the level of 27% of GDP set out by the Presidential Decree. And without it, we cannot achieve economic growth, the possible rate of which, proceeding from objective reserve-based restrictions, could be up to 8% of GDP growth per year”⁷.

of government in which a significant place is occupied by representatives of big capital, who give priority to their own personal enrichment to the detriment of national interests and national security of the country.

The roots of the most critical Russian issues throughout the whole post-Soviet period (absence of high economic growth rates, which is pointed out by many experts; corruption; problems in education and healthcare; lack of citizens’ confidence in the ability to influence management decisions and, as a consequence, the remaining gap in the interaction between society and government, and many, many other issues), in fact, stretch back to the system of “crony capitalism” that is not aimed to address key issues of national development.

The problem of inequality is not an exception from this list, and the fact that it was and remains highly relevant for modern Russia, indicates that the rule of “crony capitalism” in the system of government remains dominant.

In 2017, the U.S. National Bureau of Economic Research published a report “From Soviets to Oligarchs: Inequality and Property in Russia, 1905–2016”⁸, which contains a lot of factual evidence that **the situation concerning social inequality in Russia in 2015 is similar to that in 1905** (see *Insert 1, Fig. 1 and 2*).

⁷ Glazyev S.Yu. Why is the Russian economy not growing (June 29, 2017). *Official website of S.Yu. Glazyev*. Available at: <https://www.glazev.ru/articles/6-jekonomika/54326-pochemu-ne-rastet-rossi-skaja-jekonomika>.

⁸ Novokmet F., Piketty T., Zucman G. *From Soviets to Oligarchs: Inequality and Property in Russia, 1905–2016*. National Bureau of economic research. Cambridge: MA, August 2017. P. 4.

According to experts, “the offshore capital of wealthy Russians is about three times greater than the official net gold and foreign currency reserves and it is comparable in value with the financial assets of Russia”⁹. Essentially, it means that over the past 30 years, so much capital (or national wealth) was exported from the country that it would be possible to build another Russia, and as applied to our actual situation, it would be possible to solve many pressing economic issues, which would be a starting point in addressing social problems.

It is impossible to doubt the trends in social inequality in Russia noted in the report of the National Bureau of Economic Research, because we can see the “oligarchic capitalism” in action if we consider official public statements provided by strategically important and large enterprises of private capital and national corporations in accordance with Federal Law 208 “On joint stock companies” dated December 26, 1995.

Thus, in 2006–2016, tax burden on profit tax in the ten largest Russian companies decreased twofold (from 8 to 4% of the revenue; see *Insert 2, Tab. 1*). The share of dividends received from major national corporations by the federal budget was and remains extremely low (on average over the last 10 years, it is less than 2%; see *Insert 2, Tab. 2*). Net profit of the majority of the largest enterprises of nonferrous and ferrous metallurgy in 2012–2016 compared to 2007–2011 decreased; however, the dividends of the corporations increased in 2–4 times (see *Insert 3, Tab. 1 and 2*).

The amount of average monthly remuneration paid to the management bodies of corporations exceeds the wages of their employees in dozens and hundreds of times; and for the period from 2011 to 2016, this indicator in all corporations increased significantly. For example, at OAO MMK – from 11 to 49 times, at PAO Severstal – from 262 to 606 times, at PAO NLMK – from 73 to 129 times, etc. (*Tab. 3; see Insert 4, Tab. 1*).

⁹ *Ibidem*. P. 4.

Table 3. Changes in the ration of average monthly wages of employees of organizations to the average remuneration paid to company management in 2011–2016 (times; ranked according to the data as of 2016)

Indicators	2011	2016	2016 +/- to 2011
PAO Severstal	262	606	+344
PAO NK Rosneft	276**	411	+135
PAO GMK Nornickel	107	150	+43
PAO NLMK	73	129	+56
PAO Gazprom	72	127	+55
PAO RUSAL Bratsk	75***	83	+8
OAO MMK	11	49	+38

* Monthly average remuneration per senior executive. Includes all types of remuneration, excluding dividends, including wages, bonuses, commissions, and reimbursement of expenses.
 ** Data as of 2014
 *** Data as of 2012.

For the period from 2012 to 2016, tax revenues of regional budgets, as well as average per capita incomes, did not change, and even decreased. The maximum growth in per capita money incomes of the population is observed in the Vologda Oblast (by 9%), the maximum increase in tax revenues – in the Lipetsk Oblast (by 4%). For comparison: during the same period, the fortune of the owners of PAO Severstal increased by 89%, MMK – by 181%, PAO NLMK – by 59% (*Tab. 4; see Insert 5, Tab. 1*).

Table 4. Changes in per capita money income of the population, in the fortune of the owner* and in tax revenues of the budget in 2016, compared to 2012, in %

Region / owner	Average per capita money income	Owner's fortune	Tax revenues of the budget
Vologda Oblast PAO Severstal	109.4	189.6	94.2
Chelyabinsk Oblast OAO MMK	87.9	281.2	101.0
Lipetsk Oblast PAO NLMK	105.2	158.5	103.9
Krasnoyarsk Krai PAO GMK Nornickel	94.4	122.8	102.6
Irkutsk Oblast PAO RUSAL Bratsk	91.5	84.5	88.0

* According to the Forbes Magazine methodology, the fortune of an entrepreneur includes the value of their assets: company shares, land, real estate, personal property, etc.
 Source: Forbes Magazine. Available at: <http://www.forbes.ru/rating/bogateishie>

Insert 1

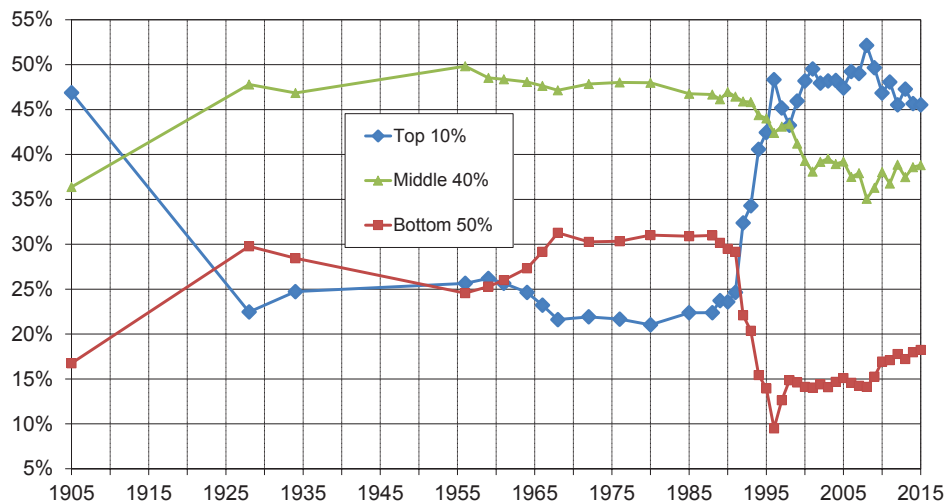


Figure 1. Income shares in Russia, 1905–2015*

* Distribution of pretax national income (before taxes and transfers, except pensions and unemployment insurance) among adults. Corrected estimates combine survey, fiscal, wealth and national accounts data. Raw estimates rely only on self-reported survey data. Equal-split-adults series (income of married couples divided by two).

Population of the Russian Federation over 20 years of age as of January 1, 2017, thousand people	Total population (100%)	10%	40%	50%
	114 566	11456.6	45826.4	57283.0

Source: Calculated by the author with the use of the data of the Federal State Statistics Service (www.gks.ru).

After the collapse of the USSR (in the period from 1990 to 2015) there was a sharp increase in the stratification of population by income. In 2015 (as in 1905), the top 10% income share was 45%; the middle 40% income group had 40% of national wealth, and 15% of national wealth was distributed among the bottom 50% income groups. This means that nearly half of incomes is accumulated in the hands of about 11.5 million people, while the share of the income of half of the respondents (57.3 million people) is 15%.

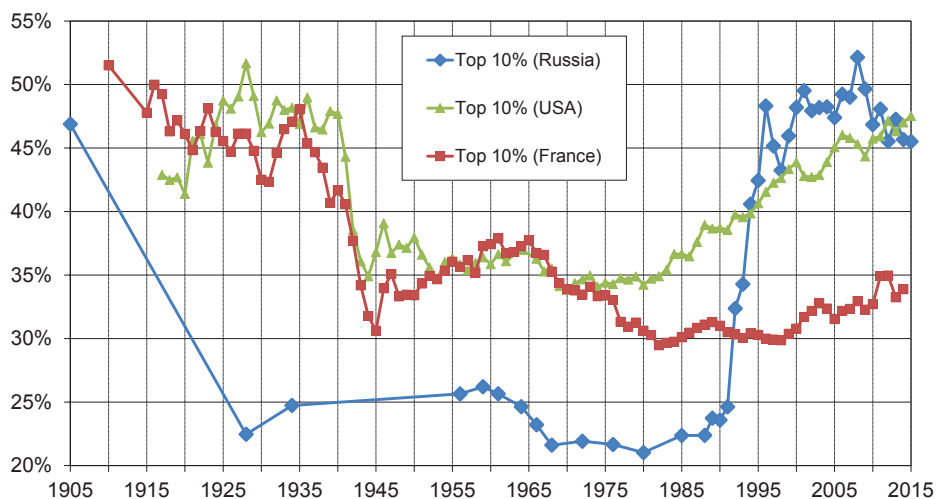


Figure 2. Top 10% income share: Russia vs USA and France*

* Distribution of pretax national income (before taxes and transfers, except pensions and unemployment insurance) among equal-split adults (income of married couples divided by two). Sources for USA and France: Wealth&Income Database (WID.world).

The share of the income of the richest 10% of Russians in 1905–1990 decreased from 45 to 25%, but between 1990 and 2015 it sharply increased (from 25 to 45%) and returned to the level of 1905. For comparison: during the period from 1910 to 2015, the share of income of the richest 10% in France declined from 52 to 33% in the USA – increased slightly (from 43 to 47%).

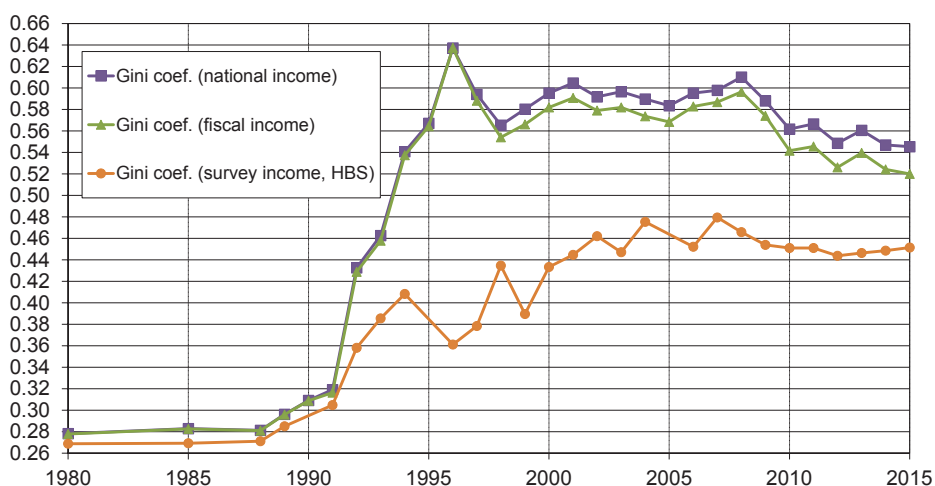


Figure 3. Gini coefficient in Russia, 1980–2015*

* Distribution of income (before taxes and transfers, except pensions and unemployment insurance) among equal-split adults (income of married couples divided by two). Pretax national income estimates combine survey, fiscal, wealth and national accounts data. Fiscal income estimates combine survey and income tax data (but do not use wealth data to allocate tax-exempt capital income). Survey income series solely use self-reported survey data (HBS).

The Gini coefficient, which indicates how the actual distribution of the total amount of incomes deviates from their even distribution, increased by 0.03 over the period from 1980 to 1990 (from 0.28 to 0.31; the value of the Gini coefficient can vary from 0 to 1, the higher the index value, the more unevenly the incomes are distributed). In 1990–2015, the Gini coefficient increased by 0.23 (from 0.31 to 0.54).

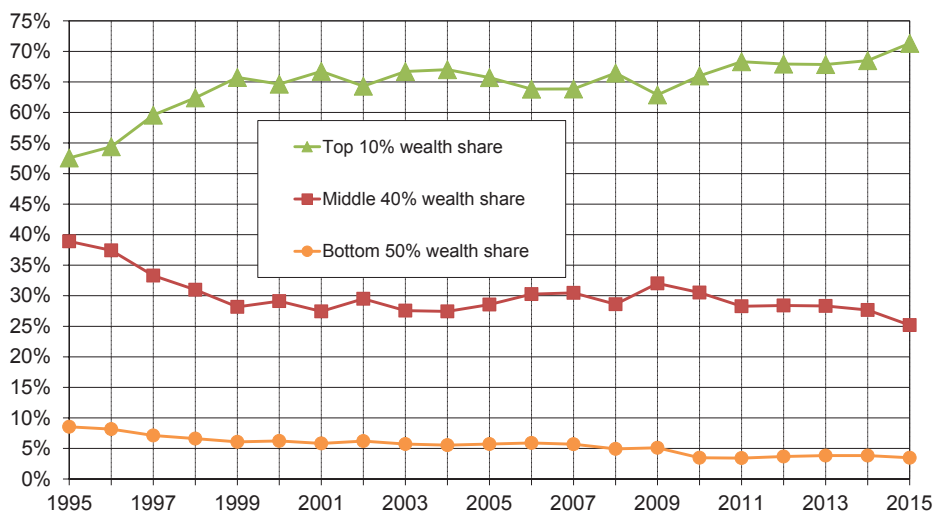


Figure 4. Wealth concentration in Russia, 1995–2015*

*Distribution of personal wealth among adults. Estimates obtained by combining Forbes billionaire data for Russia, generalized Pareto interpolation techniques and normalized WID (world wealth distributions).

Population of the Russian Federation over 20 years of age as of January 1, 2017, thousand people	Total population (100%)	10%	40%	50%
		114 566	11456.6	45826.4

Source: Calculated by the author with the use of the data of the Federal State Statistics Service (www.gks.ru).

An increase in inequality is evidenced by the dynamics of concentration of national wealth in different income groups. As of 2015, about 70% of Russia’s national wealth was concentrated in the hands of the wealthiest 10%, that is, approximately 11.5 million people (in 1995 they owned 50% of national wealth).

Forty percent of the population with average income (45.8 million people) own 25% of national wealth (in 1995, they owned 40% of national wealth).

The share of the 50% of those with a low income level (57.3 million people) accounts for less than 5% of national wealth (the figure was 10% in 1995).

Insert 2

Table 1. Corporate income tax burden* for major Russian companies

Company	2006		2016	
	Billion rub.	To the proceeds, %	Billion rub.	To the proceeds, %
Tatneft	13.7	3.4	34.8	6.0
NLMK	19.2	11.7	15.5	3.0
Sberbank	26.2	7.1	135.6	4.8
MMK	12.7	7.3	15.2	4.1
Transneft	26.0	12.8	68.5	8.1
Gazprom	211.2	8.5	288.0	4.7
Rosneft	125.4	10.0	116.0	2.3
Gazpromneft	32.4	5.9	49.8	3.2
Severstal	17.3	5.1	6.8	1.7
Lukoil	75.4	4.1	64.9	1.2
Average by ten major companies	56.0	7.6	79.5	3.9

* To ensure comparability, the tax burden has been calculated only for income tax.
Sources: companies' financial statements; VolRC RAS calculations.

Over the last 10 years (2006 to 2016) income tax burden on average for ten major companies in Russia declined from 7.6 to 3.9% of their proceeds.

Table 2. Dynamics of the dividends received from state corporations by the federal budget in 2008–2016

Indicators	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total for 2008–2016
Dividends, billion rub.	53.2	10.1	45.2	79.4	212.6	134.8	220.2	259.8	919.0	1934.3
To budget revenues, %	0.6	0.1	0.5	0.7	1.7	1.0	1.5	1.9	6.8	1.9

However, the proportion of dividends received from state corporations by the budget on average over the period from 2008 to 2016 amounted to only 1.9%. A noticeable growth of the indicator is observed only in 2016 (3.5-fold: from 1.9 to 6.8% compared to 2015).

Insert 3

Table 1. Net profit and dividends to major shareholders of iron and steel corporations in 2002–2016, billion rub.

Indicators		Average for 2002–2006	Average for 2007–2011	Average for 2012–2016
PAO Severstal (average proportion of shares is 81.5%)	Net profit	26.8	8.1	26.9
	Dividends	6.5	11.9	30.9
	% of net profit	24.3	146.9	114.9
PAO NLMK (average proportion of shares is 82.7%)	Net profit	34.6	40.6	22.9
	Dividends	8.5	9.0	20.2
	% of net profit	24.6	22.2	88.2
OAO MMK (average proportion of shares is 86.3%)	Net profit	24.8	22.4	9.6
	Dividends	11.7	3.9	7.2
	% of net profit	47.2	17.6	75.0

On average in 2012–2016, compared with 2002–2006, net profit of PAO Severstal has not changed (26.8–26.9 billion rub.); net profit of PAO NLMK and OAO MMK declined (for PAO NLMK – from 34.6 to 22.9 billion rub., for OAO MMK – from 24.8 to 7.2 billion rub.).

However, during the same period, the dividends to major shareholders of these iron and steel corporations have increased substantially: for PAO Severstal – from 24 to 115%; for PAO NLMK – from 25 to 88%; for OAO MMK – from 47 to 75%.

Table 2. Net profit and dividends to major shareholders of iron and steel corporations in 2007–2016, billion rub.

Indicators		Average for 2007–2011	Average for 2012–2016
PAO GMK Nor Nickel (average proportion of shares is 68.9%)	Net profit	80.9	90.0
	Dividends	23.2	80.6
	% of net profit	28.7	89.6
PAO RUSAL Bratsk (average proportion of shares is 100%)	Net profit	3.4	2.1
	Dividends	0.8	1.6
	% of net profit	24.1	76.2

In general, similar situation is observed in major iron and steel corporations. On average in 2012–2016, compared to 2007–2011, net profit of PAO GMK Nor Nickel increased by nine billion rub. (from 80.9 to 90 billion); net profit of PAO RUSAL Bratsk decreased by 1.3 billion rub. (from 3.4 to 2.1 billion).

During the same period, the dividends paid to major shareholders of PAO GMK Nor Nickel increased from 29 to 90% of profit; those paid to major shareholders of PAO RUSAL Bratsk increased from 24 to 76%.

Insert 4

Table 1. Dynamics of average monthly wages of workers and average monthly remuneration of executives of corporations in 2011–2016, thousand rub.

Indicators		2011	2012	2013	2014	2015	2016	2016 to 2011, %
PAO GMK Normickel PAO	Wages of workers	56	63	68.5	76	75	85	151.9
	Number of executives, people	20	19	24	26	27	27	135.0
	Remuneration	6015	12850	14253	6541	11433	12738	211.8
	To the wages of workers, times	107	204	208	86	152	150	+43
PAO RUSAL Bratsk	Wages of workers	No data	45	47	52	53.0	56	124.4
	Number of executives, people	No data	28	28	27	27	29	103.6
	Remuneration	No data	3391	4119	3924	3653	4640	136.8
	To the wages of workers, times	No data	75	87	75	69	83	+8
PAO Severstal	Wages of workers	34	39	47	53	54	61	179.4
	Number of executives, people	10	10	10	10	22	22	220.0
	Remuneration	8904	5417	6680	9563	37403**	36997**	415.5
	To the wages of workers, times	262	138	142	181	695	606	+344
OAO MMK	Wages of workers	40	43	46	47	52	55	137.5
	Number of executives, people	10	26	25	25	23	23	230.0
	Remuneration	434	1613	3879	1467	2827	2677	616.8
	To the wages of workers, times	11	37	85	31	55	49	+38
PAO NLMK	Wages of workers	35	39	43	48	52	58	165.7
	Number of executives, people	17	21	19	18	18	18	105.9
	Remuneration	2551	1600	2515	5363	7174	7464	292.6
	To the wages of workers, times	73	41	58	111	137	129	+56
PAO Gazprom	Wages of workers	77	79	90	94	106	114	148.0
	Number of executives, people	27	27	27	27	27	27	100.0
	Remuneration	5540	6574	9235	13559	14818	14491	261.6
	To the wages of workers, times	72	83	102	145	140	127	+55
PAO NK Rosneft	Wages of workers	44	51	60	65	70	75,5	116.2***
	Number of executives, people	12	19	21	20	18	14	116.7
	Remuneration	Data not available			17942	28337	31055	173.1***
	To the wages of workers, times	Data not available			276	405	411	+135***

* Monthly average remuneration per senior executive includes all types of remuneration, excluding dividends, including wages, bonuses, commissions, and reimbursement of expenses
** The growth in remuneration is due to the establishment of a management company.
*** 2016 compared to 2014.

In 2011, the average monthly remuneration of executives of major corporations in the tens and even hundreds of times exceeds the wages of employees: at PAO Gazprom – in 72 times; at PAO NLMK – in 73 times; at PAO Severstal – in 262 times; at PAO NK Rosneft (according to the data as of 2014) – in 276 times, etc.

By 2016, this indicator has significantly increased in all major corporations: at PAO Gazprom to 127 times; at PAO NLMK – 129 times; at PAO Severstal – 606 times; at PAO NK Rosneft – 411 times. **Moreover, in the majority of the corporations there has been an increase in the number of “recipients” of this remuneration:** for example, at PAO Severstal – from 10 to 22 people; at OAO MMK – from 10 to 23 people, etc.

Insert 5

Table 1. Dynamics of people’s per capita monetary incomes, fortune of owners of metallurgical corporations, and tax revenues of the budgets of Russian Federation constituent entities in 2012–2016 (in the prices as of 2016)

Indicators		2012	2013	2014	2015	2016	2016 compared to 2012, %
Vologda Oblast	People’s per capita monetary incomes, rub.	25036	26913	28273	28652	27379	109.4
	Fortune of the owner of PAO Severstal, billion rub.	528.1	479.4	1123.0	965.8	1000.1	189.6
	Tax revenues of the budget, billion rub.	55.1	50.9	52.8	48.7	51.9	94.2
Chelyabinsk Oblast	People’s per capita monetary incomes, rub.	26475	27863	28228	27527	23272	87.9
	Fortune of the owner of OAO MMK, billion rub.	168.7	121.0	297.2	336.7	474.4	281.2
	Tax revenues of the budget, billion rub.	129.8	129.5	131.6	133.2	131.1	101.0
Lipetsk Oblast	People’s per capita monetary incomes, rub.	27146	28955	31326	31012	28547	105.2
	Fortune of the owner of PAO NLMK, billion rub.	580.4	752.6	1002.0	824.8	920.1	158.5
	Tax revenues of the budget, billion rub.	46.6	46.5	50.8	51.7	48.4	103.9
Krasnoyarsk Krai	People’s per capita monetary incomes, rub.	29664	31128	29792	29975	28010	94.4
	Fortune of the owners of PAO GMK Normickel, billion rub.	902.9	830.1	1807.1	1242.5	1108.8	122.8
	Tax revenues of the budget, billion rub.	189.0	180.7	176.3	188.2	194.0	102.6
Irkutsk Oblast	People’s per capita monetary incomes, rub.	24057	24883	24875	25183	22017	91.5
	Fortune of the owner of PAO RUSAL Bratsk, billion rub.	345.1	289.8	531.2	186.4	291.5	84.5
	Tax revenues of the budget, billion rub.	146.1	134.0	133.5	116.1	128.5	88.0

*According to the Forbes Magazine methodology, the fortune of an entrepreneur includes the value of their assets: company shares, land, real estate, personal property, etc.
Source: Forbes Magazine. Available at: <http://www.forbes.ru/rating/bogateishie>

The maximum growth of people’s per capita incomes for the period from 2012 to 2016 is registered in the Vologda Oblast (by 9%), the maximum increase in tax revenues of the budget – in the Lipetsk Oblast (by 4%).

For comparison: during the same period, the fortune of the owners of major corporations located in these areas increased in 1.5–3 times: PAO Severstal – by 90%; OAO MMK – by 181%; PAO NLMK – by 59%; PAO GMK Normickel – by 23%.

Thus, the law is built so that the profit from the exploitation of national wealth goes to owners of corporations and is realized primarily in their private interests. As a result of this policy of “crony capitalism” that has taken root in the system of public administration, the number of dollar billionaires in Russia over the past 10 years increased by 60% and their wealth increased by 50% (Tab. 5).

However, the policy of “oligarchic capitalism” brings profit only to the people who create it and support it. So for about 30 years (1989–2016), **the growth of the aggregate real income of 50% of Russians with the lowest income (more than 57 million people) decreased by 20%**, and as for the 40% of those with average incomes

(almost 46 million people), it increased only by 15%. For comparison: the share of incomes of the richest 10% (11.5 million people) increased by 171%, that is, it almost doubled, and **the income level of 0.001% of the richest Russians (about 1,000 people) amounted to 4,122%, i.e. increased in almost 40 times** (Tab. 6).

In 1989–2016, the national average annual growth rate of people’s incomes amounted to 1.3%. At that, **57 million Russians face a decline in the growth rate of their income (-0.89%)**, and the richest 11.5 million people in the country experience an increase in their income by almost 4%; **among the 1,000 most wealthy Russian citizens, the growth rate of income in 1989–2016 amounted to 15%**.

Table 5. Changes in the wealth of Russia’s dollar billionaires

Year	Number of people	Fortune, billion US dollars	Fortune, billion rub.	On average per billionaire
2006	60	337.3	9168.4	152.8
2007	100	521.7	13343.5	133.4
2008	32	102.1	3553.1	111.0
2009	62	265.0	7983.0	128.8
2010	101	432.7	12660.1	125.3
2011	96	376.1	11240.6	117.1
2012	110	426.8	12835.0	116.7
2013	111	422.2	14689.3	132.3
2014	88	337.0	23476.8	266.8
2015	77	282.6	22357.7	290.4
2016	96	386.3	22077.3	230.0
2016 in % to 2006	160	114.5	241	150.5

Table 6. Growth of incomes and inequality in Russia (1989–2016 years), in %

Income group (distribution of per adult pre-tax national income)*	Number of people in the group as of January 1, 2017**, people	Average annual growth rate in 1989–2016	Aggregate real growth in 1989–2016
Total population	114566000	1.3	41
Bottom 50%	57283000	-0.89	-20
Middle 40%	45826400	0.5	15
Top 10%	11456600	3.8	171
Including Top 1%	1145660	6.4	429
Including Top 0.1%	114566	9.5	1054
Including Top 0.01%	11457	12.2	2134
Including Top 0.001%	1146	14.9	4122

* Distribution of pre-tax national income among equal-split adults. The unit is the adult individual (20-year-old and over; income of married couples is split into two). Fractiles are defined relative to the total number of adult individuals in the population. Corrected estimates (combining survey, fiscal, wealth and national accounts data).

** The population of the Russian Federation over 20 years of age was calculated by the author according to the data of the Federal State Statistics Service (www.gks.ru).

Source: Novokmet F., Piketty T., Zucman G. *From Soviets to Oligarchs: Inequality and Property in Russia, 1905-2016*. National Bureau of economic research. Cambridge, MA, August 2017. P. 78.

“Russians are sensitive to the inequalities that they face personally or see their existence in society. Income inequality is perceived most acutely today, and the sharpness of this inequality for the population has increased significantly during the crisis (which is not surprising, as income inequality in modern Russia defines a number of non-monetary inequalities that afflict today’s population, including the opportunity to receive necessary medical care)»¹⁰.

It should be noted that a high degree of social inequality is manifested in various spheres of life and goes far beyond financial well-being. Experts at the Institute of Sociology point out that “despite the fall in the real incomes of Russians due to the growth of prices in the past year, they began to note certain disparities as painful to society, rather than to themselves. This applies to all the inequalities they consider to be most common: inequalities in the access to healthcare and good jobs, inequalities in housing conditions, in opportunities for children from different social strata, in access to education... **High scores with which Russians estimate the severity of different types of inequalities currently existing in the Russian society are not detached from reality, but dictated by it**”¹¹.

As we can see from the data presented in *Tab. 7*, income inequality is perceived by Russians most acutely, but it is not the only issue that alarms them: other issues include the painful perception of inequalities in access to medical care, housing conditions, and good jobs. They are perceived as “painful to society” by 50–80% of Russians.

¹⁰ *Rossiiskoe obshchestvo: god v usloviyakh krizisa i sanktsii. Informatsionno-analiticheskii material po itogam obshcherossiiskogo sotsiologicheskogo issledovaniya* [The Russian society: a year in the conditions of crisis and sanctions. Information and analytical materials on the results of nationwide sociological research]. Moscow. Institut sotsiologii RAN, 2015. P. 32.

¹¹ *Ibidem*. Pp. 30-31.

Table 7. Perception of the acuteness of various inequalities by Russians, October 2015, %* (ranked by the inequalities painful personally for respondents)

Inequalities	Most painful for society in general	Most painful for oneself (for one’s family)
Incomes	82	66
Access to medical aid	59	39
Housing conditions	61	30
Access to good jobs	50	23
Opportunities for children from different social strata	31	18
Access to education	40	16
Leisure opportunities	14	12
Property ownership	18	12
Acquaintance with the people of influence	10	11
Getting to a necessary destination by public transport	8	10
Physical capabilities	7	9
Using computer and the Internet	3	3
<i>There are no such inequalities</i>	<i>3</i>	<i>9</i>

* The data show the situation concerning working Russians.
 Source: *Rossiiskoe obshchestvo: god v usloviyakh krizisa i sanktsii. Informatsionno-analiticheskii material po itogam obshcherossiiskogo sotsiologicheskogo issledovaniya* [The Russian society: a year in the conditions of crisis and sanctions. Information and analytical materials on the results of nationwide sociological research]. Moscow. Institut sotsiologii RAN, 2015. P. 31.

Thus, having analyzed the factual information obtained from various sources, we can conclude that the contours of a political system established by the ruling elite in the 1990s for the purpose of self-enrichment continue to prevail. With the fraudulently acquired capital, they were able to penetrate into the very depths of the political system of the country, thus forming a system of “capitalism for the few”, which “successfully” allows them to extort national wealth and use it for their own purposes. In other words, **the problem of social inequality in Russia remains unresolved not because there are some obstacles on the way to achieving this goal, but because the ruling elite does not set such a task in the first place.**

Deliberately ignoring social decrees of the President and the needs of the population, the financial and economic bloc of Russia's liberal Government creates favorable conditions for the enrichment of representatives of big business; as a result, by 2016, Russia has topped the ranking of countries by volume of "crony capital" (18%)¹².

There are a lot of representatives of economic science, who speak openly about the domination of oligarchic capitalism in Russia and warn about the disastrous consequences it may bring to our country (S.Yu. Glazyev, S.S. Gubanov, B.Yu. Titov, M.G. Delyagin, etc.). And it is not only about a threat to social stability, but also about the gap between key participants of the geopolitical competition. History has many examples of how this factor became crucial for the collapse of Russian statehood: **such critical backwardness in scientific, technological and socio-economic development was the prerequisite for the fact that the West actually financed the Revolution in 1917 and the collapse of the Soviet Union in 1991. And both these "projects", in fact, turned out to be quite successful for the West...**

In March 2012, on the eve of Vladimir Putin's third presidential term we paid attention¹³ to his call to **"turn the page", to "end the phase" and "settle the matters"** of the 1990s, when **"business was often reduced to a simple division of the state pie"**.

¹² The rating is based on the results of studies conducted in 22 countries. The top five countries in the rating include Malaysia (13%), the Philippines and Singapore (11% for each). At the bottom of the rating are South Korea, Poland and Germany (less than 1%). The Crony-capitalism Index is compiled by the journal *Economist*. The authors of the rating estimate the total wealth of billionaires whose business lies mainly in industries prone to monopolization, state regulation and state participation (gambling, oil and gas, and defense sectors, coal industry and metallurgy, real estate and construction, infrastructure projects, and banking), and compare it with the country's GDP (Source: Crony capitalism is mostly legal, but it is always unfair (editorial). *Newspaper "Vedomosti"*, 2016, May 9).

¹³ Ilyin V.A. K itogam politicheskogo tsikla [To the political cycle results]. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz* [Economic and social changes: facts, trends, forecast], 2012, no. 1 (19), p. 13.

B.Yu. Titov: "Now the World Bank estimates the growth opportunities of the Russian economy at 1.2% up to 2025. Our government's assessments are the same. We believe that the Russian economy cannot develop with the rate of 1% of GDP per year when the average global economic growth is 3%. If we don't have a 4–6% growth, then Russia will experience further stagnation and move to the second, and then the third tier of countries according to its economic indicators... A growth rate that is less than 2–3% means that Russia may forever lag behind leading countries of the world, since the 1% growth of GDP at purchasing power parity (PPP) in China is 197 billion US dollars, in Russia – 37 billion US dollars. This means that 1% growth in China is 5.3% growth in Russia. We believe that in 2019, this growth should be 3.5–5%. The growth of 4–6% should be maintained until 2025. Then it may slightly decrease by 2035 – to 3–3.5%"¹⁴.

- "...Concerning what happened in the 1990s. We talked a lot on this subject, when the business was often reduced to a simple division of the state pie";

- "...We, of course, must turn over this page, as well... We need to close this period. Different options are offered, it is necessary to discuss them with society and with the expert community, but it is necessary that society should approve these options of settling the issues of the 1990s such as, frankly speaking, a dishonest privatization, and various auctions";

- "...It is necessary to provide public legitimacy of the very institution of private property, to ensure public trust in business; otherwise we will not be able to develop a modern market economy, nor can we create a healthy civil society... major decisions should be taken in 2012"¹⁵.

Moreover, Vladimir Putin stressed that "the main decisions about this should be taken as early as 2012"¹⁶.

¹⁴ The implementation of "Growth Strategy" will allow Russia to double its GDP by 2035: an interview with B.Yu. Titov (February 20, 2017). *Official website of the Stolypin Club*. Available at: <http://stolypinsky.club/2017/02/20/boris-titov-realizatsiya-strategii-rosta-pozvolit-rossii-k-2035-godu-udvoit-obem-vvp/>

¹⁵ Vladimir Putin's speech at the Congress of the Russian Union of Industrialists and Entrepreneurs on February 9, 2012.

¹⁶ Ibidem.

Almost six years passed since that time. V. Putin’s third presidency is coming to an end. However, it is premature to speak about any tangible signs of overcoming the “oligarchic capitalism” and its consequences. And this cannot but raise the questions: what next? What are we to expect from the next presidential term of Vladimir Putin, whose victory in the 2018 election is predicted by the majority of experts? Will he manage to reorient the country’s political system so that key issues of national security and national development took priority over the interests of “oligarchic capitalism” in the value system of the ruling elite? And will he be able to do so in an evolutionary way, not allowing a crisis of Russian statehood to break out? Will Russia be able, in the end, during the next six years to take the next step in its historical development, which is essential for maintaining its national security in the context of rapid progress?..

The questions are numerous, and the answers to them will be received, probably, in the nearest six-year period (which will be the last presidential term of Vladimir Putin, according to the Constitution of the Russian Federation). The solution to these issues will depend on **an integrated approach to improving the efficiency of public administration and on the political will of the head of state**, because the fusion of the interests of the political elite and oligarchy exists at all levels of the administration system, and this situation impedes the implementation of national interests, and this problem cannot be overcome without making tough internal policy decisions. It is important

that awareness of the problem of “oligarchic capitalism” and its negative consequences for the country should be a priority in the Program of action of the President for the near six-year term and that the general population should see that this Program is implemented on a system basis, that is, year by year, consistently, no matter what external or internal circumstances may be.

In conclusion, we should note that the President has the powerful resource that has more than once played a crucial role in Russia’s history: this resource is the trust of the population. However, like any other resource, the support that people show toward the head of state is not unlimited: it depends on how the key needs of the population are reflected in legislation and in administrative decisions of the authorities. According to the latest nationwide sociological research¹⁷, in society there is a growing need for change. The value of stability is increasingly giving way to the values of development. It is possible to realize this demand only if there is an effective system of public administration aimed to implement national interests; therefore, overcoming of “crony capitalism” is the main condition for Russia’s transition to a new stage of its historical development.

¹⁷ According to the Institute of Sociology, for the period from 2014 to 2017, the share of Russians who believe that “the country needs changes; it needs new reforms in the economic and political life” increased by 14 p.p. (from 30 to 44%). The proportion of people who believe that “the country needs stability; it is more important than change” decreased by 14 p.p. (from 70 to 56%). Source: Solov’eva O. People are tired of stability. *Nezavisimaya Gazeta*, 2017, July 13. Available at: http://www.ng.ru/economics/2017-07-13/4_7028_people.html

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Centralization and Autonomation as the Drivers of Socio-Economic Development of the Russian Far East*



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Abstract. The article considers macroeconomic trends in the development of the economic complex in the Russian Far East. We explore the interaction of dynamic and structural parameters of reproduction and the specifics and regularities of promising modernization in the region. We analyze how the regional economy responds to various types of institutional impacts, and study the features of regional governmental economic policy in the east of the Russian Federation. We consider trends in external and internal impacts of economic, institutional, military and political nature. We describe formation regularities and assess sustainability trends. The aim of our research is to find the answer to the question about the possibilities and ways of transforming the socio-economic system of the Far East in accordance with the current

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national geo-economic paradigm. We prove that the best results in the development of the Far East were achieved in those periods when non-economic goals of the state were combined with the use of centralized material and financial resources of the state for the purpose of generating intra-regional economic and financial resources based on the support provided by government to the institutional environment that should be as comfortable as possible for the formation of endogenous reproduction within the region. We confirm a hypothesis that we have previously formulated in our joint publications; the hypothesis is that the periods when the state was pursuing exclusively “colonial” goals of getting the maximum possible utility from the region at a minimal support at the expense of governmental resources of endogenous drivers of development were the least successful from the point of view of maintaining stable socio-economic dynamics in the region. We discuss the correlation between endogenous and cumulative regional economic growth in conditions when the importance of institutional framework generated at both federal and regional levels is increasing. We show that the modern period of institutional innovations in the field of regional economic development has the following specific feature: it combines “colonial” exploitation of transit and natural resource utilities of the region with the restoration of creating a diversified economic complex. The analysis of development trends in the region over the past 10 years shows that centralized financial resources are being substituted with institutional incentives; this may lead to an increase in the terms of building the capacity for endogenous development of the region’s economy and make its results less predictable.

Key words: Far East, macroeconomic trends, institutions, autonomation, integration, economic growth, development, East Asia.

Introduction

In 2013, accelerated development of the Russian Far East was proclaimed a national priority for the whole 21st century¹. In 2012, Vladivostok hosted the APEC summit, which was held in Russia for the first time after its accession to this international organization in 1988. The events were preceded by another reconsideration of the geo-economic positioning of Russia in 2007–2012, which resulted in a shift of strategic focus in the development of economic interactions from the Atlantic to the Pacific direction.

In a sense, this reconsideration is a unique phenomenon in Russian economic history.

Naturally, for almost a century and a half-long history of colonization and development

of the Far East, excluding the period of 1930–1960, neighboring countries of Northeast Asia were priority partners and the sources of resources for the development of the Russian Far East. And in certain periods (1922–1928 and 1991–2000), the markets of Northeast Asia and the profit obtained through trading with them were the only factors that preserved the integrity of the region’s socio-economic system [4].

However, the eastern priority applied only to the Far Eastern economic region. The “pivot” to the East for the entire national economy² has been marked for the first time. And this means changing the role of the Far East itself as a spatial “macroeconomic agent” of the national economy. If earlier the region was *de facto*, in terms of national economic

¹ Address of the President of the Russian Federation to the Federal Assembly, December 12, 2013. Available at: http://www.consultant.ru/document/cons_doc_LAW_155646/

² Probably, the decision of the Security Council of the Russian Federation adopted in 2006 can be considered as the starting point (see, for example [12, pp. 17-25]).

development strategy, a relatively autonomous economic subject, which in varying degrees was supported by the metropolis in the resource and institutional aspect, then now it is a priority subject in national socio-economic dynamics, and the functioning of this subject should ensure the achievement of strategic goals of the national economy.

The economic complex of the region has been formed as a result of interaction of various trends and external and internal impacts of economic, institutional, military and political nature. The present paper is devoted to the description of regularities in the formation of these trends and estimation of their stability; the goal of the paper is to answer the question about the possibilities of its transformation in accordance with a new geo-economic paradigm; another goal is to evaluate critical points of application of management actions to achieve the changes desired.

Many research works study the development of the Far East at certain stages and under different institutional modes of operation; the works analyze the regional economy and its interaction with national and international economic space. In the Soviet period of the history of economic thought, the main attention of researchers was drawn to the problem of finding a rational concept for the development of the region and to the issues of optimal allocation of the productive forces, distribution and efficient use of economic resources.

Researchers N.N. Kolosovskii [8], A.N. Gladyshev [3], B.F. Shapalin [3] F.F. D'yakonov [6], and V.S. Nemchinov [17] formulated the basic provisions of the concept for development of the Far East in the framework of the common national economic complex of the USSR taking into consideration limited trade integration with the countries of Northeast Asia,

primarily Japan, that started in the 1960s. V.S. Nemchinov's concept of plurality of markets was the most advanced from the point of view of today's ideas about the integration of the region and the country in global markets.

Researchers A.G. Granberg [5] and P.A. Minakir [15] continued these studies in the post-Soviet period; they focused on modifying the institutional environment and changes in the priorities of governmental regional policy. Particularly intensive studies of the transition period in the economy of the Far East were held in the 1990s [22; 23; 24]. Scientific literature paid great attention to the issues of foreign trade and overall foreign economic specialization of the Far East, to the problems of its economic and institutional integration with the Asia-Pacific region and Northeast Asia. Various aspects of these issues were addressed in the research works by N.L. Shlyk [21], V.S. Nemchinov [17], P.A. Minakir [15; 16], J. Stephan [29], C. Davis [26], and N. Lynn [28].

These and other problematic issues including the location of production and its specialization, spatial distribution of production factors, territorial organization of the productive forces in the Far East, are examined in this article from the aspect of analyzing temporal patterns of formation and development of the region's economic complex that explain its dynamic and structural features and prospective responses to various innovations in the field of governmental economic policy.

Stages in the formation of the regional economic system.

The beginning of colonization. 1860–1913.

Intensive economic development of the Far East began at the end of the 19th century, when the construction of the Trans-Siberian Railway

was launched. However, the history of economic development of the region began much earlier, almost immediately after the accession of Priamurye and the Ussuri region to the Russian Empire [1; 29, pp. 21-56]. The prime goal of building the region's economic potential was a non-economic one: it was the establishment of a Russian military base in the Pacific area. Governmental policy of the time was focused on national expediency, rather than economic efficiency.

Already in 1861, the imperial government introduced special rules for migrants who settled in the Far East; the rules included the provision of tax and land benefits. Since 1881, new preferential rules were introduced. As a result, for the period from 1861 to 1890, about a million people moved to the Far East from the European part of Russia. This created labor potential that formed the basis of the future economic growth [9, p. 39].

Agriculture was the first sector to be developed in the region, and the degree of its marketability increased almost fivefold by 1902; it was followed by the food industry, construction materials industry, production of fur, fish and sea mammals.

By 1905, nearly 25% of all mined gold in Russia was produced in the Far East [2, pp. 46-64]. Coal production increased fivefold in 1894–1903 (from 16 to 80 thousand tons). In the early 20th century, there began the exploration drilling to tap oil, and the exploration of non-ferrous metals deposits. At the time, the markets of the European part of Russia were geographically inaccessible; as a result, economic turnover of the Far East relied heavily on foreign markets. This was facilitated by the right to free trade of foreign goods granted in 1860 to the ports of Primorsky region.

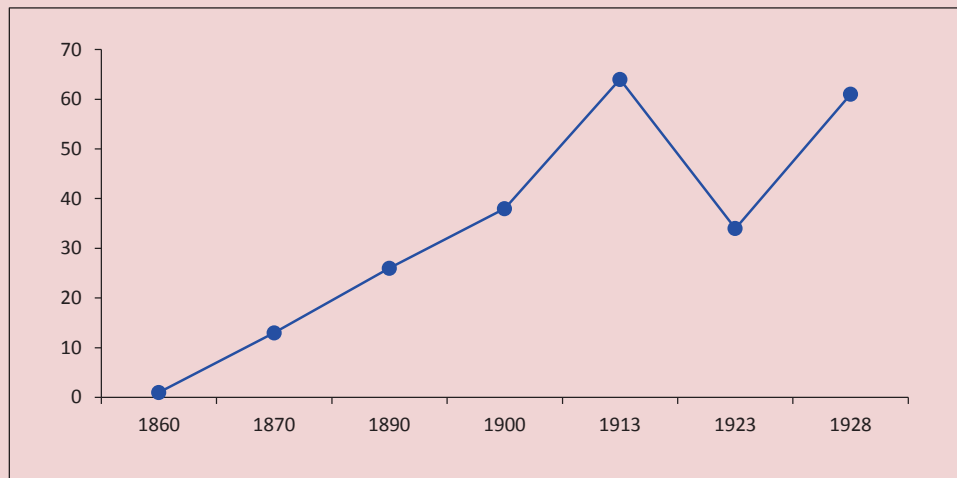
The construction of the Ussuri Railway, economic growth in Russia (1907–1913) and proactive governmental policy gave a powerful impetus to economic development in the Far East. State resources were allocated in direct and indirect form (subsidies, reduced transport tariffs, provision of support to settlers, etc.). At the same time, the economic complex of the region, with the exception of state-owned enterprises satisfying the needs of the army and navy, operated autonomously on the basis of market principles and criteria. Economically, the region was fully opened, economic barriers in the western direction were alleviated with the help of state protectionist policy. As for the barriers to external communications with the Asia-Pacific Region, they were simply nonexistent. In 1913, foreign trade turnover of the Far East was more than 98 million rubles in gold, of which imports accounted for more than 76% (or over 75 million rubles in gold) [9, p. 143]. Workforce was largely formed by legal and illegal immigrants from China.

As a result of the concentration of capital, including foreign capital, in the leading industries (gold and coal mining, fishery), as well as due to rapid development of trade, there was an increase in the income generated and in the total number of jobs in the region by the beginning of the First World War. In 1900–1913, the volume of industrial production in the Far East increased by almost 70%.

War economy. 1914–1922.

With the beginning of the First World War, the situation changed. State support was continuously decreasing and almost stopped since 1917. This led to a nearly complete decline of industry in the Far East, the industry which was to concentrate exclusively on the criteria of economic efficiency, from the point of view of which the region was far from leading

Figure 1. Changes in the volume of industrial production in the Far East, million rubles (in comparable prices as of 1926)



Source: Archival materials on the regional economic plan of the Far East ("Dal'kraiplan"). Khabarovsk. 1938. # 51. Sheet 2.

positions not only in Russia, but also in Siberia: it had the lowest concentration of production and, consequently, the lowest productivity [15, p. 140].

The scale of economic activities had to be matched with the changed conditions of functioning "on one's own basis". The gold industry found itself in a difficult situation. By the end of 1922, gold mining was only about 10% of the prewar level. Commercial production of tungsten, tin, and limestone stopped. The carrying capacity of the railways decreased more than fivefold.

The established economic relations of the Far East were almost completely disrupted, both within Russia and with Asian countries. The economic cycle was limited to the regional market. By 1922, industrial output in the region decreased by 47% in comparison with 1913 (Fig. 1).

Due to the critical importance of external economic resources at that time, that period can be defined as "negative colonization": the

country invested its income in the region rather than sought to extract additional income from it. This can be interpreted as investments in future profits, but from the point of view of the region itself, it was the recipient of the country's income.

Economic recovery (1923–1932).

The Center did not render any significant assistance to the Far Eastern region during that period. The region could rely only on its own resources. Regional planning and management authorities received broad powers, including the power to handle financial issues of capital construction and prospective development strategy. This helped concentrate resources in the most important and most promising areas (fish, forestry, gold mining) [16, p. 56]. In fact, in this period, a concept for planned management of the economy of the Far East was formulated which was implemented in the following 50 years. The essence of the concept consisted in concentrating limited resources in the sectors of specialization with simultaneous

unconditional minimization of current and non-recurring costs in almost all the other economic sectors of the region [15, p. 144].

The concept was successful in the actual situation of the 1920s. In 1923–1928, the economy of the region received nearly one billion rubles of investments mainly from intraregional sources. Almost 15% of the total amount of investments was financed by a surplus of foreign trade, the cost of which was about 7% of the gross output of the region. The export quota reached 24% in the forest industry, 23.7% in the coal industry, and 7.4% in the fishing industry [16, p. 59].

By 1928, the economy of the Far Eastern Republic was largely rebuilt, new industries – petroleum and cement – emerged, and the gross industrial output of the Far East amounted to 95.3% from the level of 1913³. While in general, the region's economy remained predominantly agrarian. Only 9% of the population was employed in industry, and the value of agricultural products accounted for nearly 70% of the entire gross domestic product of the region.

Since 1928, the automation of economic life in the Far East gave way to integration into the national reproductive process. It was facilitated by changes in the national military and political priorities. Given the importance of the economic potential in terms of potential remoteness of the Far Eastern theater of military action from the European part of the USSR, a decision was made to accelerate the creation of economic potential that would be relatively autonomous in its main production elements in the Far East. Accordingly, the scale and source of resources for accumulation changed fundamentally.

³ Archival materials on the regional economic plan of the Far East (“Dal’kraiplan”). Khabarovsk. 1938. # 51. Sheet 2.

As a result, in 1928–1932, additional investments allowed the volume of production in the heavy and extractive industries to be increased fourfold and the production of consumer goods – by 1.9%. Exports presented a significant share of total production: 24% – in the forest industry, 23.7% – in the coal industry, and 7.4% – in the fishing industry.

The Far East was turning from an agrarian into an industrial region.

Industrialization and the war economy. 1933–1945.

Since 1930, the economic barrier between the Far East and the “continental” Russia almost disappeared. Subsidies from the state budget compensated for increased transportation costs, costs of labor and energy. However, there emerged a political barrier on the eastern borders of the region, which led to a complete reorientation of the Far Eastern economy toward hinterland regions of the USSR. After 1933, centralized capital investment was pumped into the economy of the Far East. In 1933–1940, 10.2 billion rubles was invested in the economy of the region [20, p. 73]. The share of the Far East in the country's capital investment rose from 0.8% in 1924–1927 to 6.3% in 1932–1937, and to 7.5% in 1938–1940. Only the Central and the Ural economic areas had the share exceeding that of the Far East [20, p. 73]. Over 100 industrial sites in Komsomolsk-on-Amur, Khabarovsk, Vladivostok, and Blagoveshchensk were built and renovated. The strongest gold and tin industries in the Soviet Union were created in the Magadan Oblast and in Yakutia [15, pp. 160-161].

By 1940, gross industrial output of the USSR increased in 8.5 times in comparison with 1913, and in the Far East – in more than 15 times. Coal production grew in 19.3 times,

reaching 7.2 million tons by 1940 (in the whole Soviet Union, the growth was in 5.7 times), which allowed the country to abandon coal imports. Tree hauling in the region reached 15.8 million cubic meters by 1940, having increased in 4.6 times in comparison with 1928 and in 5.5 times in comparison with 1913 [15, p. 165]. By 1938, the Far East has turned into an industrial region, the share of agriculture in the total product of industry and agriculture fell from 68% in 1913 to 19.6% in 1937 [20, pp. 76-87].

Despite the war, the economy of the Far East continued to develop. By 1950, industrial output increased by 63% in comparison with 1940. The monotony of economic growth reflected the fundamental effect of centralization of resource allocation and the priority of non-profit and non-economic allocation criteria.

The Far East was not the main region to which the industrial potential of the USSR was evacuated during the war. However, several industrial enterprises from central regions of Russia and Ukraine were moved there. Industrial and infrastructure construction continued during the war; the region's share in the capital investment in the 1940s was 7.8% of all capital investments of the USSR, which was higher than in the 1930s [3, p. 31].

The beginning of stagnation. 1946–1964.

The necessity of rebuilding the Soviet economy after the war demanded the concentration of all available resources in the Western regions of the country. The region's share in the federal investment declined, and it was impossible to mobilize missing accumulation resources within the region at that stage, because the scale of the Far Eastern economy and the needed amount of investment increased dramatically. The Far East for a time lost its status of a priority region from the

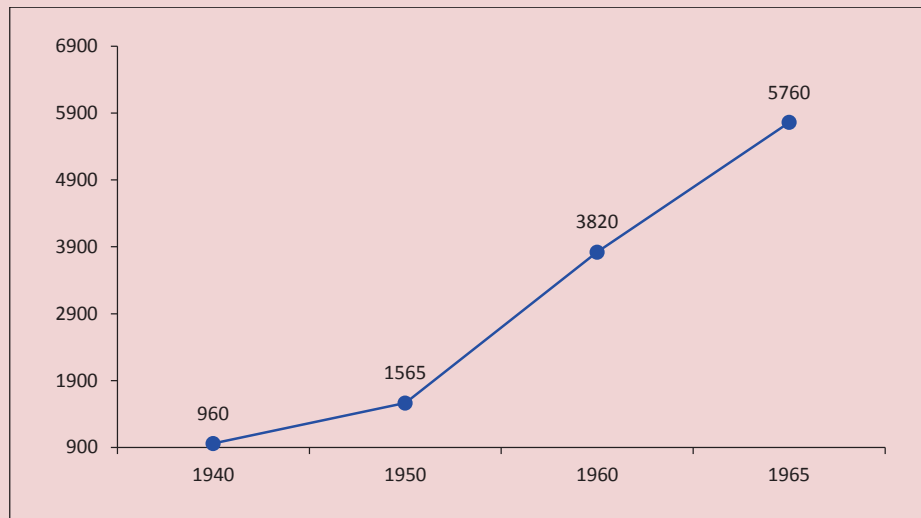
military-political point of view, which meant the need to engage in interregional competition for centralized accumulation resources. Such competition occurred on the basis of economic criteria, according to which the majority of economic sectors in the region lagged behind those in the Siberian and European regions.

Due to the fact that fixed capital in the industries, the investment in which in the 1930s–1940s was carried out at an accelerated pace, was relatively new, and the high level of capacity utilization was widespread in the Soviet economy, the region's economy was able to continue to grow rapidly (*Fig. 2*), maintaining high average annual growth rates of its industrial production (9%).

But the pace of development in the Far East began to slow down and became lower than national average in the industry of the USSR (12.3% per year), which led to the Far Eastern dynamics lagging behind (in 1945–1964, the growth of industrial output in the Far East amounted to 600% vs 723% in the Soviet Union on the whole [13, p. 53]), which was contrary to the accepted regional development concept, involving the accelerated development of its economy.

An economic reform that was being prepared could reinforce the trend, since the reform envisaged a large-scale implementation of cost accounting principles in the allocation of resources, including the allocation of resources with regard to spatial planning, as well. It would pose a major challenge for the development of regional integration and subsidiary industries, for which the performance indicators limited the possibilities of development, given the narrowness of the domestic market. At the same time, the lag in the development of these industries could block the development of the entire economic complex.

Figure 2. Dynamics of gross industrial output in 1950–1965, million rubles (in comparable prices as of 1926)



Based on: [3, p. 31; 20, pp. 76-87].

Under the circumstances it became necessary to adjust the overall regional development concept through export-oriented production [17, pp. 3-15]. By the end of the 1950s, the focus on foreign trade was already quite evident. The volume of foreign trade turnover in the region increased in 15.5 times in comparison with 1938 [11, p. 13]. Since 1964, the concept received political interpretation. Long-term compensation agreements on the development of forest resources, coal, and natural gas were signed with Japan; according to the agreements these industries could obtain loans from Japan for fixed and working capital with the payment being made with finished products of these industries.

Five-year plans between the reforms. 1965–1991.

Since the mid 1960s, there was another change in the economic situation in the Far East economy, which by this time was already rigidly connected to the national economic complex of the USSR.

First, the plans to increase the efficiency of production by implementing the principles of cost accounting in the assessment of enterprise performance did not and resource allocation system did not work out; and an extensive way of development became the defining strategy for the Soviet economy. It meant an increase in resource intensity of output growth and, therefore, an increase in the evaluations of the usefulness of the branches of specialization of the Far East to the national economy. The Far East started to attract the attention of the central government as a new source of raw materials for some industries.

Second, the military-political situation in the Far East became more acute once again, due to tense relations with China.

The circumstances led to the adoption of special decrees by the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR (1967, 1972); the decrees provided for the allocation of additional public investment to the

development of the regional economy, construction of new industrial facilities, development of the raw materials base, energy, and defense industries. The share of the Far East in national investment began to increase and reached 7.1–7.4% in 1965–1975. Regarding the acceleration of growth rates this impulse did not have a significant positive effect (Tab. 1). The fact that the region's growth rates were above national average was a small solace in the background of general decline in growth rates.

Growth rate was falling not only in industry in general, but in the industries that were most efficient and privileged from the viewpoint of obtaining resources in connection with the exhaustion of cheap sources of raw materials and slow introduction of new equipment and technologies. The lack of accumulation resources to provide for retired raw materials extraction capacities became even more pronounced.

In 1986–1987, an attempt was made to enhance the effect of using foreign markets for the region's development. Mikhail Gorbachev declared the beginning of the turn of Soviet foreign and economic policy toward the Pacific region. A long-term state program for economic and social development of the Far Eastern economic region and the Transbaikal region for the period until 2000 was adopted in September 1987 and proclaimed a new era for the Far East.

From the very beginning, the proclaimed goal of creating an economic complex that

would be competitive in the international market economy was at variance with the program provisions concerning the common tasks of system-wide integration of regional economy in national economy with the help of centralized capital investments. In 1986–1990, 51.5 billion rubles (7.6% of Russia's aggregate national investments) was allocated to the Far East. It was quite comparable with the scale of investment in the development of the Far East in the period of industrialization. However, the program failed to change the inertia of the development. There existed neither the tools, nor ideology for an investment maneuver implemented for the purpose of upgrading the quality of the regional economy. The predominantly extensive development with limited resources led to further deceleration in growth, the increase in disparities reflect the system's regional and national issues. However, it was structural problems that are not directly testified to, and did not anticipate the ensuing systemic crisis.

However, in 1987–1991, the economy of the Far East, being part of the national market and receiving government support, was gradually transformed into a marginal and relatively autonomous system with uncompetitive production, low export potential (including the export to domestic markets of other regions), and high dependence on imports. The transformation was actually completed in 1991 in the form of collapse of economic relations, which put the regional economy on the brink of disaster.

Table 1. Average annual growth rate of industrial production, %

	1965-1970	1971-1975	1976-1980	1981-1985	1986-1990
USSR	8.3	7.3	4.1	3.4	2.5
Far East	8.3	7.0	3.6	3.7	2.8

Sources: *Narodnoe khozyaistvo RSFSR v 1975 g.* [Economy of the USSR in 1975]. Moscow, 1976; *Ekonomiko-statisticheskii spravochnik DVER* [Economic and statistics reference book of the Far Eastern economic region]. Khabarovsk – IEI DVO RAN, 1992.

Transformational crisis and economic recovery. 1992–2007.

The transformation of the principle of “economic feasibility” as a criterion for interregional resource allocation and markets into the principle of interregional competition based on comparative parameters of production costs and investment expectations turned out to be devastating for the Far East of Russia, for which (see above) for almost 100 years, the allocation of resources had been based on non-economic criteria, and the only form of competition had been the competition for centralized “funds” (material, food, financial, etc.). In 1992–2007, the economy of the Far East went through a sharp downturn (1992–1994) and depressive stabilization (1995–1998) to economic recovery (1999–2007) (Fig. 3). The Far East economy passed the lowest point in the crisis only in 1999. But the very period of transformational recession was not homogeneous.

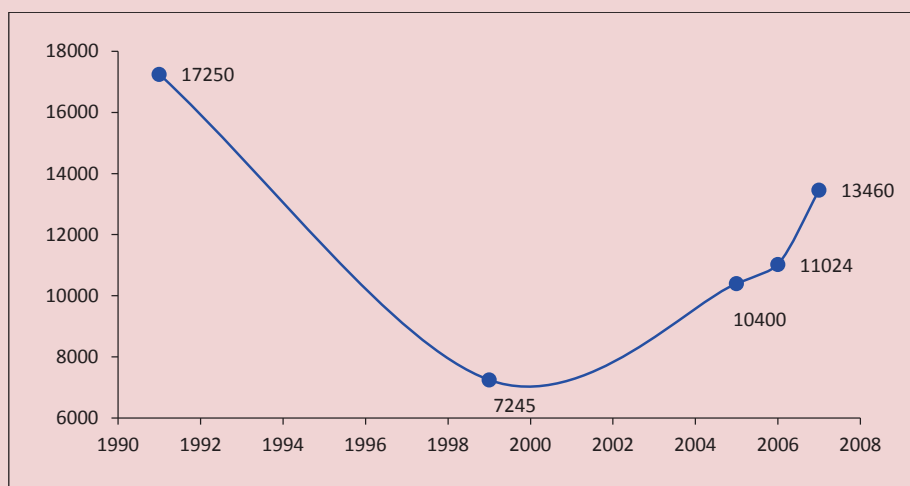
Since the beginning of the reform there was no catastrophic collapse of the regional economy in terms of collapse of economic ties with the subsequent collapse of production and social systems. At the very beginning of the reforms (1992–1993), there were factors that supported the economy of the region.

First, the trend of priority development of the commodity sector, traditionally viewed as a negative trend, became positive under the new conditions, albeit for a short time. The raw materials sectors that defined industrial dynamics in the region, continued to receive state support for some time.

Secondly, the revenues from foreign trade that had been previously accumulated exclusively in the state budget started to come on the balance sheets of Far Eastern exporters, which compensated for the reduction in domestic demand and income.

These circumstances helped mitigate the manifestation of shock in the industrial

Figure 3. Dynamics of industrial production, million rubles, prices as of 1926



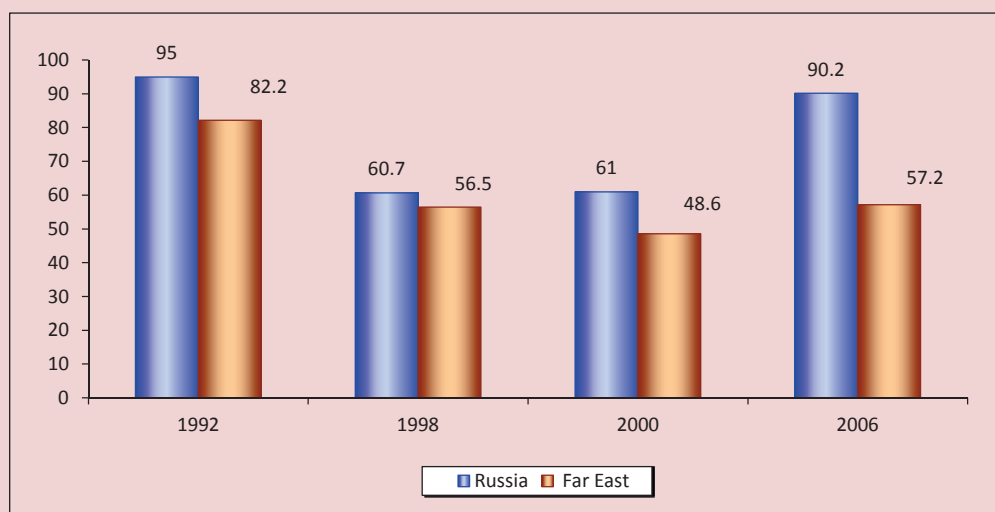
Sources: *Rossiiskii statisticheskii ezhegodnik: stat. sb.* [Russian statistical yearbook: statistics collection]. Moscow: Goskomstat Rossii, 1998. 813 p.; *Rossiiskii statisticheskii ezhegodnik: stat. sb.* [Russian statistical yearbook: statistics collection]. Moscow: Goskomstat Rossii, 2006. 750 p.

production in the region compared with the situation in Russia in 1992–1993 (25.2% against 29.5% in Russia on the whole in 1992–1993); but in general, the regional economy was unable to replace the lost external (centralized) compensators with intra-regional or foreign economic ones, which resulted in a rapid formation of “dynamic scissors”, and in the region’s economy lagging behind national average (*Fig. 4*). In 1996, a “presidential” program for socio-economic development of the Far East until 2005 was adopted; it declared the restoration of state support for the development of the region at the expense of the federal budget, that is, the transition to a policy of maintaining cumulative economic growth. But the program could not amend the situation, and actual possibilities of the federal budget were greatly exaggerated. It became virtually impossible to overcome the transport and energy barriers and carry out structural modernization and major changes

in the migration situation, even without the subsequent 1998 financial crisis, which actually annulled this program.

During the entire period after 1992, the region actually functioned in conditions of competitive interregional allocation of resources, which meant that the Far East would invariably lose, since its economic agents, as shown above, had no comparative economic advantages. Moreover, even the then level of state support for regions in reality resulted in a comparative loss of the Far East, because governmental policy was also based on the principles of comparative effectiveness of the spatial distribution of resources, which was obviously higher in regions possessing the initial economic advantage, and the Far East was not among them. As a result, state distribution only aggravated the relative economic depression of the region in full accordance with the concept of the so-called cumulative causation [27].

Figure 4. Dynamics of GDP/GRP, %, 1991=100



Sources: *Rossiiskii statisticheskii ezhegodnik: stat. sb.* [Russian statistical yearbook: statistics collection]. Moscow: Goskomstat Rossii, 2006. 750 p.; *Rossiiskii statisticheskii ezhegodnik: stat. sb.* [Russian statistical yearbook: statistics collection]. Moscow: Goskomstat Rossii, 2008. 847 p.

In those conditions, economic growth in the region could only be predominantly endogenous in nature, based mainly on the accumulated inertia of the productive and social capacities created previously and on the income generated by export industries (forestry, mining, fishing, metallurgy).

By 1998, the region's economic development reached its lowest point: the volume of gross regional product reduced by 44%; the volume of industrial production decreased by more than 50%; investment in fixed capital decreased by more than 70%.

Slow recovery of the regional economy began only in 1999 through the strengthening of the ruble after the devaluation following the 1998 crisis, and a stimulating role that export played in the Russian Far Eastern economy. The value of exports from the region in 1991–2007 increased more than fivefold. Growing export incomes acted as a compensator for reducing interregional demand in the 1990s and as a factor in increasing the aggregate demand since 1999. It was largely facilitated by modernization of the “export core”, the group of specialization sectors that provided the bulk of regional exports. Since 2004, export deliveries of oil and gas from offshore fields of Sakhalin began, and by 2008, oil production has increased compared to 2000 in 3.6 times, and gas production increased in 2.7 times. It radically changed the structure of exports in the region. If in 1992, the export of oil and oil products was 4.1% of total exports, then in 2004, it was 33.6%, and in 2008 – 49.8% [13, p. 97].

It did not change the fact that the Far East had no support from the economic growth factors that were crucial for the Russian economy in that period; the factors included the rapid growth of income from hydrocarbon

exports and the increase in domestic final demand as a result of aggregate income growth. The first factor emerged too late; besides, there was a very low level of localization of that part of income from exports, which remained after deduction of compensation under the agreement with the foreign investors of payments. The second factor was blocked by the fact that the region itself lacked the production and services of final consumption, which could perceive the impetus from the incomes.

However, in this period, favorable conditions began to be formed for the promotion of endogenous factors in economic growth due to the increased rate of investment in fixed assets mainly in two areas – investment in infrastructure in order to increase resource exports (sea ports, railways, motor roads, electricity, pipelines), and investment in the processing industry that was focused on export and national needs (oil and gas refining, machine building, wood processing, mining industry). The average annual growth rate of investment in fixed capital during this period amounted to more than 14%. In addition to some part of the investments allocated to the tertiary sector of the economy, most of them were allocated to the projects with relatively long term of development, which manifested in the statistical decrease in the marginal productivity of investment in fixed capital.

The financial and economic crisis of 2008–2009 demonstrated the futility of hopes for the possibility to base macroeconomic dynamics in the Far East on endogenous factors. The cumulative impact of the shock of external demand due to the downturn of economies in Northeast Asia and the shock of domestic demand due to the reduction of federal budget revenues and decline in economic activity in the private sector led to the fact that in the first

half of 2009, there was a nearly 18% decline in the region's industry compared to the 11% reduction in Russia as a whole.

“The pivot to the East”. 2009–2017.

An increase in the assessment of “national economic value” of the Far East was due not so much to the crisis of 2008–2009, as to the deep geopolitical and macroeconomic problems emerging during its development, which required adjustments in national geo-economic policy in Russia. It was associated with the fact that already by 2007 there was an aggravation of the challenge of maintaining the possibilities of extensive growth of export rent in European markets, which was and remains the main source of comprehensive income and the main factor in economic growth of the national economy. Tough market competition, encouraged by restrictive regulation on European energy markets, increasingly interfered with the maintenance of stable positions in European markets. As for the increase in the share of intensive drivers of growth in foreign trade rent, it is impeded by the technological dependence of Russian export companies and a slow structural modernization of the economy that prevents from quick and efficient replacement of traditional export with its new types.

In addition, a model of the Russian economy established by 2009 assumed that in order to maintain the stability not only of growth, but also of the entire system of socio-economic functioning it is necessary to ensure not only a certain level of extraction of export rent, but its increase, as well. It was objectively possible in short term only if the spatial field of extraction of export rent was expanded, while its product structure was maintained.

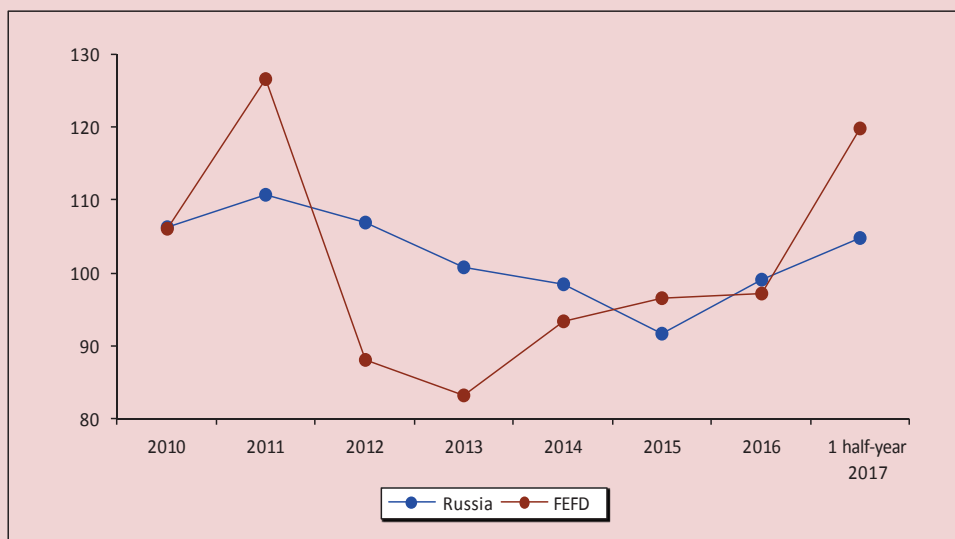
East Asia and, in particular, China were considered as a new and promising space for

export expansion, especially in the energy sector. The implementation of the concept of “spatial re-branding”, of course, implied a substantial strengthening of infrastructure of the Far East as a transit ground for the country's exports to new markets. The markets of East Asia, which traditionally served as the main compensator of fluctuations in domestic demand for the stabilization and development of economy of the Far East, now had to be turned into one of the main sources of growth and development for the national economy as a whole.

By 2009, much was made in the course of solving the most pressing infrastructure issues. New electricity generation capacities were commissioned, grid infrastructure was enhanced, the Trans-Siberian Railway and the Baikal–Amur Mainline were upgraded, tariff policy on railway transport was adjusted, seaports were renovated and developed; all this significantly improved the condition of the transport infrastructure [14]. In 2009–2011, the priority development of major export infrastructure was continued. The region received considerable investment resources. The volume of gross investments amounted to 2.5 trillion rubles or 9% of fixed capital investment for Russia as a whole, which was comparable in proportion to the period of the 1970s, when the region modernized and expanded the military-industrial complex of national importance.

This time, investment boom was associated with the establishment of a reliable transport and energy infrastructure aimed at overcoming the existing restrictions on the intensive exploitation of existing deposits of mineral raw materials, fuel and energy resources of the region and the development of new ones; it was also aimed at increasing export deliveries to

Figure 5. Investments in fixed capital, percentage of the previous period



Sources: *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2016* [Regions of Russia. Socio-economic indicators. 2016]. Rosstat. Moscow, 2016. 1326 p.; Information for monitoring the socio-economic situation in constituent entities of the Russian Federation. Federal State Statistics Service. 2017. Available at: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1246601078438

the countries of the Asia-Pacific region. The most important projects of this kind included the Eastern Siberia–Pacific Ocean oil pipeline, resource projects in Southern Yakutia, the facilities of the APEC Summit in Vladivostok, regional pipelines, a network of federal highways, and modernization of sea ports [19].

Institutional maneuver

The construction of major corporate projects in the Far East (those directly related to the APEC Summit and those that implement a long-term export strategy) has been completed or was close to being completed by 2012. This led to a decline in investment activity in the region (Fig. 5). There remained high investment risks for private capital; it was reflected in a relatively higher index of investment risk in the region in comparison with national average⁴.

⁴ The index of investment risk is assessed by the Rating Agency “Expert RA” and is a combination of social, economic, financial, criminal, environmental, and managerial risks.

The federal budget, of course, could not compensate for the outflow of private capital.

But even if it were possible, it is unlikely that the result would be a significant change in the comparative macroeconomic dynamics in the region and in Russia as a whole, which does not depend much on the dynamics of investments in the economy of the Far East due to the above-mentioned specifics of the sectoral structure of investments leading to a long payback period and a low level of localization of the demand generated by investment. The actual investment dynamics have little effect on the pace of development of the region (Tab. 2).

If the strategy of “investment pump” is inefficient from the point of view of achieving a dramatic change in the macroeconomic trends of the region, then the situation is different in the formation of standards of economic development of the region, i.e. dramatically improving the quality of life and

Table 2. Comparative growth rates of macroeconomic indicators, 2009–2016, %, 2009=100

Indicators	Russia	Far East
Gross regional product	116.3	114.5
Industrial production	116.4	136.1
Export	91.3	157.4
Investments in fixed capital	113.4	86.2
People's real incomes	106.9	112.2

Sources: *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2016* [Regions of Russia. Socio-economic indicators. 2016]. Rosstat. Moscow, 2016. 1326 p.; Information for monitoring the socio-economic situation in constituent entities of the Russian Federation. Federal State Statistics Service. 2017. Available at: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1246601078438

the business environment in the region. Without achieving this result, it is impossible to expect any stable integration of Russia in general and the Far East in particular in the economic system of East and Northeast Asia, even the state of the export infrastructure is satisfactory. For this sub-region of the world, the level of economic development and the institutional environment of potential partners are, if not decisive, then one of the most important conditions not just for trade interactions, but for full-fledged integration that is the ultimate goal of Russia in the East.

Therefore, it is necessary to solve the problem by promoting development rather than growth; that is, to change the quality of the social, utilities and business environments in the region, create incentives for intraregional income generation, achieve a fundamental change in the ratio of alternative costs to people's incomes with the help of boosting business in general and investing in particular, since it will help solve the problem of outflow of the population and improve its quality more efficiently than all kinds of programs and benefits. This implies changing the structure of investment flows, which, given the absolute value, should be aimed at addressing the above tasks and supporting them with the help of institutional innovations.

Consequently, the most important condition of sustainable and effective development of the Far East, confirmed by the entire history of formation and modification of macroeconomic and social trends, is to preserve public investment of the measures aimed to address the issues of social and infrastructural development of the region in establishing an effective institutional environment promoting the activation of endogenous drivers of regional economic growth.

Aggravation of the macroeconomic and budget situation, along with awareness of the above-mentioned fundamental problems that have prevented success in the development of the region, has led to a change in the state policy for stimulating the development of the Eastern regions since 2013.

In the framework of a new state program for development of the region (2013–2018), the Eastern policy started to emerge as two relatively independent, although related, fragments. First, it was assistance, including financial assistance at the expense of the federal budget, to the development of the export infrastructure for extending foreign trade of Russian exporters in the eastern direction. Second, it was the implantation of institutional innovations [7; 10] aimed to raise private investments, including foreign ones, in order to

increase the degree of endogeneity of economic growth in the region.

Obviously, these changes do not take into account to the fullest extent the trends in economic development of the region described above. The main issue is to preserve the interconnection between economic growth and socio-economic development, which is manifested in the interpretation of private investment as a tool to substitute public investment to support economic growth, especially in the export-manufacturing sector. Meanwhile, the priority tasks of economic development consist in the transformation of the Far East into a prosperous and modern region by improving human capital, community environment, and social infrastructure, and by creating comfortable business environment. The solution to these problems is possible only with the help of public-private partnership of the national level, in which public investment is focused on infrastructure and institutional framework of regional socio-economic partnership, and private investment is concentrated in the sphere of maximizing export rent on the basis of exploitation of efficient natural and economic resources in the region and in the interregional system of national economy.

Conclusion

The study of the interdependence of macroeconomic trends and institutional environment for development of the Far East shows that there is no unambiguous solution to the problem of designing the “best” correlation between the objectives and means of regional development. This correlation was different for various historical stages, depending on the nature of the objectives pursued and the choice of tools for achieving them. However, it is possible with a certain degree of generality

to formulate conditionally optimal relations between the goals of development and the types of economic policy in the region.

The best results were achieved when non-economic goals of the state, for the achievement of which the region used centralized state material and financial resources, were combined with the goals of generating intraregional economic and financial resources, which was based on the support provided by government to the institutional environment that was as convenient as possible for the formation of endogenous reproduction within the region.

Accordingly, the periods when the state pursued exclusively “colonial” goals of extracting the maximum possible utility in the region with minimal support at the expense of state resources of endogenous development factors were the least successful from the point of view of maintaining stable socio-economic dynamics in the region.

Relative success was achieved with the use of a combination of building a preferential institutional regime that helps enhance the endogenous growth and development factors in the region, but that is not supported by the economic and financial resources of the state. In this case, positive economic and social development of the region is possible, but the influence of the state on the rate of this development and its feedback influence on the solution to public issues become minimal.

The modern period is characterized by a combination of “colonial” exploitation of transit and natural resource potential of the region, on the one hand, and on the other hand, by the substitution of economic and financial resources of the state with the institutional incentives in the sphere of designing an endogenous socio-economic system of the

region. Such an eclectic combination of the approaches and purposes of application of economic and institutional resources will most likely result in a failure to implement the goals of neither the federal nor the regional level. We can assume that in the future it will be necessary to construct a new institutional economic framework for solving the dual problem of socio-economic development and national economic integration with East Asia.

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Regulation of Industrial Emissions Based on the Agent-Based Approach*



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Abstract. The article demonstrates one of the most advanced methods for regulation of industrial emissions, which is used by governments of different countries – an emissions trading system based on the bubble principle. This method is a tool for incentive-based control to encourage businesses to reduce the burden on the environment, providing emissions limits of harmful substances, but at the same time giving them some freedom to choose the methods to achieve the specified emission standards. To create a domestic comprehensive system for emissions regulation it would be useful to use the instruments for preliminary evaluation of effects from the implementation of various control measures. One of such instruments may be the agent-based regional model developed by the authors in the present paper. The model will help test different combinations of control measures – both administrative and market – with the use of computer experiments in order to find a balanced combination. The model simulates production activity of agent enterprises which employ agent people. Apart from products, enterprises also produce emissions keeping within the established limits or exceeding them and paying fees for emission excess. Businesses can also participate in emissions trading, that is, they can sell surplus emissions quotas to other companies or buy the necessary quota if it is cheaper than paying fees. In addition, enterprises can improve emission purification or modernize production achieving dramatic reduction in the content of harmful substances in emissions. The controllable model parameters the user can vary during experiments include the fees for exceeding the enterprises' quota for emission of various pollutants and requirements to reduce total regional emissions which are represented in the model by corresponding reduction factors. The main difference of the presented agent-based model from other models of this type covered in the literature is the introduction of the planning horizon in the enterprises' utility function which helps businesses build their strategy to reduce emissions, calculated for several years ahead.

Key words: agent-based model, air pollution, market-based instrument, bubble principle, emissions trading, incentive-based control.

The issue of reducing the anthropogenic load on the environment in general and reducing pollutant emissions into the atmosphere in particular has been relevant in the past decades. A huge step to addressing the issue across the planet was the adoption in 1997 of the Kyoto Protocol – an international agreement which obliges developed countries and transition economies to reduce or stabilize greenhouse gas emissions. Under the Kyoto Protocol, Russia committed itself to stabilize average annual emissions to the level of 1990 and managed to exceed the target, reducing emissions from the power sector by 37% in 20 years. With regard to Russia's international obligations, the country currently does not

plan to participate in activities to implement the Protocol. However, within the country, the objective of reducing emissions remains relevant as the issues associated with high levels of polluting substances in the atmosphere remain in many industrialized regions of the country (according to the observations of Voeikov Main Geophysical Observatory, in 243 Russian cities in 2016, 20 of them were included in the list of cities with very high levels of air pollution, 24 of them were highly polluted¹). Therefore, to address this important issue it is required to use all possible administrative and economic corrective measures for polluting enterprises,

¹ Available at: <http://voeikovmgo.ru/index.php?id=681&lang=ru>.

especially measures which are not only justified from the point of view of the economic theory but which proved its effectiveness in practice.

The works [3; 22] present the analysis of different management mechanisms of environmental-economic systems including optimization, game-theoretic and simulation models. The work [3] considers in detail a wide range of measures from introduction of monitoring systems, systems of compensation of costs of reducing risks, penalties to systems of economic motivation for enterprises to improve their environmental behavior such as emissions trading. It should be emphasized that the Kyoto Protocol also provides for the use of the so-called flexibility mechanisms including emissions trading which implies that states or its individual economic entities can sell or buy quotas for greenhouse gas emissions at national, regional or international markets.

The emissions trading mechanism is based on the so-called “bubble principle” which aims to maintain the target level of pollution in the region allowing businesses in the region (“bubble”) which managed to reduce total pollutant emissions below the specified level to sell excess emission reductions to region’s enterprises which exceeded its quota. This is indeed a mechanism of flexibility since it helps businesses choose the most economically feasible strategy to achieve specified environmental standards. Businesses are given a choice to pay fines, buy/sell emissions quotas, install cleaning equipment or upgrade the production itself, etc. while retaining the total environmental load within the region. Corresponding quota banks are established for implementing the emissions trading mechanism.

It is important to note that the mechanism is quite effective from the overall societal point of view as it helps achieve environmental goals in the most cost-effective manner.

The specified advantages of the bubble principle mechanism have made it so attractive that attempts are being made to adapt it for using, for example, in regulating disposal of sewage into water bodies (see, for example, [8]).

At present, different countries have vast practical experience in the implementation of market-based systems of regional air pollution regulation. The experience of the U.S. is the most indicative in this respect, the analysis of which is viewed in detail.

The U.S. sulphur dioxide (SO₂) emissions trading program

The sulphur dioxide (SO₂) emissions trading program launched in the U.S. in accordance with Title IV of the 1990 U.S. Clean Air Act (CAA) Amendments² was the world’s first large-scale system of pollutant emissions control and trading. The stated purpose of the Acid Rain Program (ARP)³ was to reduce total annual SO₂ emissions in the U.S. by ten million tons compared to 1980 when total emissions were around 26 million tons. Unlike conventional environmental legislation, the law did not provide for how enterprises were to reduce SO₂ emissions. Instead, the first stage of the Program in 1995–2000, restrictions were imposed on total SO₂ emissions at 3,200 coal plants in the country; the government established the market of government-issued SO₂ emissions permits

² U.S. EPA (United States Environmental Protection Agency). 1990 Clean Air Act Amendment Summary. 2017. Available at: <https://www.epa.gov/clean-air-act-overview/1990-clean-air-act-amendment-summary>.

³ U.S. EPA (United States Environmental Protection Agency). Acid Rain Program. 2017. Available at: <https://www.epa.gov/airmarkets/acid-rain-program>.

which could be bought and sold. As a result, by 2007, total annual emissions declined slightly below the stated target level of the Program (a nine million ton decline, which amounted to 43%, compared with the levels of 1990), yet electricity generation at coal power stations increased from 1990 to 2007 by more than 26%⁴.

As for the actual Acid Rain compliance costs, although they exceeded the level ideal from the point of view of economic efficiency, they were still significantly below the estimates claimed by government analysts during discussions which preceded the launch of the Program. One of the reasons for such results may have been the underestimated influence of high prices of SO₂ emissions. High price of emissions was an impetus for the introduction of technological innovation in the industry in terms of both atmospheric emissions treatment systems and exploitation of power plants, which reduced the costs during the period [9; 19; 21].

In *Figures 1, 2* the circles on the map-scheme of the U.S. demonstrate SO₂ emissions in the territory of each state as of 1990 and 2015 (the radius of the circle depends on the amount of emissions in thousand tons). The green background reflects states which participated in programs for air pollution control Acid Rain (ARP), and Cross-State Air Pollution Rule (CSAPR), which controlled emissions of fine particles. In addition, there is a diagram on the right demonstrating the performance of the

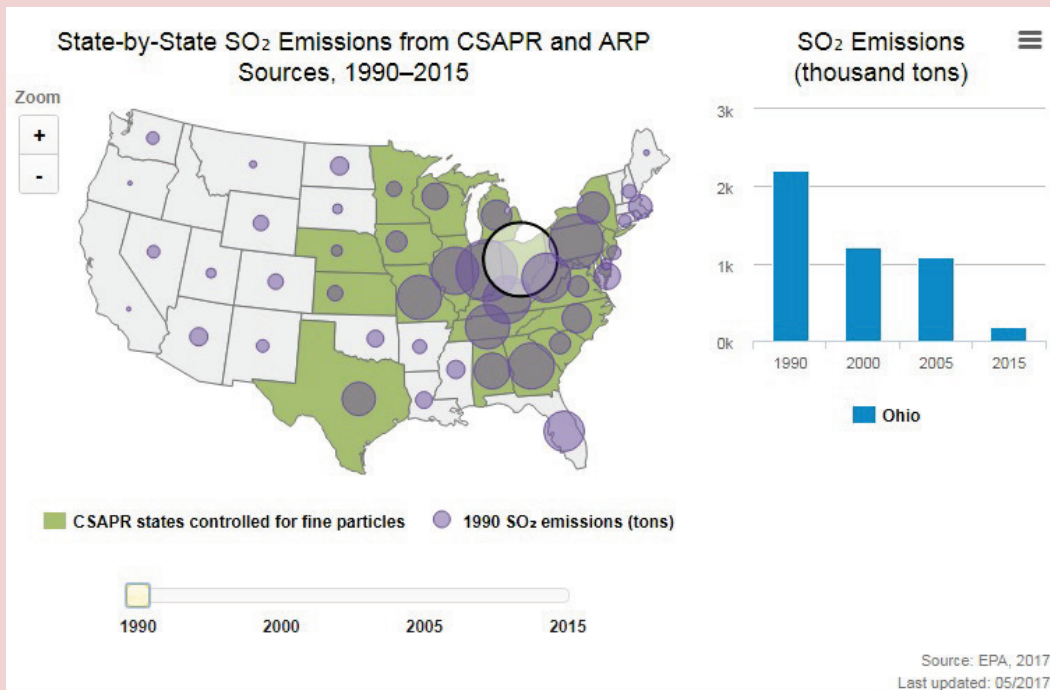
indicator for the entire period for the selected State of Ohio with the maximum levels of emissions at the beginning of the period and the most impressive reduction – 92% (from 2211.6 thousand tons in 1990 to 177.3 thousand tons in 2015).

For more detail about the experience of implementing market-based systems of regional atmospheric pollution control in different countries see [1; 10; 11; 18]. Analysis of the practically obtained results demonstrates the effectiveness and efficiency of such systems, hence the feasibility of implementing a similar emissions control system in Russia. It is obvious that the development of complex atmospheric emissions control measures in Russia requires the use of best foreign experience and the study of local characteristics both technological and institutional. The use of tools for preliminary assessment of effects from the implementation of various control measures would be the most helpful when creating a national integrated system of emissions control. In this regard, special attention should be paid to methods of simulation modeling as this approach helps in the course of computer experiments test different combinations of control measures – both administrative and market – and find a balanced combination.

Among modern approaches to simulation of large socio-economic systems the most appropriate is the agent-based approach [5; 7; 15]. The terminology of V.N. Burkova [2] considers a large (or active) system in this case as a system including independent actors acting in accordance with their interests and abilities. The agent-based approach simulates the actions of individual independent actors (represented by agents in an agent-based model); the state

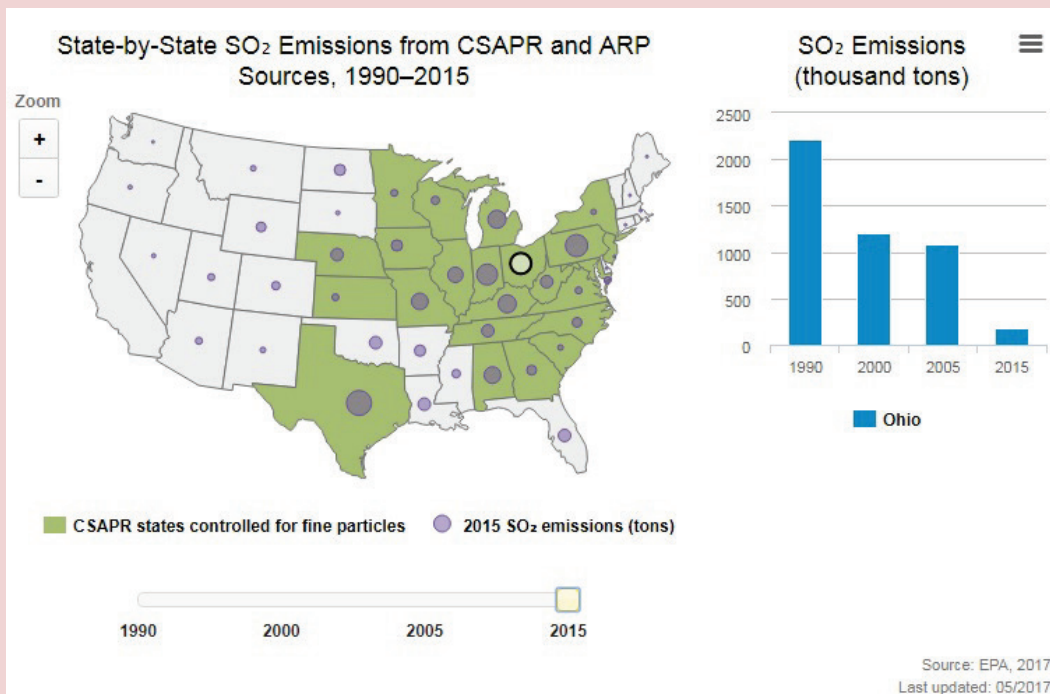
⁴ U.S. EPA (United States Environmental Protection Agency). Air Markets Program Data. 2012. Available at: <https://ampd.epa.gov/ampd/>; U.S. EIA (Energy Information Administration). Annual Energy Review. 2012. Available at: <https://www.eia.gov/totalenergy/data/annual/showtext.php?t=ptb0802a>.

Figure 1. SO₂ emissions distribution map in the U.S. States, 1990



Source: U.S. EPA (United States Environmental Protection Agency). Emission reductions. 2017. Available at: https://www3.epa.gov/airmarkets/progress/reports/emissions_reductions_SO2.html#figure3.

Figure 2. SO₂ emissions distribution map in the U.S. States, 2015



Source: U.S. EPA (United States Environmental Protection Agency). Emission reductions. 2017. Available at: https://www3.epa.gov/airmarkets/progress/reports/emissions_reductions_SO2.html#figure2.

of the overall system is the integrated result of actions and interactions of these agents. The autonomy of agents means that they have certain resources (opportunities), a mission and relevant criteria for its completion, as well as the ability to make decisions on selecting an action from the available options. It is necessary to emphasize that the agent-based model (ABM) can create an indefinitely large number of agents with individual characteristics meaningful in terms of their participation in economic life; the values of these characteristics can vary for each agent. It is exactly the “bottom-up” construction of a digital analogue of the real large socio-economic system that makes it possible to recreate all the features of its social structure in an artificial environment and achieve maximum likelihood when simulating the processes taking place within.

A brief overview of environmental and economic ABMs

Many literary sources widely present ABMs which simulate the processes associated with land cultivation, fishing and other human activities which directly use natural resources and affect the environment of places of people’s residence through overexploitation of these resources. These activities often increase the risk of natural resource depletion and environmental disasters on a local scale.

In [13], agent-based models designed to simulate and analyze various processes related to environmental management in different Asian countries are reviewed in a separate chapter. The presented model helps analyze the mutual influence of social processes and performance of environmental parameters of territories and is designed to search for

a rational compromise between the interests of people engaged in various types of human activities in order to prevent land degradation and achieve balanced use of renewable resources.

Examples of research contributing to the solution of such issues are the two ABMs designed for setting up computer experiments and providing recommendations for selecting a more effective form of financial support for the rural population from the point of view of natural resources management, and investing in the development of agricultural territories. The research concerns the study of specific nature of labor management of the life of the rural population in small Asian countries – Nepal and Thailand – which are dependent on the region’s climate conditions (rain periods) and the underdeveloped infrastructure. The first model presented in [14] reproduces complex interrelations of objects of socio-environmental-economic system of Nepal. The key features of the model are: a) simulation of population migration caused by the low standard of living; b) use of the social capital construction which takes into account human relations, patterns of behavior, etc. which facilitate collective actions; and c) the recreation of water storage features, the reconstruction of which is able to improve yields in dry-weather periods and thereby increase the standard of living of the rural population.

The experiments have enabled the model’s authors to forecast the results for ten years for each rural settlement and for each form of investment taking into account different climate scenarios, which can help shape the best strategy for the development of these settlements.

The second model presented in [20] also aims to develop the program of government investment (in this case Thailand) for construction of water supply and drainage infrastructure. An important requirement to the Program is its sustainability taking into account the specific nature of labor activities of the rural residents. The model has been tested in experiments, preliminary results have been obtained.

We also mention another ABM presented in the work of Russian authors [4]. It is a conceptual model of a multi-agent system of environmental security management with agents of the environmental-economic system with rather complex design (intelligent agents) able to cooperate when developing the management mechanisms and coordinate activities at different levels of the hierarchy, starting with companies' agents and ending with the supervisor agent represented by the government. The supervisor agent has the power to change the rules of the game for companies' agents, namely, change restrictions on emissions, fines for exceeding permissible emissions levels. The decisions of companies' agents are to choose the strategy of investment in environmental activities – distributed in sequence time of investments, ensuring the achievement of environmental standards by a specific point in time. Data on testing the model are unfortunately not given in the work.

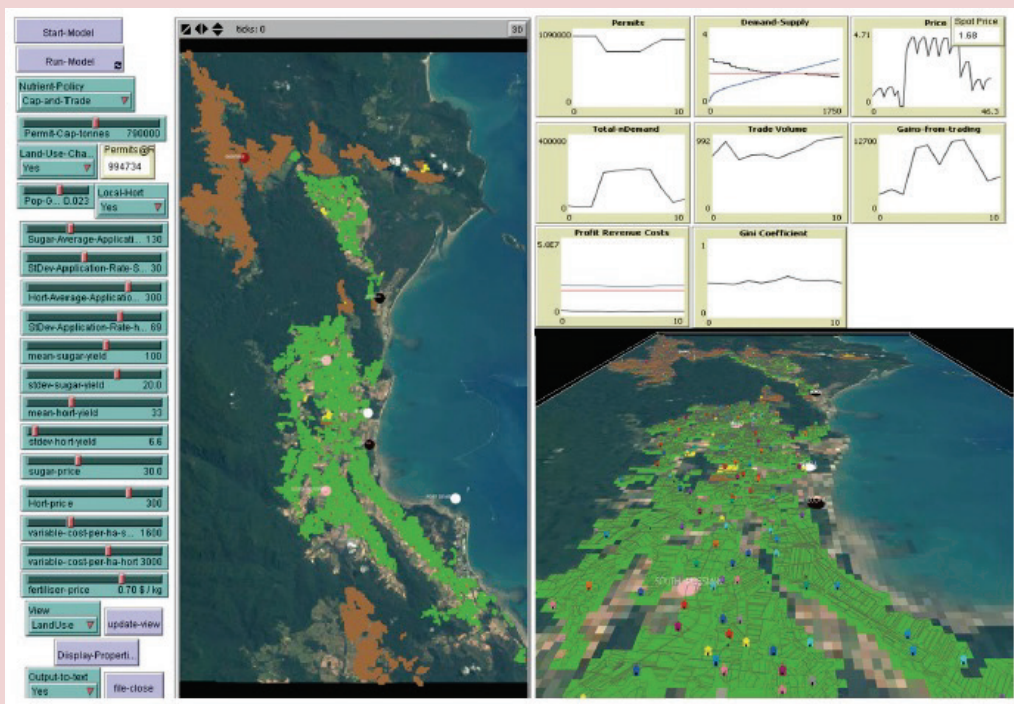
The literature, albeit in much smaller quantities, also presents the ABMs devoted to the issue of pollutant emissions trading. The present paper mentions two of these models.

The first ABM presented in [16; 17] is designed to analyze the impact of various regulatory measures and cap-and-trade on

water emissions and water quality along the coastline of Australia. Pollutant emissions into water create problems for maintaining healthy marine ecosystems, which in turn affects land use conditions. The agents in the model do gardening or sugar cane cultivation; the cultivation of these crops has different impacts on the environment. The model interface at each step of simulation clearly demonstrates the current state of the entire simulated ecosystem on the map and helps the user manipulate many parameters in the course of computer experiments (such as crop yields, prices, etc., the total of more than 15 parameters) in order to assess the implications of various scenarios. *Figure 3* demonstrates the interactive interface of the model including a spatial map with the boundaries of the selected plots and houses on them. The top left corner has the model's start button. On the left, there are control buttons – sliders and switches, each associated with one of the options. The switch helps the user select one of the given values of parameters (for example, activate or deactivate emissions trading mode); by moving the slider the user can increase/decrease the values of corresponding parameters in the model. At the top right of the interface, graphic materials demonstrate the performance of modeling results during simulation (quota, prices, supply and demand curves, traded value, etc., the total of eight graphs).

[12] presents an agent-based model which simulates the behavior of electricity industries and the impact of the CO₂ emissions trading policy on this behavior, which in Europe is one of the main tools for achieving agreed goals of reducing CO₂ emissions (in Europe, power generation accounts for one third of CO₂ emissions). The corresponding

Figure 3. Interactive interface of the model

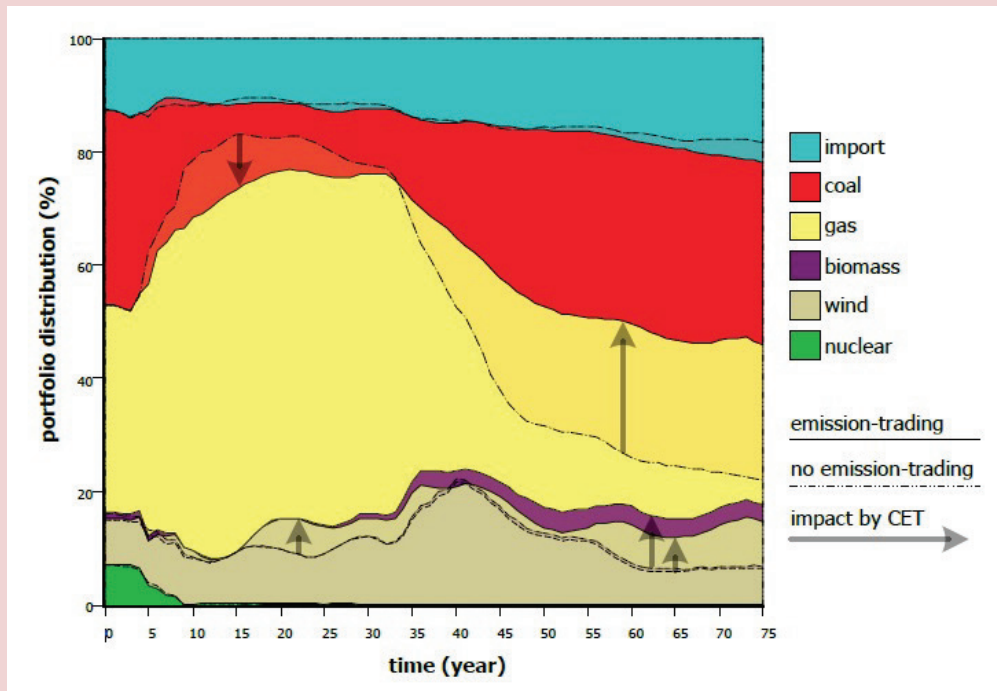


Source: S. Heckbert Agent-based modelling of emissions trading for coastal landscapes in transition. *Journal of Land Use Science*, 2011, vol. 6, no. 2–3, p. 140.

Program has been implemented since 2005. Companies’ agents in the model can buy/sell emissions quota, as well as invest in changing production technology, shifting it towards using other low-carbon energy sources. The experiments indicate a certain influence of the government policy on changes in the structure energy source enterprises use – a long-term shift of the structure towards more intensive low-carbon power generation. However, this effect is relatively insignificant and is often greatly delayed. In most scenarios, absolute emissions from power generation are increased, which corresponds to the observed trend of increasing current capacity through establishing new coal power plants. Apparently in power generation, the

economic effect of CO₂ emissions trading is insufficient to outbalance economic incentives for choice of coal. *Figure 4* demonstrates the performance of the structure (portfolio distribution, %) of power sources used by enterprises of the European Union in the presence of emissions trading (emission-trading, indicated by a full line) and without it (no emission-trading, indicated by a dashed line), gray arrows indicate changes caused by the policy implementation (impact by CET). The following types of power plants are presented: nuclear, wind, biomass, gas, and coal; the share of imports is also reflected. The figure suggests that the main types of applied energy sources are natural gas and coal; with the share of coal growing steadily

Figure 4. Performance of the structure of power sources used by EU companies and the influence of CO2 emissions trading system on it



Source: Chappin E. J. L., Dijkema G. P. J. On the Impact of CO2 Emission-Trading on Power Generation Emissions. *Technological Forecasting & Social Change*, 2009, no. 76, p. 367.

by the end of the forecast period and in both scenarios, although the emissions trading system significantly slows down this growth.

Analysis of economic methods of environmental management and experience in the application of the agent-based approach to the modeling of these processes stimulated the authors to develop their own agent-based model for testing various strategies for the implementation of the bubble principle in regional management. Thus, the purpose for the study was to develop a regional agent-based model recreating the internal structure and the regulations of a region as a complex socio-environmental-economic system including independently operating large economic actors

– enterprises; and simulating the response of these actors on emissions control. The ABM serves as a tool for preliminary assessment of effects of implementing various control measures.

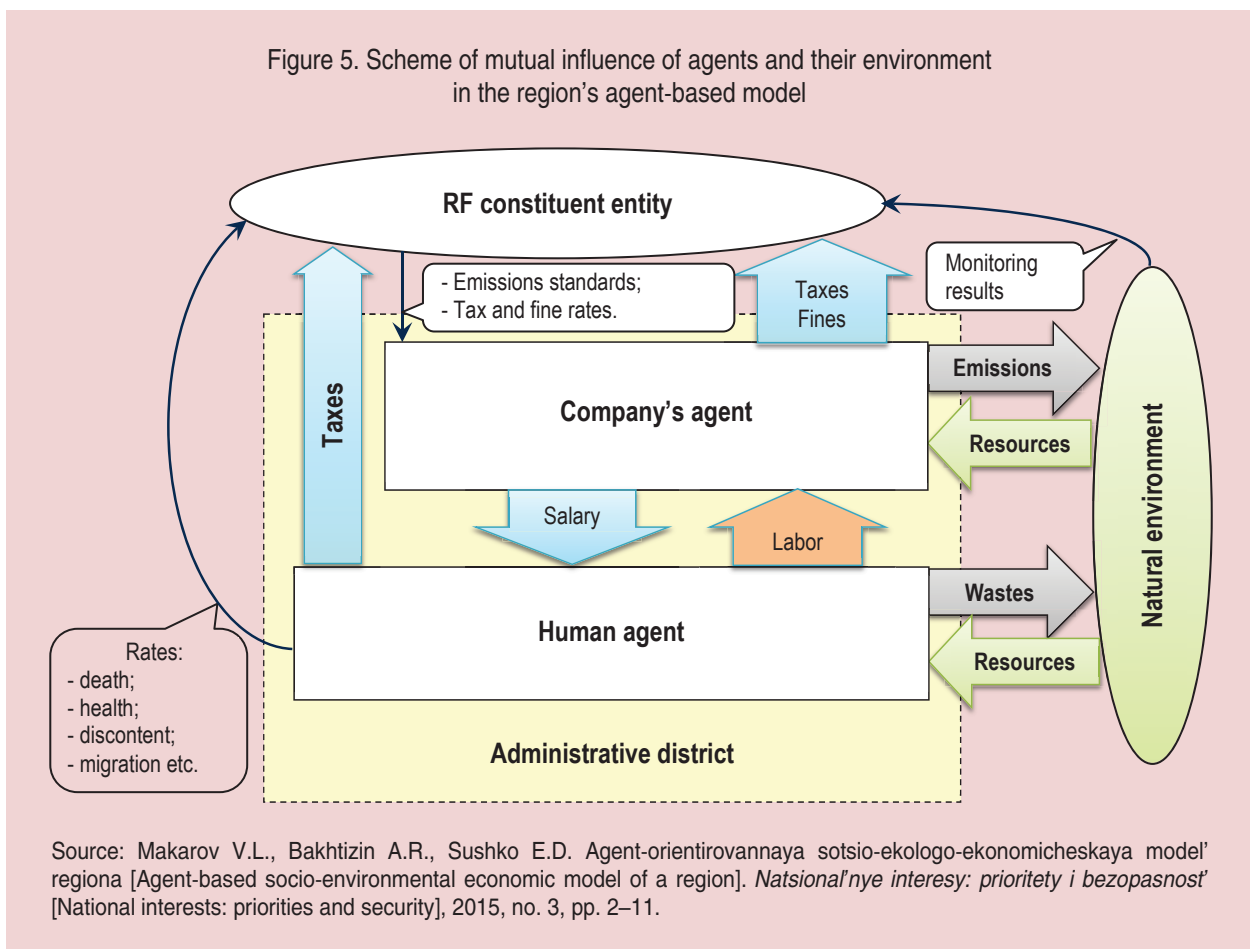
The model of environmental behavior control for companies’ agents

Environmental behavior of enterprises in the article refers to as management of emissions of harmful substances generated during the production process. The conceptual framework of the agent-based model for enterprises’ environmental behavior management developed in CEMI RAS (Central Economic Mathematical Institute of the Russian Academy of Sciences) includes the following provisions:

- The system of enterprise environmental behavior management simulated in the model must be comprehensive and must include both administrative and economic measures of influence on companies' agents.
- The system must encourage enterprises to reduce total regional emissions.
- The system must be flexible enough to provide the choice of behavior strategies for enterprises in compliance with the standards of the environmental status of the region as a whole.
- From the point of view of the control center (which is represented by the user of the ABM), it must be sufficiently transparent and efficient.

The above-described mechanism of the bubble principle, which was tested in practice and proved its effectiveness, meets all these requirements.

The technological framework for the designed agent-based models of enterprise environmental behavior management was the construction of the regional socio-environmental-economic agent-based model presented in article [6]. *Figure 5* demonstrates a generalized scheme of the mutual influence of agents and their environment in the regional agent-based model with broad arrows indicating the directions of resource transfer and thin arrows – the directions of information flows.



The article is focused on the development of mechanisms to simulate the impacts of people's activities – its residents and companies located in its territory – on the region's environment in an agent-based model, as well as reciprocal influence of the state of the region's environment on the health and mood of its residents.

The present work, developing the specified socio-environmental-economic model, also focuses on providing the realistic simulation within the framework of the ABM of various strategies of environmental behavior of companies' agents associated with their participation in the emissions trading system. To achieve this goal we developed a rather complicated structure of a company's agent and consequently complicated the agents' environment. The model consists of formal structures ("classes" in the terminology of modern object-oriented programming) corresponding to actors (agents) involved in the emissions trading process and objects of the external environment. The classes of subject agents differ from object agents in that apart from the characteristics of the content of the real world important to the objectives set out in the model they also include software modules ("methods") which implement the procedure for simulating agents' behavior in a particular class. When starting, the model creates populations of agents and many objects – examples of each class of the model with individual values of specified characteristics.

The class system of the ABM:

- **Class of companies' agents**

a) features:

- enterprise's index;

- name;
- industry affiliation, type of activity (index);
- number of employees;
- production volume;
- administrative affiliation (index);
- object – image of an enterprise on the region's geographical map;
- location on a geographical map of the region-source of emissions;
- planning horizon;
- technological level (on a scale);
- net emissions by main types of gases;
- emissions by type;
- emissions quota by type;
- list of types of emissions not limited by quota (Q^+);
 - list of types of emissions with exceeded quota (Q^-);
 - fines for exceeding emissions by type and total;
 - income from emissions trading by type and total;
 - cost of installing filter trap systems;
 - cost of upgrading;
 - list (collection) of human agents – enterprise employees;
- b) motivation: to reduce total costs over the entire planning period associated with compliance with the regional environmental requirements.
- c) types of actions available to the agent:
 - selling free emission quotas if the enterprise's emissions are below the set quota;
 - purchase of missing emissions quota if enterprise's emissions exceed the set quotas;
 - fines for exceeding emissions quota;
 - installation of filters reducing atmospheric emissions;

- modernization of production in order to move to the next technological level of emissions reduction.

d) methods (procedure):

- procedure for calculating total costs over the entire planning period for different variants of activities;

- procedure for comparing different options and selecting the best with least total costs.

- **Class of regions**

- unique number;
- name;
- geographical map of the region;
- point of monitoring of atmosphere pollution on the map;

- levels of pollution by type of emissions;
- price of quota per unit of emissions by type;

- sales of emissions quota (emissions bank) by type;

- revenues from fines for emissions by type;
- reduction factor in the resolution on emissions trading (α);

- number of companies' agents;
- list (collection) of companies' agents.

- **Class of emissions**

- index of the type of emissions;
- name;
- permissible concentration;
- unit cost of filter installation;
- fines for pollution;
- price of a quota per unit of emissions.

- **Class of activities**

- index of activity type;
- name;
- number of technological levels;
- production function as dependence of production volume on the number of employees in technological levels;

- financial costs of transferring production to the next technological level (by technological level);

- time required to transfer production to the next technological level (by technological level);

- minimum and maximum emissions per unit of production by type of emissions and technological level.

The overall management of the model is implemented by **the main class**. It provides initial data entry; creates populations of agents and examples of other model classes of a specified number; sets the initial state of the system corresponding to the base year of simulation; displays the status of agent populations and other general indicators of the model on the screen; arranges dialogue with the user; organizes the process of simulation at each step. In addition, each class with a collection of agents also contains the method for gathering statistics on this collection for generalized indicators.

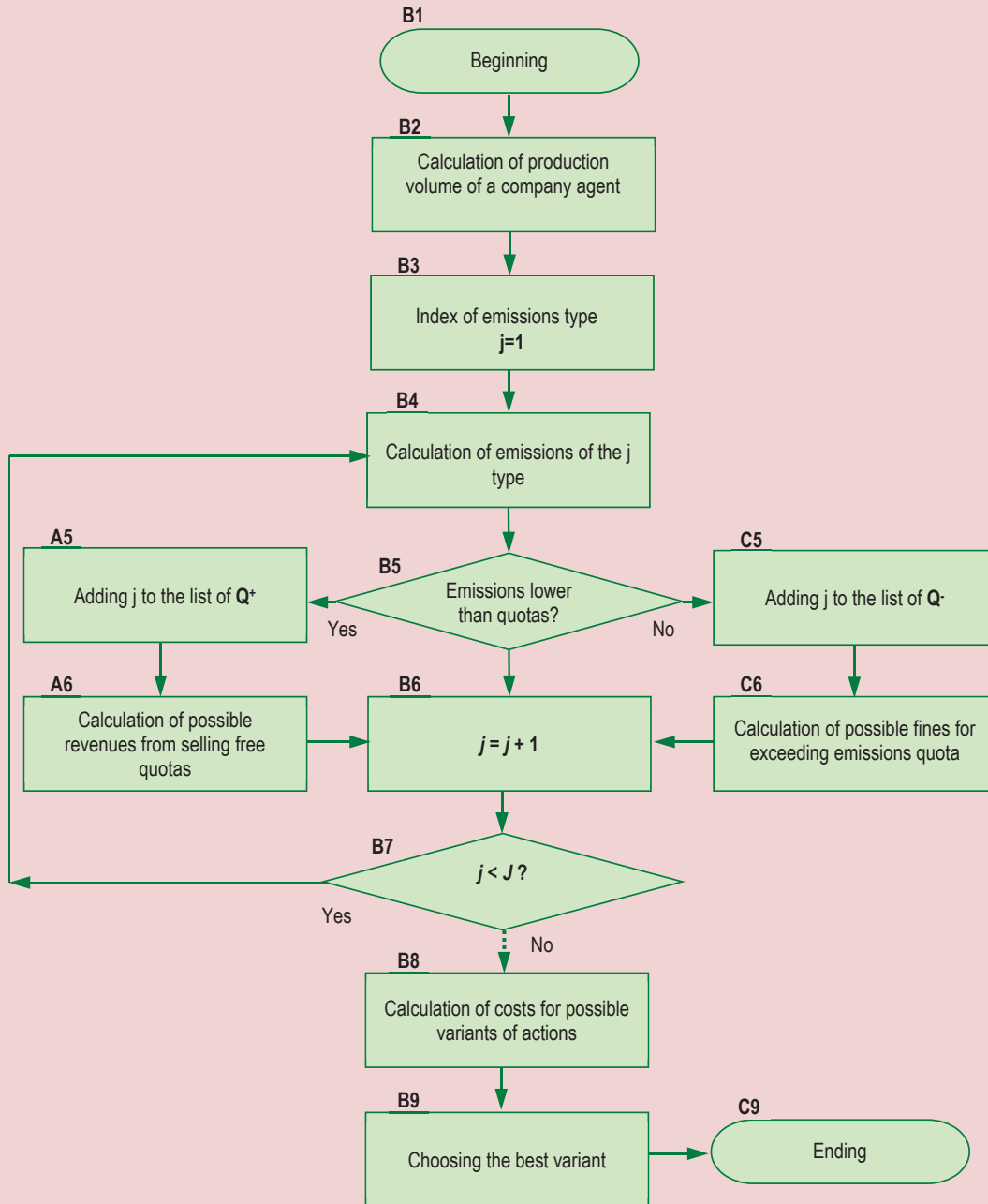
The class of human agents in the model ensures reproduction of the population and its labor potential but it is not involved in the process of emissions trading, so we do not describe it in detail – its design matches the design of human agents from [6].

Let us now consider how the process of emissions trading is implemented in our regional ABM according to the bubble principle. The general scheme of the algorithm of behavior of a company's agent at each step of simulation is demonstrated in *Figure 6*.

This procedure is repeated for each company's agent from the population of agents of this type:

B1. Activation of the selected company agent at the current step of simulation.

Figure 6. General scheme of behavior of a company's agent



B2. In this block, using the production function, we calculate the volume of production of a company agent at the current number of agent workers and the level of technological development.

B3. The beginning of the cycle which sequentially examines each type of emissions j ($j = [1, J]$, where J – number of types of emissions associated with production technology).

B4. The calculation of emissions of the j type corresponding to the volume of production and specific emissions of this type at the current technological level of the enterprise.

B5. The unit for comparing the amount of emission of the j type with the enterprise's corresponding quota. If the amount of emissions is below the quota transition to unit **A5** takes place, and then to **A6** where the j type is added to the list of Q^+ ; revenues from selling unused quotas are calculated. If the amount of emissions exceeds the quota transition to unit **C5**, and then to **C6** takes place, where the j type is added to the list of Q^- ; fines for exceeding quotas are calculated. In both cases, there is a transition to the next type of emissions (unit **B6**); if all types are considered then the cycle ends.

The actions of the company agent are reproduced in the model in two stages. At the first stage, all agents of the population determine the amount of quota for selling or buying, which forms the bank of emissions quota of different types (at this stage, all the above described units for each agent are implemented). After that the agents proceed to analysis of conditions of implementation of various available behavior strategies and select the best one (units **B8** – **B9**).

In *Figure 6* the transition from one stage of agent's behavior to another is underlined with a dotted arrow between blocks **B7** and **B8**.

B8. The calculation of costs for possible variants of agents' actions. The enterprise's costs in the model consist of: a) fines for exceeding emissions quota from the list of Q^- ; b) cost of purchase of missing emissions quota from the same list; c) cost of filters trapping contaminants and reducing emissions; d) cost of modernization helping the company to move to a new technological level which reduces net emissions.

The enterprise can fully or partially compensate for these expenses by receipts from proceeds from selling surplus emissions quota from the list of Q^+ including those occurring after the installation of filter traps or modernization of production.

The calculation of costs is carried out for the entire period corresponding to the agent's planning horizon. It is obvious that to consider an option such as modernization the planning horizon should be considerably bigger than the period of the implementation in order to return modernization costs.

It should also be noted that the policy of the center (in this case, the region) aims to reduce the overall level of pollution, therefore the reduction factor is introduced: $0 < \alpha < 1$; it is multiplied by the sold emissions quota in the quota bank. The factor may vary for different emission types depending on the overall level of pollution and the policy of regional authorities.

B9. The comparison of the calculated impacts of various options available to the agent and choosing the best one which minimizes the total costs over the planning

horizon. It is important that the ABM consistently simulates the behavior of each company's agent; the sequence is set randomly. In the end the choice of agents which happened to be at the beginning of the process may narrow down the choices for the remaining agents (e.g., if quotas are already sold out).

The model then simulates the implementation of the variant. For example, if an agent made a decision about modernization of production during the implementation period of the project to transfer production to the next technological level, the agent continues to pay fines (or buy quotas if it is more profitable), at the end of this period it changes its technological level and the characteristics of the production function and net emissions of different types at the same time. The following stages of simulation use new values of these characteristics for calculations.

C9. The completion of agents' actions at the stage.

Obviously, total costs and hence attractiveness of this or that variant for the agent

depends on the level of fines for exceeding quotas and values of factor for different types of emissions. It is these values that are controlled by the model parameters, varying which in the course of computer experiments the user can test different variant of their ratio for obtaining maximum effect from the implementation of the mechanism of the bubble principle.

The design of the AOM was implemented as a separate unit of a large socio-environmental-economic model and tested on conditional data on the level of fines, emissions, emissions quotas, and the cost of modernization. Experiments were carried out for multiple, conditional enterprises in the region of the same industry with different level of technological development. All of these conditions of experiments have a significant impact on the result; therefore, although the model demonstrated an adequate response to the variation of its parameters, the results are preliminary so far. After adapting the model to specific conditions of the region it can be used at the level of regional authorities.

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Theoretical Aspects of Agent-Based Modeling in the Development of the Forest Complex*



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Abstract. One of the ways to ensure sustainable economic growth in modern Russia is to enhance the efficiency of utilization of forest resources. The forest complex is a comprehensive open system with close relationships between different aspects such as ecological, social, economic, cultural, educational, and public administration. It is difficult to find a comprehensive solution to the issues of development of the forest complex if there is no evidence-based system for management decision-making. One of the promising areas of scientific research in this direction could be the application of agent-based models simulating the processes of using, protecting, and reproducing forests, forest products and forest management. The aim of the paper is to study scientific approaches to the construction of agent-based models applied to the forest sector in order to define common approaches to the formation of a set of agents and create an

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environment for their functioning. We provide an overview of the experience of simulation modeling of individual processes in the forest complex with the use of the agent-based approach. We give a general characteristic of the problems associated with the management of the forest complex in Russia (at the federal and regional levels). We provide an overall assessment of a high complexity of the forest complex as an object of study. The article presents a brief overview of relevant Russian and foreign research devoted to the general methodological issues of simulating the forest complex and specific models implemented with the use of an agent-based approach: the model for the Swiss timber market; the model for protection of forests in British Columbia (Canada) from insect infestation; the models for predicting and controlling forest fires, an enlarged architecture of an agent-based model for the regional forest complex. We define requirements for the regional forest complex model and consider individual aspects in the implementation of its elements. When developing the architecture of the model, we use comprehensive, system, ecosystem and institutional approaches, which allows us to create a model closest to the real forest complex. In conclusion, the article provides a general assessment of the efficiency of application of agent-based modeling in the forest sector.

Key words: agent-based modeling, forest complex, systems for support to decision-making.

Introduction

The forest complex of the Russian Federation occupies an important place in the economy of the country. Forests of Russia are among the most important renewable natural resources. They constitute more than a quarter of world reserves of wood biomass and perform important ecological and environmental functions.

Forestry is a complex system with many different interacting agents, which include public authorities, timber and woodworking enterprises, people that use forest resources for their own needs, etc.

The forest complex is characterized by geographical fragmentation and remoteness of enterprises (forest users), fragmentation and different degree of accessibility to forest resources and markets. Timber processing and logging are seasonal. Climatic fluctuations have strong influence in this regard.

It is obvious that finding a comprehensive solution to the tasks of development of the

regional forest complex is difficult without creating an evidence-based system to support management decision-making. One of the promising research areas in this direction could be the development, testing and application of simulation models for the processes of using, protecting, reproducing forests, forest products and forest management.

General approaches to simulating the forest complex as a comprehensive dynamic system

Today, there exist many approaches to structural formalization of the functioning of the forest complex. Russian scholars such as T.N. Ivanova, N.E. Antonova, A.S., Sheingauz, and A.A. Kiseleva consider the subject in detail.

In the work by T.N. Ivanova [7], the timber industry complex is defined as a system of enterprises of the forest industry and related parts of the state apparatus, science and enterprises of other industries, ensuring its functioning. In accordance with the definition the following elements are highlighted:

1) individual enterprises or their associations that manufacture timber products, connected via information, material and energy flows;

2) enterprises that provide goods and services vital for the functioning of the timber industry complex (equipment, energy, transportation services, etc.);

3) governing bodies that regulate the development of the timber industry complex, forming its investment and business climate.

Thus, economic interests for governing bodies include the receipt of tax revenues; for the business community, forest, timber and wood processing sectors – raising investment in the timber industry complex, promotion of expanded reproduction and gaining profit from timber sales.

Researcher N.E. Antonova in her work [1] proposes a verbal model of the regional forest complex as a natural and economic system based on A.S. Sheingauz's functional model of forest management and classification of forest functions into classes such as social, resource, economic-ecological, and landscape-stabilizing.

The basic subsystem of the proposed model is the forest, which is represented as a set of forest environment and forest resources. The main principle of formation of the system architecture is its division into three blocks according to the functional principle associated with the use of the forest. Three ways in which the forest can be used are as follows: social, environmental, and resource. Social use and environmental use fall within the scope of public consumption, and resource use belong to the sphere of private consumption. Private

consumption forms the timber industry complex, comprising of three successive stages of timber processing: timber harvesting, physical transformation of timber and chemical (thermo-chemical) treatment of timber. The actors of use are defined for each block. According to the author, such actors include the state, represented by federal and regional authorities, local self-government, forest business, residents, and non-governmental organizations. The actors related to forest business are defines separately. They are represented as economic agents – forest users.

Researcher A.A. Kiseleva in her works [8, 9] considers that in the structure of the existing regional timber industry complexes there are the following groups of organizations:

1) enterprises engaged in various stages of the technological chain of production and processing of forest resources, which includes silvicultural, forest-harvesting, wood-sawing, woodworking, pulp and paper, and wood chemical production;

2) organizations engaged in the production, social, institutional and market infrastructure, ensuring the functioning and development of major technological forest industry enterprises;

3) enterprises engaged in logistical support of the regional timber industry complex;

4) research structures and educational institutions engaged in the training of human resources for the regional timber industry complex;

5) organizations engaged in the supply of major forest industry enterprises with the means of production (forest-harvesting, wood-sawing, woodworking, chemical, fire protection and other equipment).

The subjects of the timber industry complex are grouped in three major blocks, based on their participation in direct management and use of forest resources.

A large number of works study the cluster approach to the development of the regional forest complex. The cluster architectures they present can also be used as examples of the overall architecture of the forest complex. For instance, A.A. Kiseleva suggests an option of cluster architecture in which the core of the model of the timber industry cluster of the region are the enterprises engaged in the harvesting of timber, production of lumber and wooden containers, manufacture of cellulose, wood pulp, paper and paperboard, manufacture of plywood and wood boards, production of wooden building parts, manufacture of paper containers and paperboard containers and other articles made of paper and paperboard, and wood chemical production. The sales and procurement structures of the business operate under orders and contracts with the enterprises, organizations and business structures within the core of the cluster. Service structures are directly associated with the production functions and sales of the cluster.

Despite significant differences in the approaches described above, it is possible to identify several common points when describing the general scheme of functioning of the regional forest complex [5]:

1. The forest sector is a complex and open dynamic system, in which there are close relationships between its elements from different domains: ecological, social, economic, cultural, educational, public administration,

etc. The complexity and openness of the system defines the possibility of multiple architectures of such systems.

2. Such systems, when described, are usually represented as a set of interrelated systems.

3. Existing models of structural formalization of the subject area of the regional forest complex are focused on describing the structure of systems governing the forest complex and, therefore, they cannot be directly used as the basis for creating an architecture for the model aimed to search for common ways of improvement of state management of the forest complex that are associated with the selection of control actions.

4. Many works study the cluster approach to the development of the regional forest complex. The cluster architectures presented in them can also be used as examples of the overall architecture of the forest sector.

5. Sustainable forest management paradigm should become the main goal of using the model.

6. Managing the forest complex should be understood as the targeted impact of the bodies managing the timber industrial complex, which are the subject of management, on the object of management – the timber industrial complex; this impact helps achieve strategic objectives of the timber industrial complex, taking into consideration specific prerequisites and conditions in the regions.

7. When building a model of the regional forest complex, it is necessary to consider many interacting components that are related by their nature to various systems. All these

components should possess a set of properties that ultimately in combination determine the current performance of the forest complex.

Classic methods of analytical modeling have been traditionally used in modeling individual elements in the work of woodworking and timber harvesting companies. But, due to a high complexity of the real system of relations in forestry, the application of these methods faces a number of challenges, the main of which is the necessity of finding a balance between simplification and complexity of the system. As a result, in the development of the models, we have to discard the factors that have no effect (little effect) on the studied characteristics of the system. The choice of factors in this case is highly subjective, since it depends largely on the skill and intuition of the researcher. In addition, in the modeling of complex systems using analytical and simulation methods it is difficult to introduce changes, sometimes even minor, in the structure of the model. In this regard, in order to solve the problems of complex systems modeling, the agent-based modeling paradigm emerged; it uses intelligent agents as a high-level abstraction for formalizing and structuring the subject area and as a powerful tool for the development and implementation of complex models.

Agent-based modeling is a kind of simulation modeling. Its distinctive feature consists in the use of agents with individual behavior as basic elements. The agents have such properties as activity, initiative, ability to learn and communicate, intelligence, etc. Moreover, each agent possesses not only a given set of personal characteristics, but

also an objective function, on the basis of which responses to changes in the external environment and the behavior of other agents are simulated.

One of the main advantages of agent-based approach includes the ability to simulate the system as close to reality as possible. Limitations in the degree of detail in such models depend only on computational performance of the computers used [12]. Another important advantage of models of this type is “bottom-up” modeling that provides an opportunity to build adequate models in the absence of knowledge about global dependencies in a given subject area.

Review of foreign agent-based models in the forest industry

Currently, despite the fact that the method of agent-based modeling is relatively new, the range of scientific works devoted to its application in various branches of forestry is wide enough. This applies mainly to foreign studies. A large number of materials are dedicated to various aspects of modeling timber markets. Klaus G. Troitzsch [30] attempts to apply agent-based models of the urban housing market in Brazil and the German pharmaceutical market to build the model of the wood market in Switzerland. Noting significant differences between the forest industry compared to other industries, Klaus G. Troitzsch comes to the conclusion that in order to understand the actual wood market the agent-based models are more appropriate than the classical models of markets, because they can take into account all the characteristic features of forestry.

Ernst Gebetsroither, Alexander Kaufmann, Ute Gigler, Andreas Resetarits [21] present a comprehensive agent-based model of self-organization processes in adaptive forest management. The proposed model consists of two interrelated but, in all other aspects, independent subsystems that are implemented with the use of agents. The first – socio-economic – subsystem is represented by agents that perform the roles in the harvesting, processing and sale of timber. The second – environmental – subsystem simulates the processes of forest development. The agents are trees competing for living space.

Of interest can be a model described in the works of F. Kostadinova and others [24, 25], which presents the timber market of Switzerland, constructed with the use of agent-based models. The simulation was conducted on the basis of the Swiss canton of Aargau due to the following factors:

- relative availability of necessary input data for modeling;
- geographical position and conditions for wood production among Swiss cantons;
- availability of the necessary number of agents sufficient from the point of view of modeling, allowing to provide a large number of interactions among themselves, while ensuring reasonable timing of calculations.

When the model was designed, it took into account only the production and consumption of forest wood, including wood fuel produced from industrial production waste, excluding other sources, such as secondary wood processing.

The following data were used for model calibration:

- the number, size and location of wood-fueled heating systems in Switzerland;
- the number of loggers and the number of forests according to the results of the third Swiss National Forest Inventory (2010);
- the dynamics of forecast prices of oil over the past period for the purpose of determining, among other factors, the attractiveness of installing wood-fueled heating systems to consumers;
- classification and typology of forest management and wood processing enterprises, private forest owners, users of wood fuel, expert assessments.

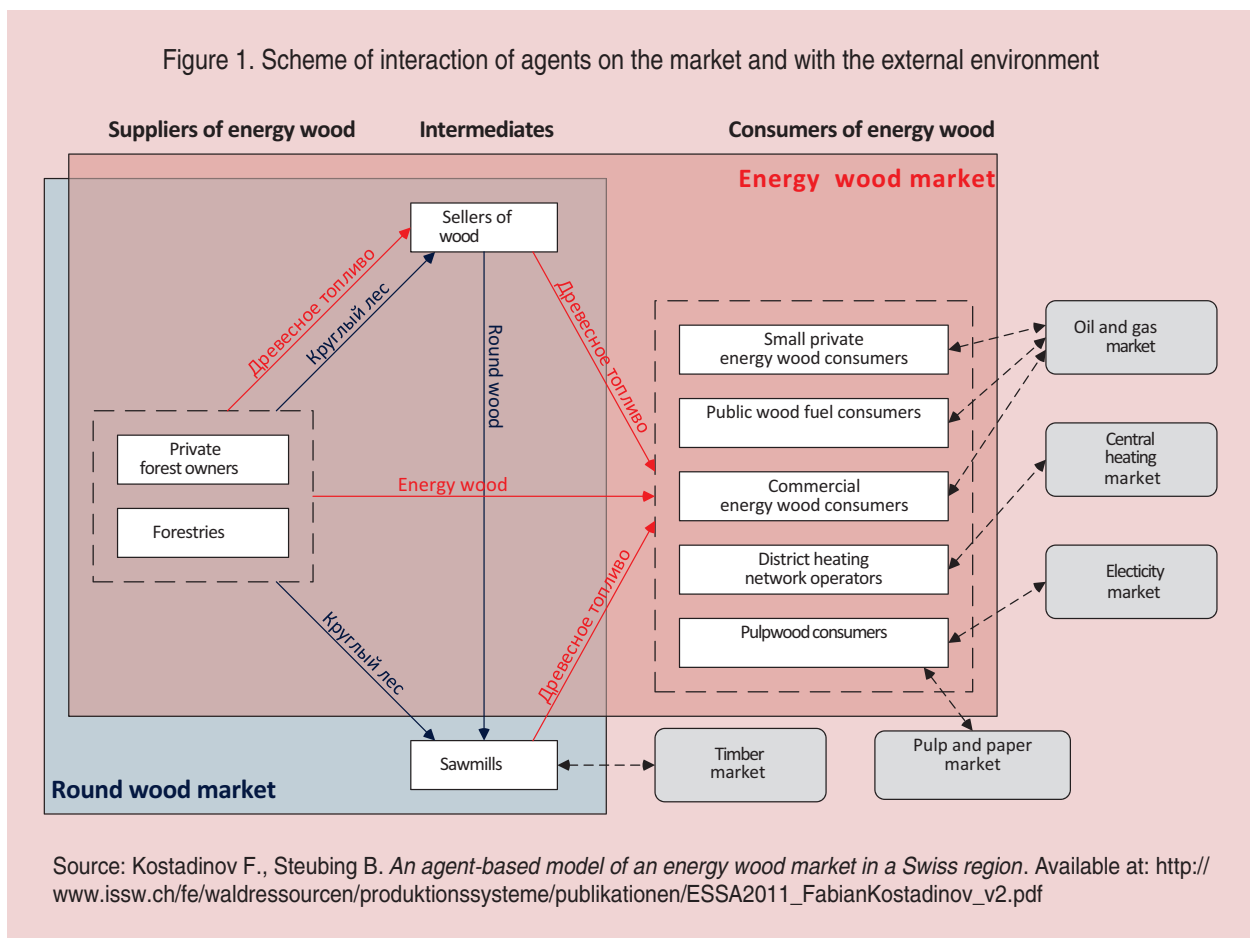
The model identifies the following classes of agents:

- Forestries – specialized organizations for forest management on behalf of third parties (municipal and state forests).
- Private forest owners – the owners of woodlots. The average size of woodlots in private ownership is much less in comparison with the forests managed by forestries. In the baseline model scenario, 50% of private forest owners have little interest in timber production and remain inactive throughout the simulation.
- Timber merchants – the intermediaries in the sale of round wood and wood fuel in both markets. They do not produce or consume either round wood or wood fuel.
- Sawmills – the only class in the model that consumes round wood. At the same time they act as suppliers of wood fuel.
- Small private consumers of wood fuel – detached houses with wood-fueled heating systems. Consume a relatively small amount of wood.

- Commercial consumers of wood fuel – private organizations that service commercial buildings that use wood-fueled heating systems.
- Public consumers of wood fuel – municipalities or similar organizations that service buildings under public ownership (schools, fire-fighting, etc.). Enjoy certain benefits in the market of wood fuel.
- Operators of district heating networks – commercial producers of heat. They service buildings connected to the central heating system.
- Consumers of pulpwood – chemical and paper industry. They compete for timber with other consumers of wood fuel.

The general scheme of interaction of agents on the market and with the external environment is shown in *Fig. 1*.

All agents have a fixed geographical location, possess a set of parameters and resources that include forests (for wood manufacturers), the supply of round wood and wood fuel (for wood consumers), and money. Agents act as suppliers, consumers or intermediaries in the market of round wood or wood fuel, depending on their role. For each class of agents there are algorithms of actions and decision-making; in addition to the criteria of profit maximization, the model takes into account the criteria of the “value of friendship” (transactions of purchase and sale with agents



who are friends), the criteria of “providing support to local markets” (the choice of the counterparty may be influenced by the desire to support local producers).

However, it is necessary to note some limitations of the model. We can see in Figure 1 that some markets such as the markets of oil and gas, central heating, electricity, timber and pulp and paper industry are outside the scope of the model and are considered as external environment. Even though some agents are quite strongly dependent on these highly aggregated markets, their interaction, as in the case of markets for round wood and wood fuel, does not take place.

In the proposed model, the pattern of natural changes in the forest fund is simplified considerably. Forest resources are simulated as homogeneous renewable resources of a certain size with natural upper threshold. The growth of the trees is distributed with the passage of time. The model does not include seasonal effects, changes in weather conditions, natural disasters, etc.

Nevertheless, at this stage, the authors themselves pursued the goal of proving the possibility and prospects of agent-based modeling to design the models of complex systems such as the timber markets.

A characteristic feature for the majority of models under consideration is the fact that certain associations of people such as private households, municipalities, commercial organizations, etc. are chosen as main agents. In the works of Stefan Holm et al. [23], Jessica E. Leahy et al. [26], Diana D. Valeriano et al. [31], the forest is considered as a resource with an algorithm of development that is simple

and does not require complex modeling. Another approach to the application of agent-based modeling methods is used in the works of Liliana Pérez and Suzana Dragicevic [28] on the protection of forests from insect infestation.

The research examines the impact of methods of protection of forests in British Columbia (Canada) from the outbreaks of mountain pine beetle (*Dendroctonus ponderosae* Hopkins, DENCPO) infestation that has resulted in extensive mortality of trees on an area of several thousand square kilometers. Given the fact that the dynamics of DENCPO infestation occurring between the trees and the insects within them, is part of a complex spatiotemporal process, at the first stage it was proposed to design an agent-based model for the behavior of insect colonies that would effectively reflect the regularities of trees being killed due to outbreaks of infection DENCPO infestation. At the next stage, different scenarios of forest management were added in the model for the purpose of assessing the effectiveness of protection of forests from pests.

Thus, the model consists of three types of agents: Beetle Agent, Pine Agent, and Forest Management Agent.

The Beetle Agent captures the behavior and life cycle of DENCPO based on the number of rules that determine the movement patterns in the forest, and selection of a healthy tree to attack, feed and breed.

When choosing a tree to attack the Beetle Agent takes into account parameters such as the arrangement of trees in the forest with the use of fuzzy sets, the natural range of DENCPO

flight, and the prevailing wind pattern in the region. Next, each tree located within the potential area of attack is estimated by the Beetle Agent by four parameters: health state of the trees within the stand, type of trees, average age and diameter at breast height. After the assessment of the hosts, the Beetle Agents decide whether to stay or fly to a different stand.

During its life cycle, the Beetle Agent passes through the following stages: egg, larva, and male or female beetle. Each stage is characterized by its own set of parameters and behaviors. The simulation takes into account the seasonal factor, when during the winter cold 80% of the DENCPO population is killed.

The Pine Agent is implemented to simulate the built-in mechanisms of resistance and self-protection of the trees against insect infestation. This agent is an autonomous entity (a separate tree) characterized by a number of parameters affecting the probability of infestation, such as type, age, height, health state, and diameter at breast height. In order to estimate the beetle population density per tree, Pine Agents are in charge to calculate the total bole surface area and on the basis of these calculations proceed to evaluate the population density of Beetle Agents per 1 m². If certain density values are exceeded, Beetle Agents start searching for new trees to attack.

To control the outbreaks of DENCPO infestations the Forest Management Agent is introduced in the model. The tasks of the agent is to assess the degree of infestation of each forest site in order to make decisions about the implementation of certain forest protection measures depending on the model scenario.

The model provides for three scenarios upon which the Forest Management Agent acts. Scenario 1 involves no action on the part of Forest Management Agents and gives them only an opportunity for monitoring and evaluation. Scenarios 2 and 3 provide for the possibility of making decisions about carrying out sanitation harvest or salvage harvesting to prevent further infection of healthy trees or entire forest stands.

The series of model experiments have confirmed the high effectiveness of active strategies of forest protection; although from our point of view, this model is interesting due to its selection of the agents, giving a new perspective on forecasting the development of forest ecosystems.

Many studies on the use of agent-based models in the forest industry are devoted to the issue of combating forest fires. Thus, the study carried out by Guangjun Zhang and Yaodong Li [22] implemented an agent-based model of a forest fire, considered as a typical open complex system. Muaz A. Niazi et al. [27] propose a virtual multi-agent forest fire simulation model based on FWI (Fire Weather Index – as estimation of the risk of fire according to weather conditions). These works are more theoretical in nature and are designed to confirm the applicability of simulation methods to complex systems.

We would like to highlight the work of Thomas A. Spies et al. [29], which uses an agent-based model of the interrelated social and natural systems to assess the impact of alternative management scenarios on the indicators of fire and environmental safety in a fire-prone landscape in Oregon, USA.

The general pattern of the model is shown in Fig. 2.

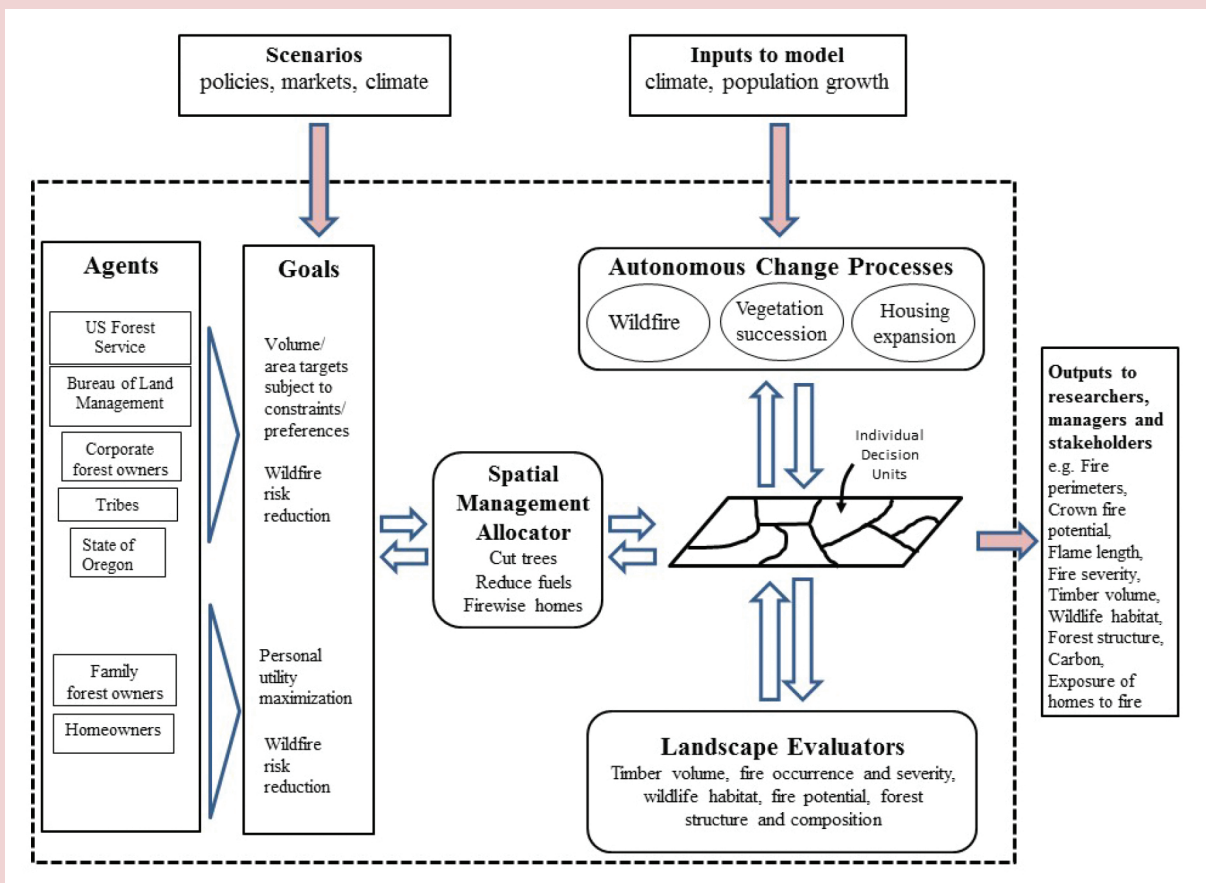
The agents in the model are large landowners engaged in forestry activities that can influence the changing landscape. Forest fires are simulated using a semiempirical fire spread algorithm that takes into account the composition and structure of forests, and the topography and weather conditions. Changes in the environment that occurred as a result of human activities and natural causes (including fire, windfalls, alternation of tree species),

create feedback that influences decisions about future management impacts of man, and the potential threat of forest fires.

Russian experience of agent-based modeling in the forest complex

In Russia, there has been a more widespread development of agent-based modeling in recent years. Scientists work to apply agent-based models in complex social systems, municipal, regional and state management, etc. The research findings include the studies of such authors as V.L. Makarov, A.R. Bakhtizin,

Figure 2. Agent-based model of the interrelated social and natural systems



Source: Spies T.A., White E., Ager A., Kline J.D., Bolte J.P., Platt E.K., Olsen K.A., Pabst R.J., Barros A.M.G., Bailey J.D., Charnley S., Morzillo A.T., Koch J., Steen-Adams M.M., Singleton P.H., Sulzman J., Schwartz C., Csut B. *Using an agent-based model to examine forest management outcomes in a fire-prone landscape in Oregon, USA*. Available at: <https://www.ecologyandsociety.org/.../ES-2016-8841.pdf>

E.D. Sushko [10, 11, 12], V.I. Suslov [17], M.R. Fattakhov [18], and others. At the same time, the number of agent-based models in the forest sector is sporadic.

For example, the works of P.T. Voronkova et al. [3, 4] raise the general questions of applying simulation modeling in forestry. We can acknowledge the work of Yu.S. Blam [2] as the most comprehensive and system study that makes an attempt to build an integrated architecture of an agent-based model of a regional forest complex represented by several forest harvesting companies (timber industry enterprise) and one comprehensive industrial enterprise that includes forest harvesting and wood processing production (timber industry complex).

The model considers various options for harvesting (clear-cut and selective) and sales of harvested wood; it takes into account seasonal factors and direct and indirect costs associated with timber harvesting. The conditional annual profit is considered as the main criterion.

Yu.Sh. Blam in the first stage formalizes the economic formulation of the problem in the form of optimization linear production-transport model and then converts it into a complex of agent-based models that describe the behavior of forest-harvesting enterprises and the timber industry complex, "other" agents of the regional level that define the external parameters of functioning of the regional timber industry complex and describes the logic and sequence of their interaction.

The author distinguishes the following types of agents: Forest Harvesting Companies Agents and Timber Industry Complex Agents presented

by the optimization linear production-transport models, Administration Agents, Markets Agents, and Finances Agents, represented by simulation units, and management decisions for these types of agents are formed in the model taking into account external influences.

At the debugging stage, these agents represent an information base generated by the scenario calculations of the basic model and generate for the first four calculating quarters the estimated parameters that coincide with the optimal solution to the original complex model. The inputs in the model, when moving to the next accounting period, are recorded taking into account the related decisions for the previous period and the information from external agents.

In continuation of the study, it is planned to develop further the scheme of interaction between the agents, to clarify the model description of functioning of enterprises in the current institutional and economic conditions, as well as to clarify the functional representation of external agents of the branch-wise subsystem of the region.

Similar to foreign works, of definite interest are the studies of the possibilities of application of mathematical modeling to fight forest fires. Here we can mention the works of D.O. Morozov, A.A. Dekterev et al. [13, 14], G.V. Sokolova [16], A.N. Razdayvodin and D.Yu. Romashkin [15]. But the possibilities of agent-based models are reflected most comprehensively in the work of S.V. Yarovoi and G.A. Dorrer [19, 20] that considers the problem of simulating forest fire situations. It is recommended to use the agent-based

approach in conjunction with the technology of geographic information systems (GIS), which allows for combining the advantages of both directions. A multi-agent model implemented on the basis of nested Petri nets enables to predict the spread of the edge of a forest fire, and imitate the direct method of fighting ground forest fire with the help of non-mechanized fire-fighting units.

The simulation environment in this study is represented by a section of the map of the real area coated with a layer characterizing the flammability of vegetational combustible materials, which is determined on the basis of a pyrological description of areas on the map of forests. Thus, for each location on the map a type of surface is set that determines the presence of major conductors of burning and their type, depending on which the base speed of propagation of the edge of the fire and the heat of ignition of the layer are defined.

The data on the speed and direction of the wind and the fire danger class are also taken into consideration as main indicators of the environment.

In the model under consideration, agents of two types are used. The agents of the first type represent sections of the front of fire spread and are used to model a forest fire, representing, in the aggregate, the outline of a fire on the map. The model allows for the simultaneous presence of several such contours propagating independently from each other in different parts of the map.

The agents of the second type simulate the actions of the firefighting forces and influence the agents of the first type.

The study describes in sufficient detail the parameters characterizing the agents of both types, their purpose, possible states, conditions and algorithms of transition from one state to another. The simulation results make it possible to solve a number of related tasks: first, to get a picture of the spread of forest ground fire in real terrain and under certain weather conditions; second, to determine the required number of fire extinguishers for the localization of ground fire in these conditions.

Conclusion

Having studied the existing experience of agent-based modeling in the forestry sector, we can point out the following:

- the range of contemporary research on the application of agent-based modeling in various branches of forestry is quite diverse, but to date there is no scientific developments in the field of building integrated models for the forest complex for the level of large territorial formations, intended for its prospective analysis and development planning;
- the range of domestic studies on this subject is more modest in comparison with foreign research;
- most models have the following feature: they use certain groups as the main agents: private households, municipalities, commercial organizations, etc., and the forest is considered as one of the resources with a simple algorithm of development, which does not require complex simulation;
- both foreign and Russian researchers studying the application of agent-based modeling in forestry note the high complexity of the forest complex as object of study due to

the large number of interdependent and often unpredictable factors, such as instability and changes in climatic conditions, possibility of natural disasters (fires and windfalls), and the need for long-term forecasting;

– due to the high complexity of the real system of relations in the forestry sector, the classic methods of analytical and simulation modeling traditionally used for modeling individual elements of the work of timber and logging companies are unable to ensure compliance with the requirements of modern systems for support of managerial decision-making in the regional forestry complex;

– the use of the agent-based approach in modeling the regional forest complex will help solve the issue of complexity and scalability of the model. The possibility of constructing multi-level and embedded agents and the individuality of the agents are most convenient for simulating such complex systems.

The most important task when building agent-based models in forestry is to determine common approaches to the formation of composition of agents and creation of

environment for their functioning. The simultaneous complexity and openness of the system provides for multiple architectures of such systems. Therefore, there is a need to elaborate the processes of identification of model elements, address the issues of their abstract representation, which will help describe the mechanisms of their interaction and formation of input impacts and obtaining the desired results [6]. It is necessary to consider the influence of spatial factors in the positioning of elements, and a multi-role aspect in the models of their behavior. An important task is to choose the scale of the model that allows efficient obtaining of the results that confirm adequacy; it will signify the possibility of its use in regional management systems.

So far, there has been no research on the general problems of building agent-based models for the forest complex. The results we have obtained in the analysis of agent-based models in the forest sector allow us to estimate the prospects of applying the agent-based approach to modeling the regional forest complex, to use the existing experience, and formulate directions of further research.

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Human and Social Potential of Neo-Industrial Development of the Arctic: Sociological Analysis, Modeling, and Regulation



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Abstract. The present article is a continuation of the previously published paper [6] and it reviews the methodology, conceptual approaches to sociological analysis, modelling, monitoring and management of human and social potential of neo-industrial development of the Russian Arctic. The successful implementation of this task and the preparation and adoption of efficient management decisions require reliable analytical and diagnostic information about the social situation in this macro-region and opportunities for supplying the planned investment projects with human resources. The aim of the study is to create a sociological ground that will help obtain necessary sociological information in the preparation and adoption of administrative decisions of government agencies in the monitoring mode and regulate social processes in the Arctic region more efficiently. With the help of the methodology of socio-

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spatial and socio-territorial identification and with the use of social simulation we carry out our own analysis of the current status and trends of human potential (quantitative and qualitative characteristics of human resources, their health and level of professional training) and social potential (social ties, trust, involvement in the regional community). It is a fundamentally new methodological approach and it has been proposed and implemented for the first time based on the materials of the Arctic region (the Yamal Peninsula) crucial for Russia. Neither domestic nor foreign sociologists have conducted such work before. The application of the social simulation methodology in a sociological study of human and social potential of the Far North, its reproduction and intensification for the purpose of neo-industrial development and social development in the empirical aspect was implemented by analyzing the statistics, mass surveys, interviews of target (reference) groups, and expert assessments. In the framework of this methodology we should particularly note an agent-based approach which along with system dynamics modeling helps identify the subject and, with some degree of formalization, to represent the subject-to-subject relations of main participants of the neo-industrial frontier and align them for monitoring and regulation. The article presents a preliminary design of the model. The model and sociological ground thus formed contains sociological information about the subjects of a new development of the North concerning the direct target (forecast) property: characterization of important constituents (components) of human and social potential of the Arctic frontier, in particular the set of direct and indirect indicators of the quantity and quality of people who have expressed a desire and intention to live and (or) work in the Arctic; their educational and professional competences; their physical, mental and social health, etc. In the general framework of social capital we highlight the indicators of social identity and social trust. The materials of a sociological research that we put forward allow us to offer the authorities and management reliable analytical and diagnostic information about actual and potential participants of neo-industrial development of the Yamal frontier. We also outline the following prospective directions of further research and development: to create an information-analytical system based on BIG DATA and DATA MINING, to map the layout of the information received, the new technologies of dialogue interaction between representatives of different social groups and institutions involved in the processes of development, etc.

Key words: Arctic, development, social and human potential, modeling, sociological research.

Introduction

In the previous article [6] we considered socio-spatial transformations of the territory of the Yamal Peninsula. The aim of the present publication is to put forward a research project, which can help build a model-sociological ground for assessing the most important components of human and social potential of the Arctic frontier with the use of an agent-based approach; we are referring to the plans for the upcoming neo-industrial development of the Arctic.

This has become possible mainly due to fundamental research carried out by V.L. Makarov and A.R. Bakhtizin [5], and by M.K. Gorshkov and V.A. Ilyin [8]. Some ideas on socio-economic issues in the development of the Russian North, proposed by N.Yu. Zamyatina [2], A.N. Pilyasov [7], A.A. Shabunova [10] and several other domestic and foreign scientists [11, 19, 21, 22] are also of considerable interest. It is especially important, because conceptual approaches of the national industrial policy in the framework

of neo-industrial development [1] have been clearly delineated in the Russian practical and academic discourse. Unfortunately, in general we have to admit that little attention is paid to scientific sociological and interdisciplinary support for an upcoming development of the Arctic [14].

We understand neo-industrial development of the Arctic region as the process of creating a territorial-industrial complex of a new type in extreme climatic conditions; this complex is based on a set of associated productions and logistics that have high technical and technological level (fifth and sixth technological orders), require skilled labor and scientific and technological support of production processes.

The formation and functioning of such a complex must be environmentally friendly; it needs to have all the necessary means to neutralize threats and risks of violation of natural balance of the territory [13, 16].

The lives of people, servicing this complex must be quite comfortable, and the area should have the necessary social infrastructure for permanent residence of the staff with families and for temporary residence of rotational workers. These circumstances are especially important for a region with extreme climatic conditions. It is also crucial to take into account the interests of indigenous peoples (indigenous ethnic groups who lead a traditional way of life connected with reindeer herding, fishing, gathering, hunting, and other crafts [4].

We have chosen Yamalo-Nenets Autonomous Okrug (YaNAO) as the main object of study of the Russian Arctic; the Okrug occupies one fifth of its territory and is the central and most significant link for the economy. YaNAO

is also called the energy heart of Russia: oil, gas and products of their processing are shipped from here to 21 European countries. Currently, on the basis of the South Tambeyskoye gas field, the company Yamal LNG, the main shareholders of which are Nova TEK (Russia), Total (France) and CNPS (China), finishes the construction of a plant to produce liquefied natural gas; the capacity of the plant is 16.5 million tons. The company also finishes the construction of a port to ship the products by sea.

When speaking about the Yamal frontier, we mean that in the scientific literature, the term “frontier” is used in two senses: as the border of developed areas, the front boundary or the whole area of new development, the border region. For instance, in the U.S., the term was officially used to denote the line bounding the area with a population density of less than two people per square mile [9]. In Russia, frontier is more often viewed not only as a border, but also as the whole area with special social conditions, public administration and social control, as the territory with dynamic and unstable equilibrium, where the informal norms in some cases are much more important than the official ones. The residents of Yamal call the rest of the country “Earth” [6].

The region under consideration – Yamalo-Nenets Autonomous Okrug – has all the features of a frontier: its population density currently stands at less than one inhabitant per square km. We agree with the viewpoint, according to which the modern concept of frontier is also characterized by the phenomenon of Arctic urbanization – a zone, where new technologies and institutions are developed. From the classical theory of the American frontier (as a very natural

development of the territory) there are parallels to the prospects of development of basic settlements of the Russian Arctic as potential centers of innovation in architecture, life support technology, institutional arrangement of communities with a large proportion of migrants and those who have been residing here for a long time, including the indigenous peoples of the North [2; 7].

Methodology and methods

Our study was constructed in the framework of a general paradigm of socio-spatial and socio-territorial identification in a transforming society [8]. We have chosen social simulation methodology in order to analyze human and social capital in different territorial units of the Arctic region. The methodology is used in solving semistructured problems by formalizing the concepts on the basis of qualitative and quantitative information about the selected fragment of social reality and participants of the relevant processes in the design of agent-based models [5; 23].

We have set a goal to form a model-sociological ground (for neoindustrial exploration of the Arctic), for which we have collected statistical and sociological data and analyzed them, which enabled us to characterize the main social groups that are agents of neo-industrial development in the region in the aspect of human and social potential necessary and sufficient for life in new conditions. We proceeded from the idea that each of the components of this potential is characterized by a specific set of quantitative and qualitative indicators previously used for system dynamic simulation modeling [12]. We can say that the human potential of the Arctic zone is a set of certain human characteristics that help forecast their future possibilities of

life in the Far North and participate in the new reproduction of this zone [17, 18].

The human potential of the Arctic frontier has the following basic features of people who live and (or) work in the Arctic:

- demographic characteristics of the quantity and quality of certain population groups who link their plans with the region, including the standard of living and quality of life;
- their professional competences, including education and training;
- their physical, mental and social health.

State and sectoral statistics also use these items to a certain extent, and they can be found in relevant statistics collections, but most of the necessary information requires that special sociological research be conducted like mass surveys of the northerners belonging to different social groups (long-term residents, including representatives of indigenous peoples of the North – indigenous ethnic groups; settlers – people who have lived in the Arctic region for less than three years; rotational workers who came here to work from other regions), in-depth interviews of experts, content analysis of the media, including social networks; analysis of accounting statements of oil and gas companies and other organizations [15, 20]. Moreover, it is necessary to carry out a sociological analysis of social potential of exploration, which emphasizes issues of social identity, and social trust.

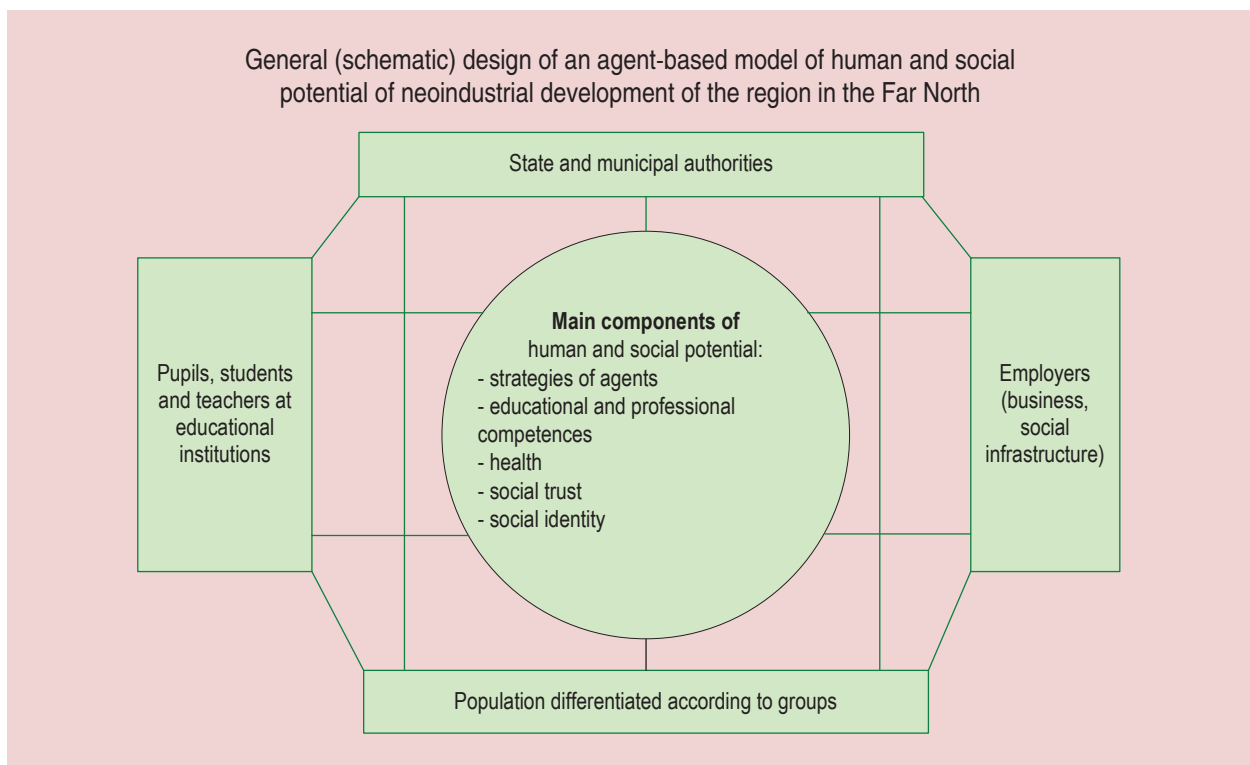
In the context of the data of the population censuses of 2002 and 2010 and current statistics materials of 2010–2015 relating to YaNAO, we have analyzed the results of several sociological surveys, including the one performed in 2015 jointly with the Arctic Research Center (town of Salekhard, V.A. Kibenko et al.); the survey

covered 2,285 respondents 18 years of age and older, who reside in the region; in the administrative center of YaNAO – the city of Salekhard (p=414, r±2.9%); in the gas “capital” – the city of Novy Urengoy (p=531, r±4.3%); in the oil production center – the city of Noyabrsk (p=517, r±3.1%) and other settlements of YaNAO, including the areas of compact residence of indigenous ethnic groups. The quota sample represented the gender and age of respondents. The overall sampling error for the district as a whole did not exceed r±2%. The materials of this main survey (hereinafter – SS main) have been compared with the results of other population surveys of different social groups of northerners (hereinafter – SS gr.), for example, such as long-term residents (in 2010, p=1013, r±2.7%; in 2015, p=1115, r±2.5%); representatives of indigenous ethnic groups (in 2010, p=596, r±2.9%; in 2015, p=603, r±2.7%); newcomers in the Northern region who have lived here for less than three years (in

2010, p=496, r±2.8%; in 2015, p=513, r±3%); rotational workers who came from other regions (in 2010, p=615, r±2.9%; in 2015, p=722, r±2.6%).

In the framework of a survey of gender differences in the health of northerners in 2010, men older than 18 and residing in the town of Nadym (p=510, r±2.3%), town of Muravlenko (p=418, r±3.1%), settlement of Tarko-Sale (p=205, r±3.3%), settlement of Tazovsky (p=231, r±4.1%) were surveyed, and another survey according to the same methodology was carried out in 2015 (hereinafter – SS health).

To assess the situation in the sphere of personnel training for the North in 2014–2016, the surveys of 195 representatives of major employers (oil companies), teachers (560 people) and students (670) of Yamal branches of Tyumen universities were conducted with the use of a quota-territorial sample (hereinafter – SS education).



Results

Developments of agent-based social models that have recently become well-known help combine system dynamic simulation with this new form of social engineering, formalize and “revive” social expectations, intentions, behavior strategies of certain population groups that are most important in addressing social issues (in this case – the development of the circumpolar region in a neo-industrial discourse) [5, 23].

The main agents in the context of human and social potentials are selected as follows:

- population groups differentiated by gender and age, by period of residence in the region (particularly – representatives of indigenous peoples of the North – indigenous ethnic groups, and rotational workers);
- pupils, students and teachers of educational institutions located in the region;
- employers – representatives of the enterprises of key profiles for the development and institutions of social infrastructure;
- state and municipal authorities (*Figure*).

Human potential of the Yamal frontier

We consider human potential in this context not just as a general definition describing the physical and spiritual strength of individuals and communities that promote the reproduction of society, but as actual abilities of people and groups that are in-demand and necessary in dealing with specific tasks in the new development of the Arctic region. First and foremost, they are the following interlinked characteristics: socio-demographic characteristics of the quantity and quality of people who want to live and (or) work in the Arctic; their professional competence; their physical, mental and social health, measured with the help of sociological scales.

Total population of YaNAO is about 540 thousand people, of which 61.7% are Russian, 9.9% are Ukrainian, 8% are representatives of the peoples of the Volga region (Tatar, Bashkir, Chuvash), 6% are representatives of the North Caucasus and Transcaucasia, and 9% are indigenous peoples of the North (the most numerous of them are Nenets and Khanty). About 17 thousand people lead a nomadic life.

In the past years, about 45 thousand migrants come to YaNAO, and about the same number of them leave; i.e. there is a renewal of about 10% of the population in the Okrug.

In addition, there is an increasing number of people who live on the move and commute long distances throughout their entire life. Today, one in four people working in YaNAO is a rotational worker who came here from another region of Russia or the CIS.

The development of new neo-industrial Arctic territories has been launched and is now accelerating. The Bovanenkovo, Novoportovskoye and Tambeyskoye centers of oil and gas production on the Yamal Peninsula, Kamennomyssky oil and gas area in the Gulf of Ob, etc., major infrastructure facilities and communications, the multi-functional sea port of Sabetta, LNG plants, etc. are being developed. It means that the need for professionally trained personnel increases significantly.

At the same time, almost three quarters (73.2%) of respondents residing in YaNAO intend to leave the territory of the district now or in the future (*Tab. 1*). In addition, more than half of parents participating in the survey (57.2%) do not want their children to live and work in the Far North when they grow up. All this, of course, heightens the importance of exploring opportunities of retaining necessary

permanent employees in the region and using interregional work on a rotational basis more efficiently [19, 20].

Speaking about human potential, the authors mean primarily the number and quality of people who are involved in the development of the Arctic region and who intend to continue living and (or) working there, the set of their professional and cultural competencies, and the ability to live permanently in the North or work there on a rotational basis provided by their good health status.

All of the identified intentions (life strategies) require further monitoring with a detailed characterization of the qualities of their bearers. Special attention is drawn to a group of agents who chose the “marginal” strategy “I want to live here for a little while and then I plan to leave”. It has the largest proportion in the modal value of distribution of agents, and from the point of view of neo-industrial development of the region it needs to clarify motivational attitudes in the dilemma “to stay or to leave”, and the prospects of retaining the necessary personnel on site, especially young and middle-aged people who have already adapted to the conditions of the Far North.

One of the important drivers of intensification of human potential in the region is vocational and educational training of specialists who are going to work in new conditions.

Training of skilled workers is carried out mainly by companies themselves at educational and training centers; highly qualified specialists for the oil and gas industry in Russia are trained in four universities: Industrial University of Tyumen (previously known as Tyumen State Oil and Gas University), Gubkin Russian State University of Oil and Gas, Ufa State Petroleum Technological University and Ukhta State Technical University. Most of the engineers in the Yamal region are graduates from the Industrial University of Tyumen, which is the largest research and educational holding that includes not only educational institutions of different levels, but also scientific research institutes, a design institute, facilities for pilot production of high-tech products and high-tech services. Workers for the North are also trained there.

In the target (reference) groups we studied the quality of training at different universities, and also how students, teachers, and representatives of employer companies assess key aspects of educational process.

The information was obtained in 2014–2016 with the help of a questionnaire survey of 670 undergraduate students, 560 professors and 195 managers representing oil and gas companies with the use of quota-territorial sample (SS education). Some results of the survey are given in *Tab. 2*.

Table 1. Desired places where residents of different age plan to live (percentage of respondents)

Intended place of residence	Respondents' age, years			
	18-24	25-39	40-54	55 and over
1. I want to live here for the rest of my life	31.3	27.1	22.4	31.1
2. I want to live here for a little while and then I plan to leave	57.0	62.5	65.4	51.1
3. I want to leave as soon as the opportunity presents itself.	11.8	10.4	12.2	17.7

Source: data of SS main as of 2015 (in collaboration with the Arctic Research Center, V.A. Kibenko), n=2,285 respondents.

Table 2. Evaluation of the quality of training of professionals for the development of oil and gas resources of the Arctic region in Russian institutions (percentage of those surveyed in each group)

Assessment	Students	Teachers	Employers
I think it is sufficiently high	47.4	59.4	22.5
I think it is satisfactory	36.9	25.4	35.0
It requires radical change	3.1	13.2	39.1
I am not sure	12.6	2.0	3.4
Total	100.0	100.0	100.0

We note a significant difference in the rating of the main agents of the components of our model: the teachers' assessments are clearly too high, and the assessments made by representatives of specialized companies are obviously more realistic. The identified imbalances require detailed explanation and further sociological monitoring with direct participation (dialogue) of main agents.

In the course of the survey specific proposals to change the structure and content of educational process were received. In addition, according to a significant number of respondents, the current interaction of universities with the regional community is implemented insufficiently. Meanwhile, a regional university that cooperates effectively with government, business, and civil society should be the main integrator of innovative neo-industrial development of the Arctic region, coordinator in the formation of new partnership

structures (business incubators, technology parks, etc.), testing ground for innovative technology and business processes, and ultimately one of the key actors (stakeholders) in sustainable socio-economic development of the Arctic.

The importance of the health component of those who participate in the development of the Arctic is confirmed by the data of medical statistics and the results of conducted mass surveys of the northerners.

For instance, the causes of mortality in the working age population of Yamalo-Nenets Autonomous Okrug are as follows: diseases of the circulatory system (21.2 cases per 10 thousand people), accidents, poisoning, and injuries (12.8 cases per 10 thousand people). The low-quality alcohol poisoning, drug overdose, suicide, and homicide account for nearly half of the causes of death. Nevertheless, self-reported health is quite high, especially in men (*Tab. 3*).

Table 3. Self-reported health in male residents of Yamalo-Nenets Autonomous Okrug (percentage of respondents SS health)

Self-reported health	2010	2015
I feel good	40	38
I fall ill sometimes	36	35
I fall ill often	10	12
I am chronically ill	8	8
I am a disabled person	3	2
I cannot say for sure	3	5
Total	100	100

However, these data indicate an emerging trend of deterioration in self-rated health in those who came to the North. The reasons for this are the climatic, socio-psychological, environmental (anthropogenic) and other factors and their interaction.

For example, with the combination of geomagnetic field disturbances and gravity anomalies, there is a dramatic increase in the number of cases of exacerbations of cardiovascular diseases, mainly hypertensive crisis, myocardial infarction, and errors of operators.

Northern natural conditions that affect the health of the people who came here from other regions are quite diverse and are still not studied profoundly. It is not only low temperature, but also the lack of daylight leading to seasonal depression and insomnia, high wind speed, atmospheric pressure, specifics of water and nutrition, etc.

Moreover, rotational work makes all of these multiple effects on the human body not continuous, but fractional in their nature. Regular long-distance commuting that implies crossing multiple time zones, changes in the climate and social conditions – all these factors do not allow an individual to establish stable relations with their external environment, so the life on the move, when rotational workers “live in the South and work in the North”, is accompanied by chronic tension of regulatory and adaptation systems of the human body.

In the course of the surveys of northerners we found out how satisfied they are with medical care in general and with its individual aspects. The indicators turned out worse than the national average ones that had been identified earlier by major sociological centers [10, 13].

Despite the sufficiently low level of people’s satisfaction with existing healthcare system, the government reduces healthcare expenditures and the number of medical organizations. Thus, in recent years their number on the territory of Yamalo-Nenets Autonomous Okrug has decreased by half (there were 48 hospitals and 78 out-patient healthcare facilities in 2000; in 2015, their number was 23 and 36, respectively). Besides, the change in subordination of local medical institutions (from the municipal to the district governance) is assessed negatively by the population.

Social potential in the discourse of the agent-based model for development of the circumpolar region

In this study, we consider social potential as a set of connections and relationships between people and social groups in relation to the type and place of their life in the aspects of social identification and satisfaction with these relationships from the standpoint of the current status and prospects.

As part of immediate preparation for the use of the methodology of social simulation based on a representative mass survey (2,285 respondents) in 2015, we investigated various combinations of regional identity, including the identity of the residents of Yamalo-Nenets Autonomous Okrug in the discourse of agent-based relations. Whom do people living in the Arctic region identify themselves with? It turns out that the priority is given to national and state identity – 43.4% of respondents consider themselves primarily as “Russian”; ethnic identity ranks second, with 16.6% (including “Russian” and “Slav” – 12.3%), followed by regional identity (“northerner” – 11.5%, “resident of Yamal” – 9.8%), and finally, local identity – 5.1% of respondents (“resident of

Salekhard”, “resident of Novy Urengoy”, etc.). It has been found that people born in the Tyumen Oblast, felt the sense of regional identity stronger, and the feeling of state and ethnic identity is stronger in those who came from other regions.

It has been found that sufficiently strong social connections between individuals and social groups can be formed only on the basis of trust at all levels of social relationships [3]. Trust is the confidence in the honesty

and sincerity of others or the state and non-governmental institutions, the media, etc. It is one of the foundations of social cohesion, which largely determines the dynamics of development of the social situation in the Arctic region under consideration.

Sociological studies documented a decrease in the level of trust in different levels of social interaction, and in representatives of different groups of agents. Thus, surveys conducted on representative samples in Salekhard, Novy

Table 4. Dynamics of changes in the level of social trust of Yamal residents (percentage of respondents SS gr. 2010 and 2015)

Object of trust	2010			2015		
	Level of trust					
	I trust	I don't trust	I am not sure	I trust	I don't trust	I am not sure
Regional government	29.6	39.0	31.4	27.0	40.5	32.5
Municipal authorities	27.5	28.7	43.8	25.8	31.2	43.0
Political parties and figures	19.0	34.9	46.1	15.3	28.2	56.5
Mass media	25.5	40.1	34.4	25.4	29.3	45.3
Religious denominations	35.5	38.9	25.6	35.4	40.0	24.6
Social environment (neighbors, colleagues)	32.8	41.4	25.8	24.0	43.6	32.4

Table 5. Trust of inhabitants of Yamalo-Nenets Autonomous Okrug in the authorities (percentage of respondents SS gr. 2010 and 2015)

Social groups of Yamal residents	Level of trust					
	2010			2015		
	I trust	I don't trust	I am not sure	I trust	I don't trust	I am not sure
Long-term residents (living in the North over five years)	24.8	26.3	48.9	24.1	42.2	33.7
including representatives of indigenous ethnic groups	18.3	31.4	50.3	18.1	32.6	49.3
Newcomers (living in the North for less than three years)	28.1	33.3	38.6	26.1	35.7	38.2
Rotational workers whose permanent place of residence is in other regions of Russia and the CIS	31.2	41.4	27.4	28.2	28.9	42.9

Urengoy, the rotational settlement of Yamburg and the settlement of Yar-Sale show that the representatives of some selected groups trust others less: aboriginal people representing a Northern ethnic group do not trust others, especially outsider visitors; those who live in the North all the time (for more than five years) have a more negative attitude toward rotational workers from other regions, etc. (*Tab. 4, 5*).

Analysis of the data suggests the presence of a very sustainable trend in the low level of trust of the agents representatives of residents toward the agents authorities and other official institutions. At the same time, it is noteworthy that there is quite a sharp decline in the trust in the immediate social environment (neighbors, colleagues, etc.).

Obviously, in the further explication of this multi-agent model, we should select this group as a relatively independent agent and take it into account in tracing the social potential, especially because it can be assumed that the solution to the dilemma “whether to leave or to stay” depends on this agent-agent link.

However, the attitude toward the authorities was and still remains the fundamental basis of the relationship of trust. This attitude is highly differentiated across different groups of the population, especially on the basis of how long the people have lived in the region.

According to the survey, the greatest level of social discontent, pessimism and distrust of the authorities is typical of the representatives of indigenous ethnic groups (Nenets, Khanty and Selkup) who believe that “everyone tries to deceive them”. They are often afraid to answer frankly, hence the largest proportion of those who chose the answer “I am not sure” (about half of the respondents).

As for the rotational workers who arrived to work in the North from other regions of Russia and the CIS, they are more optimistic than the long-term residents of Yamal.

At the same time, in all the categories of respondents there turned out to be a high proportion of those who are “not sure”, which is, obviously, an expression of distrust. It turned out that a critical attitude toward the authorities and distrust of them correlate with the increase in age and in the level of education.

Distrust of the authorities and political leaders is aggravating in connection with the increasing income differentiation and the inequality in income distribution. So, in recent years, the total incomes of the wealthiest 10% exceed in 29 times this indicator for the poorest 10%.

It was revealed that among the newcomers and rotational workers from other regions of Russia there are opposite trends in the dynamics of social trust in the immediate environment. A lot of romantics come to work in the North believing that can find a more free and pure social space there; they believe that in the North there are no traditional mechanisms of social control based on kinship and neighborhood relationships (except for the cases when the whole clan moves to the North), and you can find secured independence in this region, etc. However, not everyone can get used to the new norms of “personal” responsibility for their words and deeds, and they are sometimes excluded from relevant reference groups, become disappointed and even angry.

Thus, social potential of the regional community is largely determined by the reliability of social relations based on the trust in social and governmental institutions, as well as in the immediate environment. Not less important is social inclusion in local and

regional community (or, conversely, exclusion from it), the identity of inhabitants of the Arctic region, which further reinforces the need for research on human and social potential with the help of agent-based models.

Conclusion

The application of social simulation methodology in a sociological study of human and social potential in the region of the Far North, its reproduction and intensification for the purpose of neo-industrial and social development has shown the prospects of this trend in theoretical-methodological and practical terms.

In the framework of this methodology, the agent-based approach is especially relevant; along with system dynamics modeling it helps identify and represent subject-to-subject relations of participants of the main neo-industrial frontier and build them for the purposes of monitoring and regulation.

Thus, the contours of a model-sociological regional ground have been formed, in which human and social potentials were represented in the set of direct and indirect characteristics of the number and quality of people who have expressed a desire and who actually intend to live and (or) work in the Arctic; their professional competencies; their physical, mental and social health, etc., all this is of major importance for neo-industrial development of

the Far North.

The sociological research conducted by the authors in cities, towns, national and rotational settlements of the Arctic frontier helped obtain reliable analytical and diagnostic information on the main characteristics of social (trust in the social environment and government, involvement in the regional community) and human potentials (quantity and quality of potential participants) in neo-industrial development of the Yamal frontier.

Further work in this direction can be carried out in the field of geographic information (mapping) explication of these models and in an interactive mode of sociological monitoring with the use of computer technology that includes communication and interaction (social networks) between the agents representatives of various groups in the development of the region and its social development, the expansion of this circle with the help of experts-consultants, representatives of government, business, nongovernmental organizations, the media, and residents themselves acting as informants who are directly involved in the preparation and evaluation of management decisions. In the diagnostic and design perspective, these arrays can be combined in an information-analytical system on the basis of BIG DATA and DATA MINING.

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Demographic Theories and the Regional Aspect of Population Ageing*



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Abstract. Population ageing is a major demographic trend of our time. The increase in the proportion and number of elderly people requires that the governments of “ageing” countries develop measures to mitigate the effects of demographic ageing reflected in two interrelated aspects: maintaining sustainable socio-economic development and ensuring a decent quality of life for the elderly. At the same time, as the experience of developed and developing countries shows, in order to ensure effective implementation of the measures it is necessary to take into consideration regularities and territorial features of the age structure transformation. The relevance of our research is determined by the need for scientific understanding of the process of demographic ageing taking into account the system nature of its characteristics (global nature and inevitability in terms of the narrowed reproduction of the population)

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and the multiplicity of implications for socio-economic development. The aim of our research is to identify the regularities and regional features of population ageing. We carry out the research with the use of general scientific methods (logical and system approaches, structural-functional analysis, generalization), statistical methods (grouping, sampling, comparison, and generalization), as well as graphical and tabular methods of data visualization. The article presents a review of theoretical concepts that define the essence of the process of population ageing and the results of a comprehensive statistical analysis of the main indicators of changes in the age structure in retrospect and in prospect. We conclude that the nature of the process of population ageing is dialectical: on the one hand, it has been proven that there are phases of demographic transition universal for all countries; on the other hand it has been revealed that the specifics of change in the age structure of local areas differ in the time of passage of these phases, intensity of increase in the number of elderly population, as well as the influence of factors that are external in relation to the demographic system (e.g., economic and political situation in the country, wars, disasters, etc.). Areas that have a comparable proportion of the elderly in the population can vary significantly according to quality characteristics of this socio-demographic group. In this regard, there is a practical need to obtain objective and relevant information about the situation in contemporary Russian and Mongolian societies; it is also necessary to develop a set of measures to adjust socio-economic development taking into account the specifics revealed.

Key words: demographic ageing, age structure of the population, older generation.

Introduction

According to demographic forecasts, the process of population ageing in the future will be intense, but it will be uneven in individual regions and countries. The current stage of research is driven by the rethinking and change of scientific paradigms, the generation and development of new methodological approaches in the study of various social strata. The main blocks of scientific issues are related to demography, social institutions and the role of government. In the last decade, developed countries and later, developing countries, have faced significant changes in the age structure of the population caused by declining fertility and mortality: as the share of children and working-age population is decreasing, the share of the elderly is increasing continuously. Science calls this phenomenon “demographic ageing”. French demographer A. Sauvy points out that demographic ageing is easy

to calculate and forecast, but it is difficult to imagine what consequences it will lead to [19]. In science and journalism, demographic ageing has different definitions, from “quiet revolution” [6] to “silver tsunami” [10], and the estimates of the problem range from the greatest achievements of mankind up to the threats to its existence. Of course, population ageing is one of the global challenges of our time. When studying demographic ageing the emphasis in most cases is placed on strategies and mechanisms for leveling its socio-economic impacts that are reflected in the budget deficit of the pension system, reduction of demand in the labor market, and an increase in the burden on the health system, etc. However, rapid ageing of many countries raises the question about the nature and regularities of this phenomenon: is it similar in all countries, or does it have its specific features?

1. Population ageing in the context of demographic theory

Theoretical generalization of population reproduction regularities has been a subject of debate in demographic science during the last few centuries. One of the first to attempt to describe general patterns of demographic development was made by English scholar Thomas Malthus in his work “An Essay on the Principle of Population” (1798) [11]. The followers of Malthus, while admitting the presence of logical and statistical errors in his work, did not question the very essence of “natural law” and “natural character”.

The theory of population in the Marxist ideology stems from the recognition of critical importance of socio-economic factors in the alteration of demographic situation and the establishment of population reproduction regime. K. Marx noted that “... every special historic mode of production has its own special laws of population, historically valid within its limits” [12]. Thus, the Marxist theory of population does not agree with the “natural” and “biological” essence of population growth, which, according to K. Marx, is determined by the development of production mode and changes with the transition to the next socio-economic formation. Population theories of T. Malthus and K. Marx made a significant contribution to the development of demographic science, but in general they reflect only the quantitative aspect of the problem under consideration and pay less attention to qualitative changes (including those related to age structure).

One of the first scientists who proposed a classification of types of age structure was Swedish demographer A.G. Sundberg, he put

forward his theory in 1894 [14], and later, in the 1930s, it was developed by F. Burgdörfer. Demographic ageing was the subject of research of such scholars as E. Rosset (“Aging Process of Population”, 1968 [16]), and A. Sauvy (“General Theory of Population”, vol. 2, 1977 [19]). However, it was substantiated conceptually in the framework of the dominant theory of population – the theory of demographic transition.

Among the most significant events in the development of demographic transition theory is the publication of the book by A. Landry “La Révolution Démographique” (1934) [22], in which the model of transition was formulated; it includes three phases: primitive (high fertility and high mortality), intermediate (high fertility and relatively low mortality) and modern (low fertility and low mortality; population stabilization). We can see that each phase has specific types of population reproduction, which, in particular, are used in the substantiation of the concept of demographic transition [2]: archetype (first phase), traditional (second phase), and modern/rational (third phase). Researcher N.B. Barkalov interprets demographic transition as a change of historical types of reproduction due to general socio-economic development caused by the development of the productive forces [2]. Such an understanding of conceptual foundations of the phenomenon under consideration explains the presence of specific stages of demographic development in different regions.

W. Thompson, a classical scholar of demographic transition theory [25] was one of the first to reveal the general patterns in demographic development of countries that

differ in many characteristics (including the level of socio-economic development); he also found a chronological sequence of changes in the combinations of fertility and mortality. Thompson also drew attention to possible changes in the structure of society as a result of population ageing (comparing the conservatism of the “old” France and the nonconformism of the “young” United States of America).

The second “birth” of demographic transition theory that occurred in the 1940s was connected with F. Notestein [23]. He designed a model of demographic transition, which includes four stages: 1) high degree of stability (characterized by high levels of death and birth rates; population size is relatively stable); 2) initial growth period (decline in death rate and increase in birth rate; population size is growing slowly); 3) modern growth period (low death rate and decline in birth rate; there is a huge increase in population size due to the accumulation and realization of demographic dividends of the previous years); 4) low degree of sustainability (stabilization of birth and death rate levels and population size) [3]. It should be noted that the proposed classification of demographic transition stages is close to its modern form. In this model, demographic ageing process should begin during the transition from the second to the third stage.

Russian demographic science is developed by a broad range of researchers of demographic transition theory. At different times this area was studied by A.Ya. Kvasha, N.B. Barkalov, A.I. Antonov, V.A. Borisov, A.G. Volkov, L.E. Darskii. We should also note the contribution that researcher A.G. Vishnevskii made to the development of this theory. He published a large

number of works on the subject, and a four-phase model of demographic transition that he designed in 1982 [4; 5] is commonly used in domestic science:

- first phase: death rate is falling faster than birth rate; as a result, there is an increase in the rate of natural increase, which at some point reaches its maximum;

- second phase: death rate continues to fall and decreases to some minimum, while birth rate is declining more rapidly; population increase reduces; however, the so-called demographic dividend is formed: due to the birth rate decline, the share of working age population increases and reaches a certain maximum;

- third phase: death rate increases due to *demographic ageing (increase in the proportion of elderly people)*, at the same time, there is a slowdown in the birth rate decline; birth rate is stabilized approximately at the level of simple reproduction, while death rate remains below this level since the share of young age groups is still large.

- fourth phase: birth and death rates are stabilized at the level of simple reproduction, the increase (decrease) in population size slows down and is set at a constant level.

The models of demographic transition (earlier and contemporary) described above represent the process in stages and identify common and universal laws; and the very concept can be considered as a general theory of population reproduction in the context of the general theory of population [8]. At the same time, one of the main disadvantages of the theory of demographic transition is seen in the lack of explanation of the reasons for the changing nature of population reproduction.

First of all it concerns the postulate concerning the independence of demographic processes acting as independent variables in relation to socio-economic transformations. On this basis the conclusion is made about the universality of demographic transition in all regions of the world, regardless of factors external to the demographic system. At present it is unclear whether it is possible to stabilize the population in the fourth phase of demographic transition at the high level of demographic ageing due to natural reproduction.

According to the studies [7; 9; 15], demographic processes in many countries have features that contradict the classical notion of demographic transition. According to M.A. Klupt [9], demographic transition can have different properties if there is more than one modernity, but several of them: Western European, Russian, Chinese, etc. In contrast to the theory of demographic transition (stagewise and formalized) the scientist proposes a concept based on the theory of multiple modernities. According to this concept, any demographic phenomenon (in our case, population ageing) has its own specific features in a separate area; these features can be formed due to historical, geographical, political, socio-economic, institutional and other factors.

Probably, the two theories should not be seen as oppositional, but rather, as researcher N.V. Zvereva points out [8], they are theories of different levels. The stagewise approach used in the theory of demographic transition allows us to speak of it as “vertical”, while M.A. Klupt’s institutional theory is closer to “horizontal”, which explores the features of demographic development at the local level and with parallel trajectories.

Combining two considered concepts, we can distinguish several types of “demographic transitions”: the “French” type (simultaneous and gradual reduction of birth and death rates; demographic explosion does not occur in this case), the “English” type (birth rate remains high at the first stage, despite the reduction in death rate, which leads to demographic explosion), and the “Japanese-Mexican” type (along with the reduction of death rate, birth rate increases, leading to significant population growth) [13]. Accordingly, the transition to the third stage also occurs in a variety of scenarios: in the first case it is an early but gradual ageing, in the third case it is a late but much faster ageing. The very difference in the intensity of this process has formed the basis of territorial differentiation by the level of demographic “old age” in some countries, which we can observe at the present stage.

The social aspect of population ageing is the most difficult one to assess and measure. The increase in the proportion and size of the older population made it necessary to carry out scientific research in sociology and social gerontology, the subject of which is the elderly person and their role in public life [1; 17; 20; 21]. The problems of gerontosociology, population ageing in terms of its impact on the social situation of the elderly and streamlining intergenerational relations are examined in the works of Russian scientists such as V.D. Al’perovich, V.G. Dobrokhleb, M.E. Elyutina, T.Z. Kozlova, E.F. Molevich, A.K. Solov’ev, E.E. Chekanova, N.P. Shchukina, etc. They disclose the specifics of changes in the social situation of the elderly expressed in the attitude of society toward their economic status, in negative stereotypes

Table 1. Proportion of the population 60 years of age and older in world regions: fact and forecast

World region	Proportion of elderly people (60 years of age and older) in the total population, %		
	1950	2015	2070
World	8.0	12.3	24.4
Developed countries	11.6	23.9	32.8
Developing countries	6.5	10.7	26.6
Least developed countries	5.3	5.5	14.1
High-income countries	11.2	22.1	32.9
Countries with income above average	7.2	13.4	33.5
Countries with average income	6.7	10.5	25.7
Countries with income below average	6.1	8.1	21.4
Low-income countries	5.0	5.2	12.6
Africa	5.3	5.4	12.4
East Africa	4.9	4.8	12.8
Central Africa	5.9	4.5	10.2
North Africa	5.4	8.0	20.2
South Africa	6.0	7.5	20.6
West Africa	5.1	4.5	9.4
Asia	6.6	11.6	29.1
East Asia	7.4	16.7	38.9
Central Asia	9.7	7.9	20.8
South Asia	5.8	8.4	26.1
Southeast Asia	6.0	9.3	25.4
West Asia	6.8	7.9	22.8
Europe	11.8	23.9	33.5
Eastern Europe	9.1	21.5	29.3
Russian Federation	7.7	20.0	25.2
Northern Europe	15.0	23.4	31.8
Southern Europe	11.1	26.2	39.6
Western Europe	14.9	26.0	35.4
Latin America and the Caribbean	5.7	11.2	32.6
The Caribbean	6.1	13.3	30.4
Central America	5.3	9.3	31.8
South America	5.7	11.7	33.2
North America	12.4	20.8	30.3
Oceania	11.2	16.5	26.0
Australia/New Zealand	12.6	20.4	30.6
Melanesia	5.7	5.8	15.4
Micronesia	5.1	9.7	24.9
Polynesia	3.9	9.8	26.3

Sources: World Population Prospects: the 2015 revision. Available at: <http://esa.un.org/unpd/wpp/>; authors' calculations.

concerning the elderly, in the phenomenon of ageism, etc., and in the analysis of social well-being and behavior of old and very old people.

A systematic and comprehensive nature of population ageing differentiates the understanding of its essence in scientific concepts. Demographic science explores the basis, the reasons for the transformation of the age structure of the population, while economics and sociology study its consequences. The necessity of using an interdisciplinary approach is due to the complexity of population ageing that goes beyond its perception as a process of increasing the proportion and size of the older population. It is important to understand to what extent scientific concepts correspond to real statistical indicators of population ageing and to the dynamics of change in the age structure of the population in the regions of the world.

2. Statistical analysis of demographic characteristics of ageing in the world

Despite the presence of a single vector in the change in the proportion of elderly people, regions of the world are currently differentiated by level of demographic ageing. In 2015, the “oldest” countries included Europe and North America (average of 24 and 21% of the elderly, respectively; *Tab. 1*). However, according to a UN forecast, by 2070, the Asian and South American regions will almost “catch up” with the countries of Europe and North America concerning the share of the population over 60 years of age, and Eastern Asia, along with Southern Europe, will become one of the “oldest” world regions (39% of elderly people). The African continent is the “youngest” territory, where the proportion of elderly people is on average 5%.

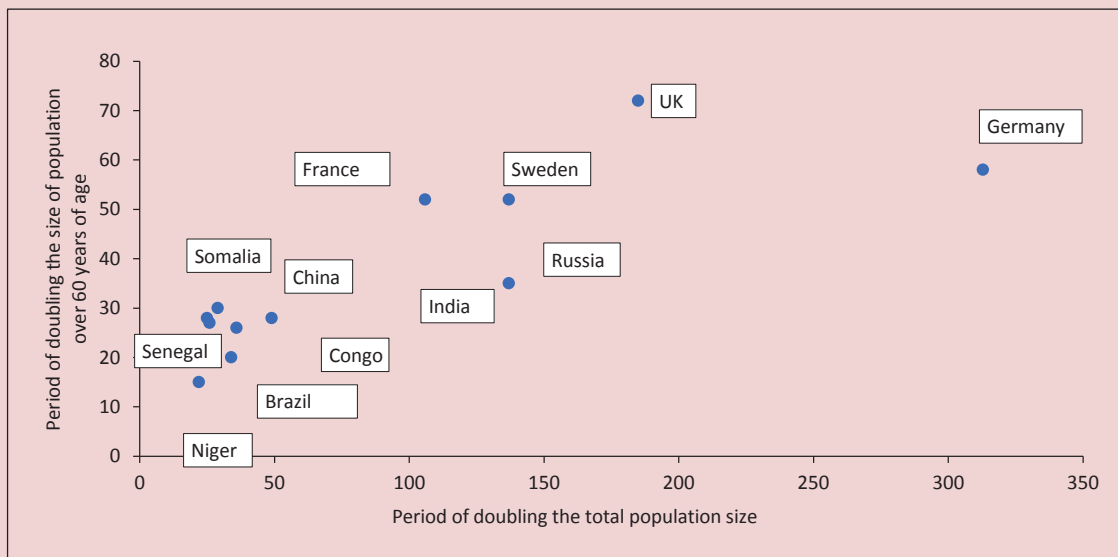
In the second half of the 20th century and in the beginning of the 21st century, the number of elderly people in the world was growing and it continues to grow at a faster pace than the total population. To confirm this statement, let us consider the periods when population size doubled, to find out how many years it will take for the figure to increase twice. The time interval from 1950 to 2015 was used in the calculations (*Fig. 1*).

The data presented in Figure 1 indicate that in developed countries (Sweden, UK, Germany, France) the period when the size of elderly population doubled is several times shorter than the period when the size of total population doubled. Although in developing and least-developed countries, two of these indicators are approximately equal, the size of elderly population doubles several times faster than in the countries of Western and Northern Europe that have already “grown old”.

The population in some regions is still relatively young. For example, in 2017 in Africa, the proportion of children under 15 accounted for 41% of the population, and we should add to their number the 19% of young people 15–24 years of age¹. Countries of Latin America and Asia, which experienced a larger decline in birth rate, have a smaller proportion of children (25 and 24%, respectively) and youth (17 and 16%, respectively). In the total population of these three regions in 2017, there are 1.8 billion children and 1.1 billion young people. However, the number of people 60 years of age and older is growing faster than in the number of people in younger age groups and

¹ World Population Prospects. The 2017 Revision Key Findings and Advance Tables. Available at: https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf

Figure 1. Periods when total population and population 60 years of age and older doubled in some countries (1950–2015), years



Sources: World Population Prospects: the 2015 revision. Available at: <http://esa.un.org/unpd/wpp/>; authors' calculations.

increases at a rate of about 3% per year. The older generation itself is ageing. Globally, the number of persons 80 years of age and older will increase from 137 million in 2017 to 425 million by 2050 and will reach 909 million in 2100. In the coming decades, many countries are likely to face difficulties with the functioning of healthcare systems, pension provision and social security for the growing elderly population, if these spheres are not adapted to demographic change.

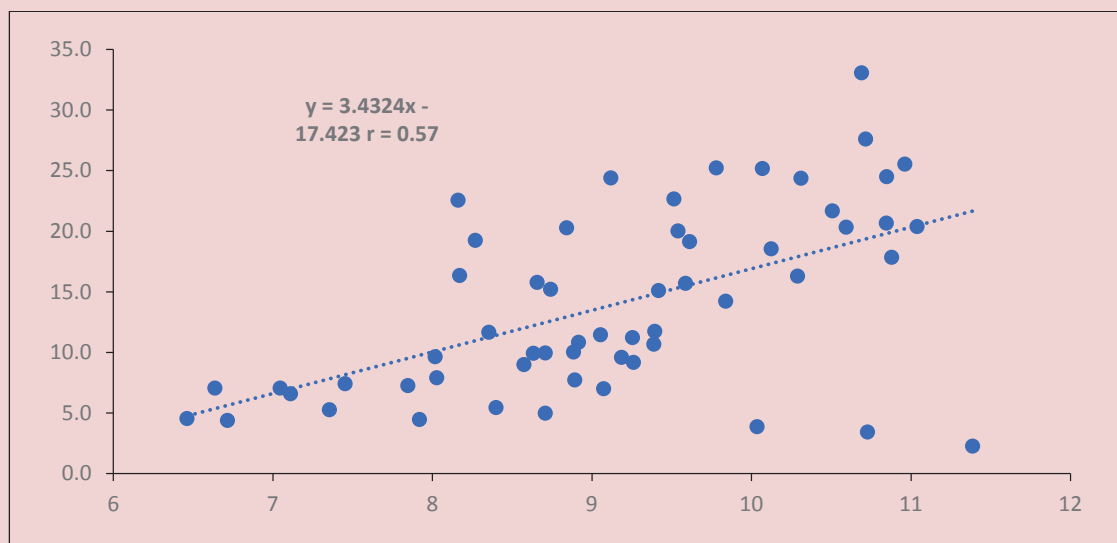
The results of a correlation analysis (Fig. 2) show that there is a fairly strong positive correlation ($r=0.57$) between per capita GDP expressed in U.S. dollars (the natural logarithm of these values was used in the calculations) and the share of the population over 60 years of age in the countries of the world. In general, this proves a conceptual statement about the presence of parallel pathways in socio-economic and demographic development.

The dependency ratio – the number of children (0–14 years old) and elderly people (60 years of age and older) per 1,000 population 15–59 years of age is the most frequently used indicator that determines the degree of impact of changes in the age structure on economic and social development (Tab. 2).

The data presented in the table suggest that the dependency ratio in the world declined in 1950–2015, but it will have increased again by 2070. However, the change in this indicator is very uneven in some territories:

1. In developed countries, the dependency ratio somewhat increased in 1950–2015, and it will increase substantially to 2070.
2. In developing countries, the dependency ratio, having shown a dramatic decline in 1950–2015, will return to the previous level to 2070.
3. In the least developed countries, the dependency ratio, having increased slightly in 1950–2015, will decline significantly to 2070.

Figure 2. Correlation between GDP per capita and the share of the people over 60 years of age in the countries of the world



Sources: World Population Prospects: the 2015 revision. Available at: <http://esa.un.org/unpd/wpp/>; The World Bank. Available at: <http://data.worldbank.org/>; authors' calculations.

Table 2. Dependency ratio in the regions of the world: fact and forecast (per 1,000 people)

World region	Dependency ratio		
	1950	2015	2070
World	734.6	621	785
Developed countries	639.4	673	941
Developing countries	773.3	576	802
Least developed countries	868.6	833	673
High-income countries	651.9	649	940
Countries with income above average	751.8	520	952
Countries with average income	767.0	585	790
Countries with income below average	783.6	644	713
Low-income countries	890.1	911	660
Africa	873.7	866	658
East Africa	919.9	931	662
Central Africa	888.8	999	649
North Africa	825.0	672	698
South Africa	813.1	600	654
West Africa	874.0	937	646
Asia	760.4	563	826
East Asia	732.0	504	1080
Central Asia	735.7	586	661
South Asia	780.1	612	752

End of Table 2

World region	Dependency ratio		
	1950	2015	2070
Southeast Asia	807.5	559	753
West Asia	811.6	612	741
Europe	617.8	657	945
Eastern Europe	604.0	598	823
Russian Federation	601.1	582	734
Northern Europe	631.0	696	918
Southern Europe	634.0	686	1117
Western Europe	619.7	708	1012
Latin America and the Caribbean	850.3	585	913
The Caribbean	837.2	623	868
Central America	922.4	611	888
South America	829.3	571	929
North America	656.0	653	895
Oceania	695.7	665	799
Australia/New Zealand	658.6	648	882
Melanesia	857.9	720	629
Micronesia	697.7	648	793
Polynesia	972.9	656	834

Sources: World Population Prospects: the 2015 revision. Available at: <http://esa.un.org/unpd/wpp/>; authors' calculations.

At the first glance it may seem that in all the three cases, the trends have a fundamentally different nature; however, that is not so. In fact, these are just different stages of demographic transition, and the main factors are the decline in birth rate and the formation of the so-called demographic dividend (the state of the age structure of the population, when as a result of declining birth rate the proportion of able-bodied population tends to a maximum, and the proportion of dependent groups – to a minimum).

As mentioned earlier, regions of the world are essentially differentiated by the level of ageing. In particular, this applies to Europe and Asia, typical representatives of which are Russia and Mongolia, respectively. Let us refer to international statistics on the age structure

of population in world regions in comparison with the data on the Russian Federation and Mongolia (*Tab. 3*).

The data in Table 3 shows that the age structure in Russia and Mongolia have common features with average indicators in their region, but at the same time they are substantially different. Russia has completed the implementation phase of the demographic dividend (like most of Europe), and the proportion of elderly people in the population already exceeds 20%. Mongolia, by contrast, has a much large proportion of children and a low proportion of elderly people; these facts allow us to consider Mongolia as a relatively “young” country that enters a phase of demographic “bonus” caused by declining birth rates.

Table 3. Age structure in world regions, Russia, and Mongolia in 2017, percentage of total population

Region, country	Age structure of population			
	0-14	15-24	25-59	60+
World	26	16	46	13
Africa	41	19	35	5
Asia	24	16	48	12
Europe	16	11	49	25
Latin America and the Caribbean	25	17	46	12
North America	19	13	46	22
Oceania	23	15	45	17
Mongolia	30	15	49	7
Russian Federation	18	10	52	21

Source: World Population Prospects. The 2017 Revision Key Findings and Advance Tables Available at: https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf

In the long term the dynamics of the age structure in Russia and Mongolia will experience the impact of demographic ageing (Fig. 3, 4). And in Mongolia the ageing of the age structure will occur at a more rapid pace due to the current trends of declining birth rate and a later entry into the third phase of demographic transition.

Considering the demographic dynamics of Russia, its indicators should be compared not only at the level of countries, but also at the level of regions of the Russian Federation due to the presence of significant territorial differences within the country. At the beginning of 2017, the Tula Oblast was the oldest constituent entity of the Russian Federation (the share of people over 60 years of age is 25% there), and Yamalo-Nenets Autonomous Okrug and the Chechen Republic are the youngest regions (6 and 7%, respectively)². The ratio between the maximum and minimum values is about 4:1. In general, the Russian Federation is characterized by intense type of ageing (like most developing

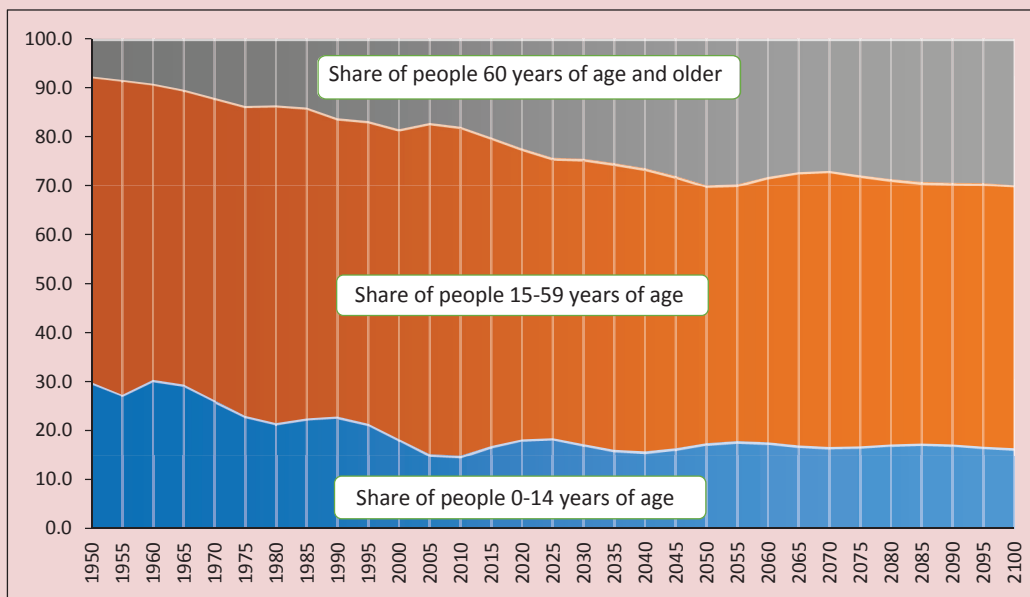
countries), which, however, has its own characteristics and is not uniform. In the context of narrowed population reproduction the age structure in all constituent entities of the Russian Federation in the future will continue to “grow older”. In Russia and in the majority of the developed world, intensive demographic ageing has changed the positive tendency toward the formation of “favorable” age structures that were typical of the population of these regions during the 20th century. The current age structure in developed countries becomes one of the main obstacles from the point of view of many aspects of social and economic development.

Conclusion

Let us sum up some results. The study that we have conducted shows that demographic ageing is a global (all regions of the world are subject to “ageing”) and irreversible phenomenon (in the context of narrowed reproduction the population will continue to “age”). The data for developed countries suggest that the pace of population ageing at some point begins to decline, which allows us to make an assumption about a certain maximum

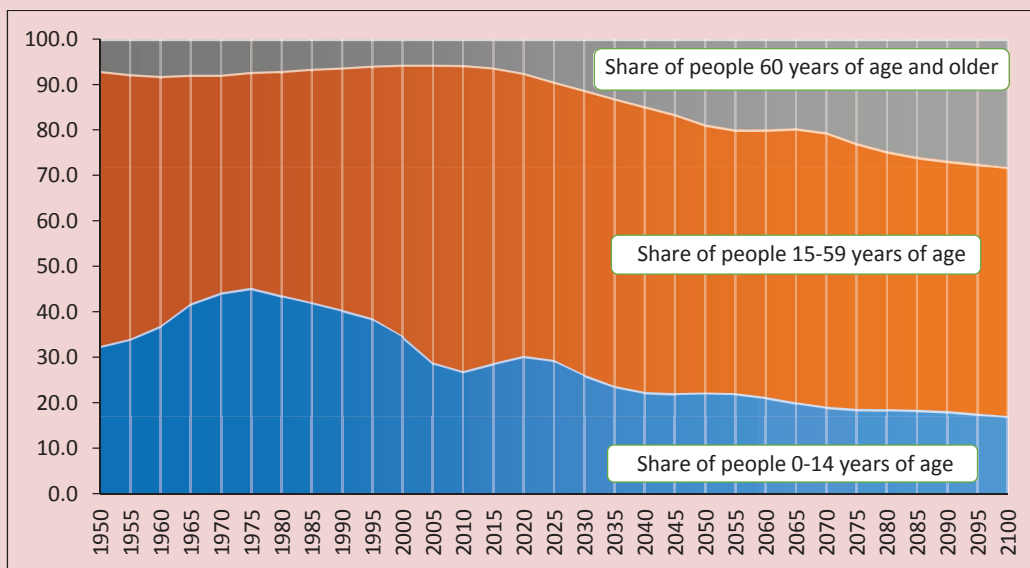
² The calculations and analysis of specifics of Russian population ageing were carried out according to the data of the Unified interdepartmental information-statistical system. Available at: <http://fedstat.ru/indicators/start.do>

Figure 3. Age structure of population in Russia in 1950–2100 (medium forecast scenario)



Source: World population prospects 2017. Available at: <https://esa.un.org/unpd/wpp/Graphs/DemographicProfiles/>

Figure 4. Age structure of population in Mongolia in 1950–2100 (medium forecast scenario)



Source: World population prospects 2017. Available at: <https://esa.un.org/unpd/wpp/Graphs/DemographicProfiles/>

percentage of the elderly in the total population, after which, probably, the population stops “ageing”. The theory of demographic transition suggests that population ageing will cease when the size and structure of the population

stabilizes after the fourth phase of the transition. So far, none of the world countries has finished the “transition” to the stable population, so it is still premature to say that the ageing process at the global level has come to an end.

Our analysis suggests that, in general, most of the provisions of the demographic transition theory are naturally reflected in practice: the obtained data allow us to speak about the presence of a single vector of changes in the age structure of the population of the world regions in the direction of increasing the proportion of elderly people. However, despite the passage of the same phases of demographic transition, the ageing rate of the population differs markedly in different regions of the world, which confirms the existence of differentiation processes of change in the age structure. This conclusion is located at the intersection of the theories of demographic transition and the institutional theory of demographic development: on the one hand, we cannot deny the existence of the phase of demographic transition common for all countries; on the other hand – it is impossible not to take into account peculiarities of the process of changing demographic structure on the local territory (in particular, the time of passing through the phase, the intensity of changes in the age structure, etc.), and the impact of factors that are external in relation to the demographic system (e.g., economic and political situation in the country, war, disaster, etc.).

In the context of demographic ageing, special importance is attached to a practical need to obtain objective relevant information about the situation in modern Russian and Mongolian societies; and at the same time it is necessary to work out a scientific understanding

of socio-demographic change and develop the author's own theoretical and methodological tools.

The features and characteristics of the population in a country must be taken into account when designing a strategy for socio-economic development in the context of population ageing. The results of the analysis suggest that the measures that may be efficient for developed countries, will fail in the developing and in the least developed countries due to the fact that in these countries, the period of implementation of the demographic dividend and doubling of the number of elderly people is much shorter. The awareness of the universality and irreversibility of population ageing makes it relevant to perceive it not as a “problem” or “challenge”, but as an “opportunity” (implementation of the second demographic dividend), a natural phenomenon that has not only negative but also positive sides. Taking into consideration economic and social dynamics associated with population ageing is important for achieving sustainable development goals [24] by 2030, relating to reducing the risk of poverty, improving health and well-being in all age groups, achieving gender equality and ensuring full and productive employment and decent work for all. With the intensification of the process of demographic ageing (in Russia and Mongolia, as well), the significance of theoretical and applied research in this area also increases.

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“Place Identity” as a Criterion for Supporting Network Communications: Theoretical Analysis and Empirical Estimation*



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Abstract. The purpose for the research is to analyze the key features of local identities based on the theoretical approach of multiple identity and analysis of large volumes of empirical information. The article is based on the hypothesis that the spread of global communications as widespread practices gradually brings citizens outside the local circle, providing socio-economic and socio-cultural integration. Methods of analysis: calculation of indices of strata proximity, regression models, analysis of variance. The research novelty lies in the substantiation of the necessity of introducing the contextual meaning of the term “place identity” which is associated with the socio-economic criteria of support for network communications by content features and is due to the mechanisms for distinguishing levels of strata

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proximity. The authors empirically verify the concept on sociological databases; identify new effects and performance of identities in Russia. The main results include: theoretical study and empirical estimation of the regional identity based on comparative analysis of performance of seven regions and Russia as a whole by a common methodology during 2002–2016; the author’s model of structuring “place identity” as a symbolic resource and a criteria of support for network communications; the differences of strata proximity levels and main factors for their reproduction. The forecast of M. Castells which states that the “information space” in the modern world dominates over the “place space” is not confirmed in Russian regions. The “professional” identity is close to the hierarchy of identities “family”-“friends”-“generation”-“region”. The radii of “understanding circles” in Russia have increased, which is associated with the extension of available means of communication. The latter reinforce the importance of professional and social contacts, which is a positive signal and is consistent with global trends. At the same time the authors reveal the effects of blocking traditional means of social mobility. Identities of religious, national, and global level are “extensive”, i.e. they are characterized by predominance of lack of identity over its presence. The research results may be used for scientific, educational, managerial, information-analytical purposes as the authors have identified signs of transformation of the Russian society corresponding to the trends in transition to the network society and contradicting them. The prospects for further research are due to analyzing important identity factors such as trust, types and performance of the value system, identification of stratification groups or clusters according to a specified set of criteria in order to determine the possibilities of enhancing and upgrading regional and other types of potential in the Russian society.

Key words: socio-cultural, identity, network communications, region, globalization, communications.

Introduction. Modern social processes denoted by concepts such as globalization, glocalization, mediatization, and development of network communication change the meaning of life and the symbolic forms of a human as part of these processes. Symbolic resources and socio-cultural means of constructing reality, concepts of identities at different levels are becoming of key importance in the functioning of societies, communities and territories. Thus, M. Castells has drawn attention to the fact that in the modern information society, territorial, regional, local, religious, ethnic (diaspora), and other types of identities are becoming determinants of important social change [10; 27; 28]. The concept of “place identity” acquires scientific and practical value, integrating the necessary value, emotional,

rational, business, symbolic and other load-bearing mental structures as benchmarks of human life necessary for a comfortable existence. The purpose for the paper is to identify key characteristics of concepts of identity and “place identity” associated with mechanisms of network cooperation, and to distinguish between levels of strata affinity, presentation of theoretical constructs and empirical evaluations of these phenomena.

The research was conducted within the scientific tradition of constructivist sociology. *The theoretical significance* is defined by the specification and justification of a number of concepts related to the definition of “place identity”. *The practical significance* lies, on the one hand, in the need to activate the regional potential and strengthen the regional

identity associated with it, on the other hand, in recurrent crises of “negative identity”. The latter create an opportunity to manipulate collective identity based on the rhetoric of “*us and others*” aimed at dehumanizing different population groups. In general, “*place identity*” is referred to as an individual’s identification with their “small motherland”, the place of their residence which is generally defined during the struggle with non-differential global symbols [28, p 112].

The research tested **basic hypotheses**: “place identity” in the information society must maintain value, emotional, rational, symbolic, business, and other symbolic pillars necessary for a relatively comfortable human existence; the level of social preparedness for inclusion in the global communications network is directly linked to the relations of regional identity (“place identity”) in respective contexts “communication” – “identification” – including on the scale of “Friend”–“Foe”; the explosive spread of global information media as widespread phenomena gradually takes citizens beyond the local circle, spreading various forms of globalization to a high level of all Russians’ “general mentality”. The more developed in the local society is the assessment of “Friend” at the global/national level the deeper penetrate the relations of the global network society into these communication networks.

Research novelty: the authors justify the necessity of introducing the concept of “place identity” into contextual circulation; by meaningful signs, the concept is associated with the socio-economic criteria of network communication support and is determined by the mechanisms for distinguishing the levels of strata affinity. It is proved that the circles of

mutual understanding in Russia have rapidly grown, which is primarily associated with the spread of free means of communication. The latter primarily reinforce the importance of professional and social contacts, which is consistent with the global trends. In terms of analysis of the conflict between “local” and “global”, the findings do not confirm the forecast of M. Castells. We agree with O.I. Shkaratan that “small motherland” is the basis of reproduction of identities, and that the means of social mobility traditional for the Russian society are currently blocked.

Literature review. Among many theoretical and empirical studies related to issues raised above, there are several groups important to the authors of this article. Conceptually and empirically, we relied on the findings of the research program “The Socio-Cultural Evolution of Russia and its Regions” initiated by the Center for Socio-Cultural Changes at the Institute of Philosophy of the Russian Academy of Sciences; the findings are reviewed in the works of research teams from 25 regions of the country, among which are the works by N.I. Lapin and L.I. Belyaev [12–15], the leading representatives of the economic-sociological scientific school of the Institute of Socio-Economic Development of Territories of the Russian Academy of Sciences: V.A. Ilyin [9], A.A. Shabunova [24, 25], M.A. Lastochkina [16; 17] and other scholars, multi-authored monographs and reviews [2]. The theory of identities is based on the study of classes, social strata, the transformation of the social structure by Russian scholars (T.I. Zaslavskaya [8], V.V. Radaev [18], O.I. Shkaratan [26]). The image of the global scientific context is created

by scientific research of the modern society (Z. Bauman [3], A. Giddens [5; 6], M. Castells [10; 27; 28], J. Habermas [23]). The features of the methodology and research results are associated with the ideas of the theory of communication networks by P. Monge and N. Contractor [32]; theories of communication, network supervision in the context of the new economy by G. Mulgan [33]; new scientific approaches to the social structure from the point of view of the exchange theory and network analysis by K. Cook and J. Whitmeyer [29]; analysis of the problems of the world of social media by D. Miller and his school [31]; with a new view on space and place from the point of view of human (humanitarian) geography of Yi-Fu Tuan [34, 35], which can be described as an alternative approach.

Theoretical approaches. The concept of defining identity was developed in the 1950–s and was understood through self-determination and self-realization in the value socio-cultural space of symbolic signs, through identification of distances of the far and the near, “Friend” and “Foe”, within which there are motivations related to the search and awareness of the actual and the desired position [4; 6; 30]. In modern society structured in dense information flows and new communication technology, the very nature of identification processes is changed. Its new role in the assignment of the necessary connections, meanings, values and social relations is modified, communication and social relations are shifted towards the dynamic present and local, in particular, the semantic vector is shifted towards the new concept of “*place identity*” [28]. Economists (Nobel Prize winner G. Akerlof and R. Kranton) considered

the economic system in conjunction with the development of identification processes. The concept of identity in a number of categories such as tastes – preferences – rules – social rules internalized by the subject – action motivation, helped G. Akerlof and R. Kranton form the theoretical framework of a new economic theory where people’s tastes and decision-making processes depend on the social context [1, p. 7]. We agree that particularly important are standards prevailing in a particular group formed at the place of residence and place of work [1, p. 157]. The concept “place identity” in transformed into the concept “identity of place of work” and afterwards into the concept “identity with the firm”. Place identity transformed through the prism of economic relations organizes and transforms the social space one way or another. A. Giddens formulated two important concepts: “place of action” and “presence” which determine the “properties of the environment” and affect the relations between the social and system integration used to form the semantic content of the interaction on a regular basis. The key components of the real interaction with global characteristics of institutionalization of the social life link the contexts of identification and places of action also reflected in the concept of strengthening group identity [6, pp. 184–185]. A. Giddens proved that “place identity” needs to be defined as a sense of an individual’s informed and accepted sense of their position in a certain social space [5]. From the standpoint of *frame analysis*, E. Hoffman developed a different approach to “space identity” as “perfect circumstances of co-presence” [7, p. 474]. Considering the concept of interactions,

E. Hoffmann highlighted promising analytical opportunities for the identity of an individual and place in line with the rituals of interaction and status signals which help investigate virtual identities as well. This approach has helped reconsider the content and meanings of the characteristics of “place identity”, network interactions, social networking, and levels of strata affinity in the information society, which is particularly important for understanding new social media and social networking in the context of the theory of *scalable sociality* [31]. *Yi-Fu Tuan* presented the definition of “place identity” in the form of *a transformable abstract space into specific place* (the concept of “space and place”) which is has certain *valuable content* of a *specific symbolic form* [34, p. 445]. The concept of “space and place” was described in the fundamental work of the same name [35]. It is important to note that the main objective of Yi-Fu Tuan’s book “Space and Place” was to explain the spatial human behavior and understand how humans perceive space and form their life world and their place. It is important how a human produces life-world and place from the environment. A human can give the meaning to space and place and build their models. The key idea of *Yi-Fu Tuan* is to show and explain how a human creates a specific place from an abstract space [35]. What matters is how a human gives the meaning to the space, how they create abstract images of a space, how they seek to conceptualize a space. When a human creates space for themselves in the forms of life-world and their own place they associate them through their values: therefore this process, according to *Yi-Fu Tuan*, is purely of a value nature. The definition of *place* is determined primarily through personal

experience and through the socio-cultural context, and is operationalized in components such as completeness, subjectivity, discretion, closeness – as conditions in which a human feels comfortable and safe. The definition of *space* is characterized by freedom, openness, isotropy (i.e., when different points of space are homogeneous in any direction), threat. According to Yi-Fu Tuan, when humans create a place, they create behavior matrices (patterns). The place serves as a source of human identity; thus the concept of “rootedness/embeddedness in place” gains particular importance [35]. These characteristics help verify the definition of “place identity” where identity is generally referred to as an individual’s embeddedness or rootedness in subjectively interpreted social categories [20].

T.I. Zaslavskaya verified the empirical model of the social structure: layer groups of the population in its vertical projection, which is divided into five main strata [8, pp. 285–306]. O.I. Shkaratan drew attention to the fact that “*small motherland*”, a territorial community, is the primary environment for a “socializing individual” as “human production” [26, p. 38]. V.V. Radaev suggested several criteria for identifying social groups, which can be re-interpreted by features of power and authority distribution; systems of social action; typological characteristics of individual action; market position in the sense that every social stratum (class) is combined by typical *life-chances* on the markets of goods, services and labor as a product of specific career opportunities. The important points are status position determined by socio-cultural orientations, standards of behavior, educational and occupational

prestige, lifestyle [18, pp. 121–135]. Further development of the identity was revealed and filled with content in the approach of *pair wise identity* based mainly on long-term relations, constantly renewed contacts and periodic coordination of conditions of an action: in this case, the *relational contract* is important, where the special role belongs to the identity of counterparties [18, pp. 49–50, pp. 79–80].

Data, methodology, and methods of analysis.

Empirical data were obtained in the national research project “The Socio-Cultural Images of Russian Regions” [2, p. 295]. The hypotheses were tested with the use of regression and dispersion analysis in the SPSS statistical package. We use the results of long-term socio-cultural monitoring (2006, 2009, 2011, 2016) in the Tyumen Oblast, Khanty-Mansi (KhMAO-Yugra) and Yamalo-Nenets (YaNAO) autonomous okrugs [21, pp. 21–48], independent research projects in the Chelyabinsk, Vologda, Kursk, and Omsk oblasts, in Russia as a whole (sampling structures – see Appendix, *Tab. 3*) [9; 11–17; 22; 24; 25]¹. The choice of regions covers Russia’s geographical range: “the European Center” + “the North” + “the Eurasian Center”; these regions are united by similar levels of development, features and levels of modernization [2]. The analysis is based on the published results [13, p. 45; 15; 19] and data arrays of the all-Russian monitoring for 2002–2015. To check the degree of generality the models were tested in 14 independent samples (see Appendix, *Tab. 3*). In order to

record the statistics of preservation of these dependencies during the transition between different independent samples we use the term “sustainable” link. The statistics of preservation of the specified dependencies between different sub-samples are fixed by the term “statistically significant” link². The analytical framework is based on the approach of “layer affinities”, on the research of group solidarities in the interpretation of N.I. Lapin through the concept of “*Us and Others*”. This approach was verified with the classification of five groups of affinity degree (high, above average, average, low, extensive affinity) and ten layers of affinity (personal affinity (friends); professional (people of the same profession, occupation); age (people of the same age); business (colleagues, schoolmates); property (people of the same income); ethnicity (people of the same nationality); settlement (inhabitants of the same village, city); religious (people of the same confession, religion); “Union” (people who were citizens of the Soviet Union); universal (all the people on the Earth). To measure “layer affinity” N.I. Lapin introduced the affinity intensity factor (AIF) calculated as *the ratio of the number of respondents who indicated the presence of affinity and those who noted its absence*. This distinguished five levels of “layer affinity” intensity: from high (AIF = 15.7) to extensive (AIF = 0.8), i.e. with predominance of absence of affinity over its presence. It was concluded that in Russia the most intense affinity is of a personal nature: friends (AIF = 15.7) and, of course, family (although there was no direct question about the family in this case). The first two types are followed by affinity

¹ The list of abstracts to the research project is presented in, for example, <http://iphras.ru/page48873902.htm>. Samples are multi-stage, quota, random within quotas maintaining control of sample representativeness according to indicators of territory-type of settlement-sex-age-education. The sample error does not exceed 3.5% by one indicator.

² As established in statistics, if the error is below the range of 0.1, 0.01, 0.001 we use the terms weak, strong (significant) and maximum degree of significance respectively.

layers such as: professional, i.e. people of the same profession, occupation (AIF = 9.6), age (AIF = 9.17) and business colleagues (AIF = 99.11). Less intensive is affinity among people of the same income (AIF = 8.2) and of the same nationality (AIF = 7.3). Affinity among people living in the same rural settlement or town is not very intensive (AIF = 3.6), even less is it among people of the same confession, religion (AIF = 2.9). Affinity among former citizens of the USSR (AIF = 1.4) is close to universal, which is extensive in nature (AIF = 0.8) [13, pp. 9–12]. Structural variables are presented numerically as a certain number of people active in various micro-situations. In this case, social reality embodied in place identity is micro-experience; and the macro-sociological level of analysis is formed by quantitative temporal and spatial conglomerates [6, p. 213]. From the theoretical point of view A. Giddens recorded the link between network cooperation and affinity, arguing that “due to electronic means of communication, especially the telephone, indirect contacts became possible, allowing close connection and affinity characteristic of the conditions of co-presence” [6, p. 121]. It is obvious that the principles of building communication links are of paramount importance in establishing local identity.

Evaluation of intensity of layer affinity among the residents of different territorial communities is carried out in the following questions: “*To what extent do you feel affinity or remoteness (“Friend” – “Foe”) with the residents of the settlement you live in (village, rural settlement, city) (settlement level); with the inhabitants of the whole region (regional level); with the inhabitants of the whole country (national level); with the inhabitants of the*

former Soviet republics (“Union” level); with the inhabitants of the whole planet (universal level). N.I. Lapin pointed out that one of the manifestations of asymmetry of social well-being is a notable, almost twofold decrease in intensity of the layer affinity of the population in all its types observed in 2002–2006 [15, p. 46]. We do not entirely agree with this conclusion, which is justified below. Until 2010, the answers to the questions were somewhat different; the same were settlement, Union, national and universal levels of identity. The comparison of data obtained up to 2010 and later is somewhat arbitrary; therefore affinity intensity factor (AIF) is analyzed dynamically. According to data up until 2010, the presence of layer affinity implied the sum of shares (in %) of answers “*Friend*”+“*close*”, the absence – “*far*”+“*Foe*”. According to data obtained in the monitoring since 2010, the question was assumed to be answered by options “*affinity is present*”, “*no affinity*”, “*difficult to say*”. We did not consider variants such as “*indifference*”, “*undecided*”, and “*difficult to say*”.

Analysis of the structure and levels of layer affinity. According to the method, the answer is “there is affinity” is interpreted as the self-assessment of availability of network identity of the specified level, and “no affinity” – lack of it. *Table 1* shows data for 2002 and 2006 for the cited article [15, p. 46]. To ensure comparability we used affinity intensity factor (AIF) proposed in the cited paper.

The ranking of levels of identity (columns 3–6 of *Table 1*) extremely steadily and in descending order of the significance level corresponds to the distribution of physical space: settlement/ region/ Russia as a whole/ Earth. The settlement level remains the

Table 1. Performance of layer affinity intensity factor (“Friend”–“Foe”)*

Territory of survey	Year	Settlement	National	“Union”	Universal
Russia as a whole	2002	3.6		1.4	0.8
Russia as a whole	2006	2.6	2.6	1.6	1.4
Tyumen Oblast	2006	8.9	0.3	0.3	0.2
KhMAO-Yugra	2006	7.3	0.3	0.5	0.2
YaNAO	2006	8.9	0.4	0.6	0.3
Tyumen Oblast	2009	6	0.2	0.3	0.2
KhMAO-Yugra	2009	8.4	0.4	0.4	0.3
YaNAO	2009	7	0.5	0.6	0.4
Russia as a whole	2010	4.7	0.9	0.4	0.4
Omsk Oblast	2010	8.7	0.7		0.6
Vologda Oblast	2010	7.6	0.6		0.5
Tyumen Oblast	2011	3.5	0.5	0.3	0.3
KhMAO-Yugra	2011	3.9	0.7	0.7	0.5
YaNAO	2011	3.7	0.8	0.6	0.6
Kursk Oblast	2012	3.6	0.4	0.3	0.2
Chelyabinsk Oblast	2012	3.9	1.1	0.5	0.5
Russia as a whole	2015	3.7	0.9	0.4	0.4
Kursk Oblast	2016	4.1	0.8	0.4	0.3
Tyumen Oblast	2016	3.0	0.7	0.4	0.3
KhMAO-Yugra	2016	2.4	0.7	0.5	0.4
YaNAO	2016	2.6	0.8	0.6	0.4

* Calculated as the quotient of the share of those who noted the presence of affinity divided by the share of those whose stated there was no of affinity.

most important for people due to territorial community; it is a territory where daily communication and interaction with other people takes place, and, as a rule, these people are “just like me”. Half to one third of respondents note affinity among the inhabitants of their own generation. The highest rate of declining intensity is observed during the transition from the settlement to the regional level; starting from the national level layer affinity is extensive. It can be argued that in Russia “space of places” continues to prevail over “space of information”. This conclusion at first glance contradicts the forecast of M. Castells. Further, we analyze this contradiction in detail. Layer affinity intensity factors decline

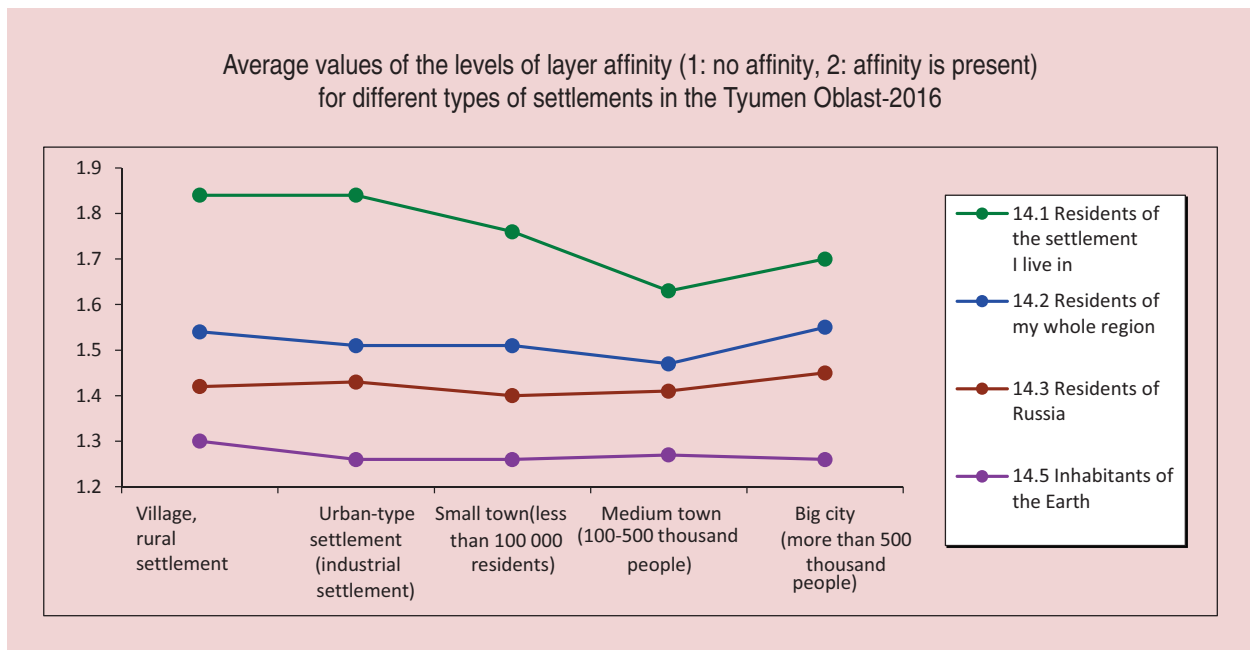
in dynamics or remain unchanged just like in the case of human identity. This happens because the number of those rejecting the existence of affinity is growing at the expense of those who previously evaded identity. The weakening of territorial social ties recognized by sociologists all over the world and the transition to supranational network interactions should be reflected in the fact that young respondents having more network (the Internet) contacts have to demonstrate slower rate of declining identity from settlement to universal.

The dynamics is such that the perception of spaces (Tab. 1 – territory, distances) using the concept of “Friend”-“Foe” becomes closer reducing the absolute value of AIF – the

share of those who consider such people as their “Friends” to the share of those who they consider “Foes”. After reaching a certain level (2–4 times) settlement affinity is not so much varied depending on the degree of area periphery (geographical, institutional, economic, social). The convergence of the perception of space is especially noticeable in geographically distant territories such as KhMAO and YaNAO where AIF has constantly decreased in the range from 7.3 and 8.9 in 2006 to 2.4 and 2.6, respectively, in 2016.

To test the hypotheses we constructed multivariate regression models. The calculations were performed based on data from Tyumen regions (the Tyumen Oblast, KhMAO, YaNAO) for 2011, 2016, from the Kursk Oblast (for 2012, 2015), from Russia as a whole (for 2010, 2015). The calculation methods are: LRM, backward selection, ANOVA, confidence factor is not less than 95%. Multivariate regression models were computed sequentially for cases of dependent variable of the self-assessment of layer affinity among the inhabitants of the Earth, the whole Russia, the whole region, with inhabitants of a settlement you live in (village, rural settlement, city). Levels of measurement: 1: no affinity; 2: here is affinity. Independent variables were selected as socio-economic (C. 27, C. 28, C. 30.1, C. 57) and sociocultural variables (C. 1, C. 42, C. 60, C. 61, C. 54) (see Appendix, *Tab. 4*). The choice of independent variables is determined by the wish to describe the social structure of the sample excluding autocorrelation. The main **conclusion** for all models is the following: none of the independent variables demonstrates the grades of identity by both affinity layers on a scale of “Friend”–“Foe” and the levels of mutual understanding.

The tools of the Tyumen Oblast for 2016 were supplemented by further questions: C.37.1–3. (see Appendix). For reasons of limited space, when summarizing the main results we present the regression table only for the variable C.14.1 called “Settlement layer affinity” (Table 4 of the Appendix). Settlement layer affinity (“place identity”) – remains the most important level of identity but declines with the transition from village to city with increasing intensity of game practices (computer, phone), with increasing levels of the social strata by self-assessment, with reducing level of settled lifestyle. National and regional layer affinity are linked to each other; they increase with self-assessment of the financial status, with increased intensity of communication in social networks during the transition from village to city and directly correlate with the age of the respondents. Universal affinity increases with the level of self-assessment across social strata, with increasing intensity of game practices (computer, phone), self-assessment, financial status, sex. Universal affinity correlates, yet weakly, with the age of the respondents. Women turned up to be more prone to expand the “layers of affinity” at all levels. The contradiction is that the considered target variables have almost no influence in terms of the number of employees (socio-professional status) and the educational status. The hypothesis about the influence of the intergenerational transition on the investigated effects is not confirmed, the results are statistically unstable. The *Figure* demonstrates four graphs of multivariate analysis of variance to demonstrate some specific effects on the example of the Tyumen Oblast, 2016.



Analysis of the structure of “circles of understanding”. The question “Among what kind of people do you usually have more understanding?” remains in the tools almost unchanged and provides for the possibility to mention all the options important to the respondents: *in the family, among friends, among neighbors, at work, around people of the same nationality, among co-religionists* (was not asked in all projects), *no understanding among other people*. This phenomenon is quite often called “circles of understanding” in the sociological literature; we will use this term below (*Tab. 2*).

We can distinguish regions with more or less traditionalist population but all Russian regions are clearly characterized by two trends which are opposite at first glance. First, the family remains an important communication resource for the vast majority of respondents. The importance of communication in the family increases in all regions. Next are the circles of communication with friends, with

colleagues, with neighbors, with people of the same nationality and confession. Second, people become less constrained at the family level; understanding is growing at work, in informal communication (neighbors). Russian regions maintain almost the same national and religious level of understanding, its importance does not exceed 4% among the population of all regions; data variation does not exceed the sample error (3%).

Discussion of results, conclusions. Theoretically, the features of identity of an individual’s or a group produce a multi-dimensional image of the social model of self-reflection of the action subject in its civil (state) and territorial status, indicate the essential points of social stratification, the attitude of the socio-professional hierarchy (belonging to a particular level of government, business, profession), demographic characteristics (age, gender). The general context of the term “identity” introduces the

Table 2. Performance of answers to the question “Among what kind of people do you usually have more understanding?”, % of the total number of responses

Territory of survey	Year	In the family	Among friends	Among neighbors	At work	Among people of the same nationality	Among co-religionists	There is no understanding	Among other people	Total*
Tyumen Oblast	2006	74	29	3	8	4	1	1	1	120
	2009	70	22	3	7	3	2	2	3	112
	2011	73	26	5	9	3	2	1	4	123
	2013	69	28	3	7	3	2	1	3	116
	2016	88	55	15	25	6	4	1	1	195
KhMAO-Yugra	2006	72	27	3	6	5	1	3	3	120
	2009	62	26	4	11	5	3	3	4	118
	2011	72	22	4	10	5	2	1	3	119
	2013	74	25	2	10	5	2	1	2	121
	2016	90	51	13	30	9	5	1	1	201
YaNAO	2006	78	22	1	7	7	1	1	3	120
	2009	67	26	4	10	5	2	3	2	119
	2011	63	23	3	12	6	1	4	4	116
	2013	64	30	2	10	6	2	1	2	117
	2016	90	55	12	28	8	2	1	1	197
Omsk Oblast	2009	67	26	3	9		1	2	1	109
Vologda Oblast	2010	62	31	5	10		1	5	1	115
Chelyabinsk Oblast	2012	79	55	14	32	5	2	1	3	191
Kursk Oblast	2012	73	21	5	5		2	1	2	109
	2015	90	50	13	20	5	6	2	1	186
Russia as a whole	2010	68	27	3	9	6	1	1	1	116
	2015	78	48	20	22	7	3	3	0	182

* Respondents were offered to mark all variants important to them.

semantic characteristics of the “environment properties” associated with two fundamental concepts: “place of action” and “presence” (according to A. Giddens) as the basis of the structuration theory. “Environment properties” affect the relations between social and system integration used to form the semantic content of interaction on a regular basis. Therefore, “place identity” can be defined as a conscious

and accepted by the individual sense of their position in the specified social space. Verification of the concept of “space identity” involves the concept of “settlement layer affinity”, or simply “layer affinity”.

The structure of layer affinity is extremely stable yet in recent years there has been a decrease of the geographical affinity factor which we empirically tested for regions

with different standard of living to and for the national average. The category “place identity” on a “Friend”–“Foe” scale remains the most stable frame among the set including: “settlement”, “national”, “Union”, “universal”; it is intergenerational and is reproduced among territories and over time. In all samples it is above half of the inhabitants. The increase of the level of settlement layer affinity over other levels of identity is significant but for each specific regional community it is steadily decreasing in dynamics. There are no sufficient grounds to assert that domination is conditioned by the material surroundings. There is no strong link between identities, circles of mutual understanding and the level of respondents’ education and status positions. The dominance of place identity is reduced with the transition from rural settlement to city, with the increase in the frequency of networking and socializing, the latter being age-related.

The level of affinity (measured as the largest circle of understanding, communication) with a family remains the most significant being above 60% in all the analyzed samples. The dominance of the family circle of communication (in contrast to “place identity”) is steadily increased in the dynamics. However, the importance of professional communication is rising at a much greater pace; the pattern is statistically steady and has maximum significance.

We cannot yet agree with M. Castells that “space of places” considered as an individual’s informed and accepted sense of their position in a certain geographically conditioned social space, integrating conditions necessary for a

comfortable existence, has lost its importance in favor of “information space” as a space of circulating flows of information, sub-territorial and supranational in nature. However, in Russia, as elsewhere in the world, “space of places” is expanding rapidly, absorbing closest and broader levels due to activities (work, social networking, friends); and this is where the main scientific contribution of domestic research and its novelty arises. We believe that such processes have a positive nature, providing the society with opportunities to increase its capacity. However, the alarming fact is weak connection of these processes with the citizens’ level of education and social status, which points to blocked traditional social mobility, confirming the findings of O.I. Shkaratan and V.V. Radaev.

The possible areas of application of the results are determined by new results and conclusions and include scientific, educational, managements, and information-analytical spheres since, contrary to frequent criticism, there are signs of transformation of the Russian society in line with the trends towards the transition to a networked society. The prospects for further research are derive form analysis of important identity factors such as trust, types and performance of value orientations, identification of opportunities for revitalization and modernization of regional and other types of potential in the Russian society. The future course development will demonstrate if the discovered trends and findings are a manifestation of the general historical trend or reflect only temporary local peculiarities of the situation in Russia.

Table 3. Size of samples used in the article by relevant databases

	2006	2009	2011	2013	2016
Tyumen Oblast	1715	1560	1271	2335	1422
KhMAO	1285	1800	1301	2264	1607
YaMAO	1000	640	482	968	541
	2006	2010	2012	2015	2016
Russia as a whole	1200	1163		1031	
Kursk Oblast			1000		500
Chelyabinsk Oblast		1000	500		
Omsk Oblast		1212			
Vologda Oblast		1500			

Parameters of regression models:

Target variables:

C.14.1 Residents of a settlement I live in (village, rural settlement, city). C.14.2. Residents of my region (oblast, okrug). C.14.4. Residents of Russia. C.14.6. Inhabitants of the Earth.

Options: 1: no affinity. 2: there is affinity.

Independent variables:

C.1. How long have you lived in this city/ town/ rural settlement/village? 1. Less than 5 years. 2. 5–15 years. 3. 16–25. 4. More than 25 years

C.27. Do you subordinates at your main job? 1. No. 2. At least 5 people. 3. 5–10 people. 4. 11–50 people. 5. 51–100 people. 6. More than 100 people.

C.28. Which of the following statements best describes the current financial situation of you and your family? 1. Not enough money for living expenses. 2. The entire salary is spent on living expenses. 3. Money is enough for living expenses, yet buying clothes is problematic. 4. Money is enough, yet we need to borrow money to buy expensive items. 5. Money is enough for practically everything, yet purchasing an apartment or a country house is problematic. 6. We can afford practically everything.

C.30.1 What social class category do you consider you belong to in your city (rural settlement)? 1. Highest social class. 2. Above average. 3. Middle class. 4. Below average. 5. Lower social class.

C.42. What can you say about your religious beliefs? 1. I am religious. 2. I am religious rather than not. 3. I am a non-believer rather an a believer. 4. I am not religious. 5. I am an atheist.

C. 54. Age groups (full years). 1:18–24, 2:25–34, 3:35–44, 4:45–54, 5:55–64, 6: over 64.

C.57. Your education. From 1 to 5, ordinal scale.

C.60. Respondent’s sex. 1.Male. 2. Female.

C.61. Type of settlement. 1: Village, rural settlement. 2: Urban-type settlement (industrial settlement). 3: Small town. 4: Middle town. 5: Big city.

Questions asked only in the Tyumen region (including KhMAO, YaNAO).

C.37.1 How much time do you spend in front of a computer working?

C.37.2 How much time do you spend communicating via social networks?

C.37.3. How much time do you play computer and/or phone games?

0. Never. 1. Occasionally. 2. Less than 3 hours a day. 3. From 3 to 8 hours a day. 4. More than 8 hours a day.

Table 4. Regression coefficients (target variable C.14.1, F=21.6).
Tyumen region (including KhMAO, YaNAO), 2016. N=3570)

	Non-standardized coefficients		Standardized coefficients		Value	95.0% confidence interval for C	
	C	Standard error	Beta	t		нижн. гр.	верхн. гр.
Constant	2.06	0.061		33.681	0	1.94	2.18
C.61.	-0.048	0.008	-0.137	-6.226	0	-0.063	-0.033
C.37.3.	-0.042	0.01	-0.093	-4.245	0	-0.061	-0.023
C.30.1	-0.051	0.012	-0.09	-4.116	0	-0.075	-0.027
C.1.	0.032	0.009	0.074	3.378	0.001	0.013	0.05

a Dependent variable: C. 14.1 Inhabitants of a settlement I live in (village, rural settlement, city)
The rest of the variables have been excluded for their insignificance; confidence interval – 95 %.

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Substantiating the Efficiency Criteria for Cluster Spatial Development of the Territory Based on the Hermeneutics of the Category of “Efficiency”*



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Abstract. Modern studies consider the issues of spatial development of territories from different theoretical-methodological and scientific-practical positions. At the same time, scientific literature pays increased attention to clusters as tools of development of socio-economic space in regions and countries. The review of relevant literature that we have carried out shows that foreign studies on clusters focus more on determining the success factors of clusters and on the development of state programs to support them. While Russian scientific literature mainly tackles the issue of developing

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methodological foundations and techniques for identifying and assessing clusters for the purpose of developing the cluster potential of territories. Moreover, if we consider world's best practices of cluster development, we see that in many works of Russian and foreign researchers on identifying clusters their effectiveness as highly organized self-developing systems is postulated and not subjected to thorough consideration. Therefore, the goal of our research is to study and develop fundamental criteria of efficiency of development of territorial clusters on the basis of achievements of economic science in the understanding of essential nature of the category of "efficiency" and to analyze a system nature of the cluster. Methodological basis of the research is represented by hermeneutic, system integration and institutional approaches. The most significant results that characterize scientific novelty of our research are as follows: 1) we postulate and prove that the differentiation of approaches to the hermeneutics of the category of efficiency is determined by the stages of evolution of scientific knowledge (classical, nonclassical, post-nonclassical) and complexity of the research object (development of simple, self-regulating and complex self-developing systems); 2) we clarify the definition of the cluster as a self-developing system based on decomposing the essential content of the term "cluster" as a complex system in the works of Russian and foreign scientists; 3) we determine and characterize the following distinctive features of the cluster as a self-developing system: stability, complexity, openness, dynamic organization, differentiability, controllability, cognition; 4) we develop a model of criterial configuration for the efficiency of cluster spatial development of economy, taking into account the interdependence and integration of institutional, organizational, managerial, economic, innovative and social aspects of cluster cooperation in the cluster system. We associate the prospects of future studies with the urgent need to identify and study the determinants of institutional technology for cultivating and supporting efficient cluster structures.

Key words: efficiency, hermeneutics, quality, system, efficiency criteria, configuration, cluster, regional economy.

Introduction

The end of the 20th century – the beginning of the 21st century was marked by increased interest in the problem of purposeful formation of regional clusters as growth poles for regional competitiveness. The countries of the European Union that have accumulated significant experience in developing successful clusters and that are leaders in economic space clustering carried out large-scale cluster studies, which can be divided into two groups.

The first group includes analytical reports on cluster development that help identify key drivers of their success and, in a broad sense,

get an idea about the European understanding of the concept of cluster development in general¹. In this connection, special attention can be paid to the project "European Cluster Observatory"² aimed to identify cluster structures and form a cross-country statistical database on the clusters. The second group consists of the studies that analyze advanced

¹ See, for example [35; 42], and also the Global Cluster Initiative Survey. Survey summary report. Available at: http://www.clusterobservatory.eu/common/galleries/downloads/GCIS_2012_SummaryReport.pdf.

² European Cluster Observatory. Official website. Available at: <http://www.clusterobservatory.eu/index.html>.

tools of governmental support of cluster initiatives and projects. It is a kind of manual for regional and local authorities responsible for the implementation of cluster policy³.

However, analytical reports and the mechanisms for applying the cluster approach presented by the European scientific community do not provide a clear answer to the question: why do some clusters become export-oriented leaders in the industry, while others either cease to exist after the completion of state support and funding programs, or are transformed into other structures? On the one hand, this is due to the fact that European research focuses on choosing best practices of cluster development of the territories rather than on identifying the fundamental causes and conditions necessary for efficient formation and functioning of clusters. On the other hand, differences in the formulation of the question are due mainly to the current level of socio-economic development and scientific and technological progress, the quality of entrepreneurial infrastructure, investment and financial opportunities, innovation potential and human capital accumulated in the countries under consideration. In fact, foreign researchers have focused on exploring the success of clusters, which is an applied category, while the efficiency of cluster-based spatial development from the position of deep theoretical analysis remains virtually unexplored even in the works of prominent researchers of the cluster theory.

³ See, for example: *Competitive Regional Clusters: National Policy Approaches*. Paris: OECD Publ., 2007. 296 p.; *Clusters and Clustering Policy: a Guide for Regional and Local Policy Makers*. INNO Germany AG, 2010. 195 p.; *Cluster Policy in Europe. A Brief Summary of Cluster Policies in 31 European Countries*. Kristiansand, Norway: Oxford Research AS Publ., 2008. 34 p.

So, for example, M. Porter measures the effectiveness of clustering of a territory through the prism of international competitiveness and points out that the indicator of success of clusters can be the share of exported goods in the global exports of this commodity, which was produced on the basis of local capital. It links performance with productivity⁴ in the following context: firms cannot function efficiently (productively), for example, in the conditions of excessive legislative regulation or in the absence of developed transport infrastructure and in other adverse circumstances [17, pp. 218-219]. In other words, in order to increase productivity, it is necessary to improve the quality, level of specialization and efficiency of production factors [17, p. 219].

E. Feser critically evaluates the diamond of national advantage proposed by M. Porter as a fundamental model with static characteristics in explaining the success of clusters and proves the importance of concentration of technology related to human, material and financial resources to support innovation activities sufficient for competition at the international level [34, pp. 6 and 22-23]. Therefore, according to E. Feser, the success of the cluster depends on its innovativeness, which can be measured with the help of various indicators characterizing the pace of innovation [34, pp. 38-39].

In our opinion, the fact that scientists have focused on analyzing only successful clusters in order to design the ideal model of cluster structure in other industries in different

⁴ Productivity is the amount of output produced per working day per unit of the capital or material resources used [17, p. 218].

countries and regions is in many respects the reason why the conceptual framework of the research on the effectiveness of clustering economic space as a whole remains underdeveloped. In this regard, the modern cluster concept urgently requires the development of a theoretical and methodological approach to understanding the effectiveness of cluster development of territories on the basis of achievements of economic science in understanding the essence of the category of “efficiency”. Therefore, the aim of the present research is to study and develop fundamental criteria of efficiency of development of territorial clusters that would develop scientific understanding of evolution of cluster structures and make it possible to specify the directions of related public policy in the future.

Hermeneutics of the category of efficiency

At all the stages of development of economic science special attention is always given to the development of the category of efficiency as one of the key concepts of this branch of scientific knowledge. M. Najmi, M. Etebari, and S. Emami point out that over the past fifteen years we can observe a significant intensification of scientific research in this direction [37]. Thus, according to B. Marr and G. Schiuma, in the period from 1994 to 2002, there emerged an article or a report on management efficiency once in every five hours [36]. Moreover, according to the authors, the number of publications on this subject continues to grow every day. Consequently, various models, mechanisms and methodologies that analyze the content of efficiency as a category are

designed by practitioners, consultants, and scientists [37]. Under the circumstances, many researchers are still trying to justify the need to unify the approaches to its definition. However, in our view, the ambiguity of hermeneutics of the category of efficiency depends objectively on the stages of development of science in general.

It is known that the historical development of science consists of three stages: classical, nonclassical and postnonclassical. V.S. Stepin points out the following criteria for their distinction: 1) features of the system organization of the objects that science deals with (simple systems, complex self-regulating systems, complex self-developing systems); 2) a set of research ideals and standards inherent in each stage (explanation, description, rationale, structure, and knowledge construction); 3) specifics of philosophical and methodological reflection over the cognitive activity, ensuring the inclusion of scientific knowledge in the culture of the corresponding historical era [23, p. 18]. The very specifics of their manifestation typical of each stage in the evolution of scientific knowledge determine the trajectory of development of conceptual and methodological foundations in a specific area of scientific knowledge. For example, the mechanical picture of the world, which serves as the basis of the categorical grid in the description of simple systems, and which is typical of the classical stage of science development, predetermined the development of “reductionist views of efficiency... associated exclusively with the idea of ... conservation, maximization of results and minimization

Table 1. Determinacy of the differentiation of the approaches to the hermeneutics of the category of efficiency by the stages of evolution of scientific knowledge

Object of study	Methodological foundations of the science	Approaches to the hermeneutics of the category of efficiency	Interpretation of the content of the category of efficiency	Authors of the theoretical approach
<i>Classical stage of scientific knowledge development</i>				
Simple systems	Reductionist approach (Laplace causality) The possibility of a single true theory	Efficiency as economy*	Efficiency is the result of rational behavior of sovereign individuals, who optimize their objective function of utility or seek to obtain maximum results	D. Ricardo, L. Walras, S. Reiteru, F. Taylor, and others
		Efficiency as performance	Efficiency is the assessment of the impact of various governmental or private measures on processes in economic life	W. Petty, F. Quesnay
<i>Nonclassical stage of scientific knowledge development</i>				
Complex self-regulating systems	Probabilistic target causation Admission of alternative descriptions of reality Correlation between the ontological bases of science and characteristics of the method	Efficiency as economy	The state of efficiency of the economic system implies that no one's situation can be improved without the deterioration of someone else's situation	A. Pigou, V. Pareto, N. Kaldor, J. Hicks, T. Scitovsky, H. Bergson, A. Sen, P. Samuelson, K. Arrow, R. Zerbe, M. Allais
<i>Postnonclassical stage of scientific knowledge development</i>				
Self-developing systems	Determinacy with objective reality. Reflection of scientific concepts. Necessity to consider the nonlinearity, historicism, human-sizedness of systems	Efficiency as economy	Efficiency is achieved by minimizing transaction costs	D. North, R. Coase, T. Eggertson, O. Williamson, and others
		Efficiency as performance	Social efficiency means achieving social goals and the productivity of creating social benefits and satisfying merit interests of society	O.S. Sukharev, J. Huerta de Soto
			Adaptive efficiency is the success in the adaptation of various subsystems to external changes and environment	D. North, R. Nelson, S. Winter, T. Buck, G. Hodgson, S. Pejovich, and others
		Efficiency as an element of the management system	Efficiency is a complex category that combines the categories of economy, performance and quality.	D.S. Sink, A. Neely, N. Slack, G.B. Kleiner, O.S. Sukharev, S.N. Rastvortseva, M.S. Solodkaya, E.V. Bazueva, and others
* Note: the dominant approach, which on the basis of the characteristics of the stage allowed us to give a true theoretical description of the hermeneutics of the category "efficiency" is highlighted in bold. Source: compiled by the authors based on the study of the works [10; 14; 15; 16; 19; 20; 21; 23; 25; 27; 28; 38; 41].				

of losses... of (known or given) economic resources” [27, p. 4]. The emergence of the ideas of “probabilistic causality” and “target causality” at the neoclassical stage of development of scientific knowledge made it possible to supplement the concept of efficiency through the interpretation of the category of optimum in the spirit of mechanistic determinism contained in the works of L. Walras, with the use of the methodological principle of relativity⁵ (Pareto approach). We cannot present the full research of the author on the correlation of the evolution of scientific thought and the hermeneutics of the category of efficiency⁶ in the framework of the present paper, so let us systematize basic author’s provisions in *Table 1*.

The limited format in which we present the authors’ provisions on the determinacy of differentiation of the approaches to the hermeneutics of the category of efficiency by the stages of evolution of scientific knowledge does not allow us to show the allocation of different kinds of efficiency at the present stage of development of economic science; these kinds of efficiency are as follows: internal and external (O. Romanova), potential and actual (V.E. Dementyev, Yu.V. Sukhotina, D. Tisa, etc.), static and dynamic (J. Huerta de Soto), D. North, O.I. Williamson, A. Abel, N. Mankiw, L. Summers, P. Zeckhauser, A.N. Asaul, H. Alonso, C. Garcimartin, etc.)

⁵ According to the principle of relativity, all physical processes in inertial systems of reference occur in the same way, regardless of whether the system is stationary or it is in a state of uniform and rectilinear motion.

⁶ The authors will present this research in a separate publication.

and, in our opinion, they are related to the increasing complexity of the object of research – the development of complex self-developing systems.

In general we can say that the vector of modern research on understanding efficiency has been formed in the context of dialectical unity of qualitative and quantitative characteristics in the complex self-developing systems for which the defining characteristic of evolution is the qualitative development characterized by quantitative certainty. In the broader, global sense, efficiency as a determinant of quality is currently a defining element in the interpretation of the term. We will use this provision to determine fundamental performance efficiency criteria for cluster-based spatial development of the territory.

We think it necessary to start modeling the configuration of performance efficiency criteria for cluster-based development of economy by clarifying the concept of cluster as a self-developing system and considering the essence of the term “cluster” as it is presented in the works of Russian and foreign scientists.

Interpretation of the cluster as a self-developing system

Studying clusters from the viewpoint of a system approach provides an indisputable basis for the development of a multi-criteria approach in the study of effectiveness of cluster-based spatial development with the dominance of the qualitative feature in the analysis. A review of the literature on this issue shows that the works of authoritative foreign scientists acknowledged as founders of the cluster

Table 2. Decomposition of the content of interpretations of the category “cluster” in the works of foreign scientists on the basis of a system approach

Authors	Main features of the system			
	Integrity/divisibility	Presence of stable relations	Orderliness	Emergence/synergism
M. Porter	The cluster is characterized by common activity of the participants working to achieve a commonly set goal. The composition of the cluster is defined in terms of geographical, sectoral and functional aspects.	The border of the cluster is determined by the degree of development of horizontal and vertical (structural links)	The cluster has a complex multicenter form of organization of its activities	The significance of firms and organizations within the cluster as a whole exceeds the simple sum of its parts
M. Enright	The cluster is represented by the geographical agglomeration of firms in related industries	Stability in the cluster is achieved with the help of vertical and horizontal links and a system of interdependent relationship of competitive cooperation that ensures long-term interaction of the participants	The nature of interaction within the cluster is organized, and it is manifested in the ability to form an organizational management structure unique to this area for the purpose of coordinating and regulating the relations between the participants	The integration of the firms in the cluster is due to an opportunity to obtain benefits and advantages derived from their location in the same area
E. Bergman, E. Feser	The cluster consists of a group of independently operating and competing industrial enterprises and organizations concentrated on a geographical basis	Sustainable links in the cluster are established between geographically concentrated companies and organizations. It is allowed to form links between members of the cluster for other reasons (joint R&D, suppliers and buyers from different regions, etc.)	Internal order and coherence in the cluster is achieved through organized cooperation between three groups of actors: producers of cluster production, related industries, and supporting organizations	When the cluster is formed, it provides businesses and organizations with additional advantages and benefits they cannot get outside the cluster-based interaction; it makes the participation in a cluster appealing to them (formation of an innovation ecosystem of the cluster and the so-called “tacit knowledge”)
S. Rosenfeld	The cluster is identified as a form of spatially limited critical mass of companies, between which there is a system of relationships based on complementarity and similarity of the firms	The cluster is formed and developed by forming a system of relations between the participants	The structure of the cluster depends on the formation and specifics of the dialogue between the participants, communication channels, and established networks.	Synergistic effect in the cluster is created due to the geographic proximity of its member firms and their interdependence
Source: compiled by the authors based on the study of the works [17; 31; 32; 33; 34; 39].				

methodology describe clusters as structures possessing the features of highly organized systems⁷.

The results of the review of scientific works of M. Porter, M. Enright, E. Bergman, E. Feser, and S. Rosenfeld are summarized in *Table 2*, which considers foreign interpretations of clusters according to four key characteristics of the systems: 1) integrity and divisibility; 2) presence of stable relations; 3) orderliness; 4) emergence and synergism.

Thus, having decomposed the essential content of the term “cluster”, we see that clusters, as understood by foreign researchers, are sophisticated systems that interact with the external environment and benefit from cooperation in conditions of competition.

Beyond our theoretical overview that defines the system characteristics of clusters, there remains the question of evolution of the cluster as a system. We emphasize that foreign scientists pay special attention to the problem of development of clusters, factors and stages in the evolution of cluster structures, specifics of modification of individual cluster elements and management models in the framework of the life cycle theory developed in the works of M. Porter [17], S. Rosenfeld [40, pp. 13-14] T. Andersson [30], Ch. Ketels et al. [42]. Thus, from the viewpoint of life cycle, clusters as open systems interacting with the external environment are considered as stable, but not static, objects.

⁷ In the article, the system is understood as “a part of the world that is relatively stable in time and space, possesses the properties of external unity, internal diversity, and epistemological integrity at the given level of observation” [7, p. 7].

In the context of the system research of clusters it is also important to pay attention to the publications of domestic scientists. For instance, the works of G.B. Kleiner, R.M. Kachalov and N.B. Nagrudnaya [7; 8] contain an in-depth understanding of clusters as economic systems and highlight the following five main characteristics of the innovation-industrial cluster:

1) the cluster is a multifunctional and multidimensional system possessing the properties of four types of systems – object, environmental, process and project⁸;

2) key feature of the cluster is complex in nature and involves institutional, contracting, harmonization and transformation-innovative components;

3) stability of the cluster is achieved through the synthesis of object, environmental, process and project strategies of development;

4) intensive manifestation of object properties of organizations participating in the cluster in a harmoniously developed cluster structure is compensated by emphasizing alternative, design, process and environmental properties of the cluster.

5) in order to meet the challenges of strategic planning in the cluster, it is necessary to search for and provide the balance between objective, design, process and environmental features of the cluster as a whole and of its participating organizations [8, p. 9].

The results of a system analysis of the clusters obtained by G.B. Kleiner and his colleagues are the basis for a definition of cluster as an object of system analysis proposed

⁸ See more in [7].

by E.V. Bochkova, E.L. Kuznetsova and V.A. Sidorov who systematized cluster features according to 17 characteristics of the system object [1, p. 32]. In our opinion, it is the most detailed system description of clusters; it takes into consideration properties such as integrity, hierarchy, dynamism, spatial and temporal certainty, causality, persistence, adaptability, etc. inherent in cluster structures and highlighted in domestic and foreign scientific literature.

Among the numerous works devoted to clusters we would like to name the research of M.P. Voinarenko: he adheres to a system-institutional paradigm and formulates the definition of cluster as an institution and the institutions [2, p. 151]. However, the definitions he proposes are dominated by an institutional characteristic, while system characteristics are to a greater extent disclosed by M.P. Voinarenko in model representations of the cluster [2, pp. 158-160].

E.A. Shastitko uses empirical observations and interviews of representatives of companies in various industries to show that it is more appropriate to consider cluster as a system, in which there is a “core” – i.e., a firm whose activity and value are essential for the existence of the cluster [29, p. 25]. Such a firm, in a certain sense, can be called a “systemically important company”. In our opinion, the critical role of a leader company in the establishment and development of the cluster, which E.A. Shastitko proved empirically, is of fundamental importance from the standpoint of determining the drivers of stability of the cluster as a system.

A.S. Danchenko in [3] analyzes basic units of system approach (“system”, “economic system”, “systemacy principle”) and on this basis in the first approximation proposes a cluster configuration in a regional economic system that needs further elaboration.

Researcher T.V. Uskova considers theoretical and methodological approaches to the creation of cluster systems, proposes a “technology” of their formation taking into account the conditions of and prerequisites for clustering at the meso-level of the economy. She substantiates an algorithm for creation of clusters in the region and a scheme of interaction of enterprises within the cluster that describes relationships and communication in the cluster system [26].

O.S. Kovalevskaya proves the effectiveness of applying a cybernetic approach to the analysis of regional clusters as complex dynamic systems which are embedded as management objects in the management system of the region [11]. The approach proposed by O.S. Kovalevskaya is interesting from the point of view of applying the concept of managing the system to cluster analysis. However, this aspect is beyond the scope of our study.

The results of the literature review that we carried out suggest that, despite the availability of research works on the subject, so far there is no certainty in the study of clusters as self-developing systems. From our point of view, cluster as a self-developing system is a type of system integrity in the form of a set of interconnected and geographically localized firms and organizations (or those that do not have clear geographical boundaries) that

Table 3. Distinctive features of clusters as self-developing systems

No.	Distinctive feature	Essence
1.	Sustainability	The ability of the cluster to maintain system integrity when functioning in a dynamically changing environment
2.	Complexity	The ability of the cluster to organize system interaction between a large number of participants, uniting them to achieve common goals and implement joint projects taking into consideration diverse linkages and interaction of heterogeneous actors with each other and the external environment
3.	Openness	The ability of the cluster to interact with the subjects of the external environment, to organize mutually beneficial exchange of resources, information, knowledge, technology
4.	Dynamical organization	The ability of the cluster to develop new levels of organization and embed them in the management hierarchy
5.	Controllability	The ability of the cluster to manage internal elements of the system and exercise controlling influence on the external environment
6.	Differentiability	The ability of the cluster to create new and relatively independent subsystems resulting from the emergence of new levels of organization in the hierarchy of control
7.	Cognition	The ability of the cluster to create special information and knowledge subsystems that contain the specifics of interaction with the external environment significant for its development and accumulate the experience of previous interactions

Source: compiled by the authors with the use of [5; 6; 22; 24].

interact with the external environment and can, with the help of such interaction, develop at the expense of their own resources and qualitative changes in target, structural, and functional characteristics.

In our view, clusters as self-developing systems, in addition to the basic system properties, possess the following distinctive characteristics: sustainability; complexity; openness; dynamical organization; differentiability; controllability; cognition⁹.

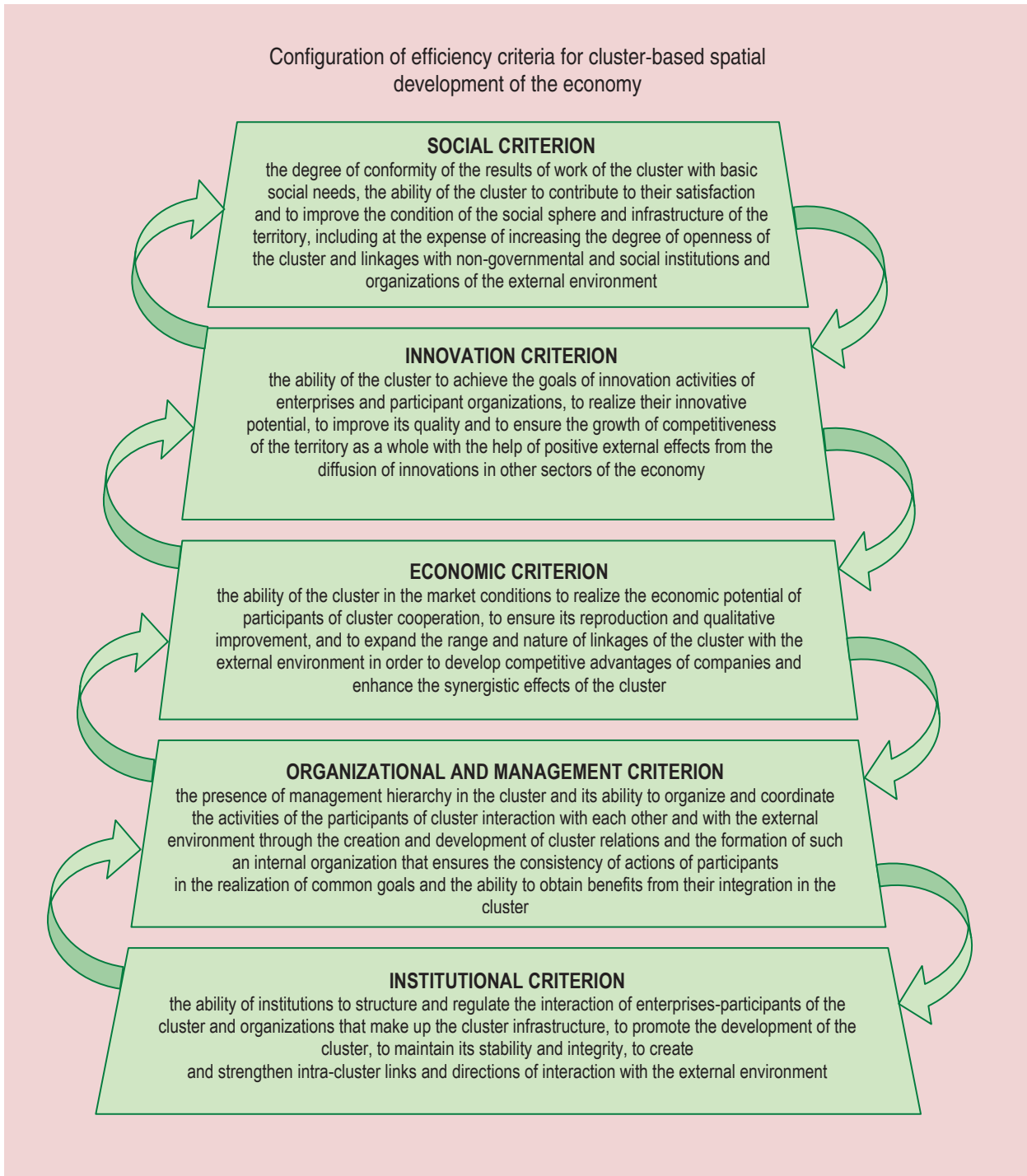
Table 3 presents the authors' description of distinguishing features of clusters as self-developing system.

⁹ When defining the self-developing system and its characteristics we relied on philosophical research by V.S. Stepin [22; 24], and also on the works of V.N. Edronova, A.O. Ovcharov [5], E.A. Zakharchuk, A.F. Pasyukov [6].

We believe that further in-depth interpretation of clusters as self-developing systems is in-demand in science and should be subject to independent theoretical research. However, the amount of research works currently available and the author's conclusions and results obtained on its basis that expand the interpretation of the categories of efficiency and system nature of clusters help clarify and supplement the criteria-based framework of the analysis of efficiency of regional clusters.

Criteria-based framework of the studies of the efficiency of clusters as complex self-developing systems

As for reviewing the efficiency of clusters and the efficiency of cluster development of a territory (primarily, region), we were unable to define a single methodological line of research in domestic and international publications. For



example, on the one hand, there are works on assessing performance efficiency of clusters as regional forms of industrial organization and the need to create appropriate mathematical tools for this purpose. On the other hand, modern publications provide interpretations of clusters as efficient tools, mechanisms, forms, structures, elements and even catalysts of socio-economic development. In this case, the basis according to which clusters are studied are not analyzed in this aspect, i.e. its efficiency is postulated *a priori*.

This gap is partially reduced in the writings of L.S. Markov, M.A. Yagolnitzer [12; 13], A.B. Drozdov, N.V. Drozdova [4], S.N. Rastvortseva, N.A. Cherepovskaya [18], and P. Teekasap [43].

For example, L.S. Markov, and M.A. Yagolnitzer describe the cluster as a special form of territorial organization of industrial production, the efficiency of which can be assessed on the basis of indicators showing the number of the employed, profitability and their changes. Despite the fact that the efficiency criteria have not been elaborated thoroughly, this method of cluster analysis takes into account not only endogenous, but also exogenous indicators of clusters activity, and by applying the econometric tools it helps establish and measure the relationship of the following levels: between individual characteristics of related factors; between various factors; between factor-based and resulting features [13]. L.S. Markov in his later work complements the system of efficiency indicators with the specific added value of companies in the cluster [12, pp. 168-169].

A.B. Drozdov and N.V. Drozdova propose an economic-mathematical model for forecasting the development of regional clusters; the model is based on the interaction of enterprises with the cluster and analyzes the efficiency of functioning of the latter. The criteria of efficiency of cluster functioning were the indicators proposed by L.S. Markov and M.A. Yagolnitzer [4, pp. 58-60]; but this fact does not expand the criteria-based framework of assessing the efficiency of cluster development in regional economy.

S.N. Rastvortseva and N.A. Cherepovskaya build their research on the processed data on the average number of employees on the full range of organizations in the statistical database of the Russian Federation and modify the approaches of M. Porter and the European Cluster Observatory in order to identify those economic activities, in which the construction of clusters will be efficient [18, p. 129]. After the technique they propose was tested in the Belgorod Oblast, five efficient clusters have been identified in which the total number of employees was 134,847 people (or 26% of the total number of people employed in the economy of the region) [18, p. 130]. It is worth mentioning that the approach developed by S.N. Rastvortseva and N.A. Cherepovskaya is original and possesses practical importance, but it has certain limitations relating to the process of collecting statistical data in Russia; besides, it does not reveal causal relationships in the cluster, as indicated by the authors themselves [18, p. 129].

P. Teekasap offers a system dynamic model for assessing the impact of governmental policy on the performance efficiency of clusters with the use of the following variables: size of the cluster; number of employees willing to work in the cluster; availability of employment; resource limitation; average wages; wages of employees of the cluster [43]. P. Teekasap's approach to the modeling of cluster development efficiency is unique because the logic of his analysis is built on the basis of three groups of model limitations: firms are divided into three types, eight types of resources are taken into account, and six options of market demand and production capacities are considered. But it is not possible to apply his approach to the Russian reality without introducing radical modifications in the model.

All of the above suggests that the efficiency of development of territorial clusters has not been studied thoroughly. In order to fill this gap to some extent, we attempt to integrate the methodology of studying the concept of "efficiency" described in the first paragraph of the present article and the system and institutional view of the cluster by identifying the criteria of cluster development efficiency in certain areas (locations) or economic space as a whole. This approach can serve as a unifying theoretical and methodological basis for further studies of clusters, understanding the nature of their efficiency, and conditions and possibilities of its enhancement.

Considering the cluster as a system operating in a certain institutional environment and possessing a structure that is institutionalized from the point of view of availability of formal and informal rules

and norms that affect the behavior of the participants and their interaction, we propose to introduce the concept of configuration of efficiency criteria for cluster-based spatial development, and to simulate this configuration with the help of a system integration concept of enterprises developed by G.B. Kleiner [9, p. 129]. We believe that this concept provides a comprehensive (as opposed to fragmented) way to determine the internal space of the system; it takes into account all the components necessary for its functioning and their interaction with each other and with external environment, and also the establishment of systemically important links that ensuring the system stability.

We shall consider the configuration of efficiency criteria for cluster-based spatial development as a certain order of efficiency criteria that reflects their position and proportion in relation to each other. The configuration and definition of each of the proposed criterion is presented in the *Figure*.

The original assumptions for constructing the configuration were as follows:

1. The selected criteria show the aspects of interaction between the participants and the arrangement of intra-cluster space that are critical to the establishment and functioning of the cluster as a system.
2. The order in which the criteria are arranged meets the principle of stratification, the use of which allows us to present the criterial structure of the cluster. The lower layer is allocated to the institutional criterion that constitutes the foundation of the cluster structure, which includes mental, value-based, cultural and cognitive institutions, followed by functional layers that define the specifics of the

cluster activity in key areas, resource limitations and targets the alteration of which is linked to specific actions and decisions of enterprises and member organizations.

3. Relationships between the criteria are of a unifying and interacting nature; they can be extended and modified at different stages of the life cycle, taking into consideration specific features of the cluster as a self-developing system.

When defining the criteria, we considered the following provisions as decisive:

1) efficiency is determined by qualitative characteristics, i.e. the criterion reflects a qualitative feature in the development of the cluster, the feature should include primarily the development of intra-cluster structure, quality improvement of intra-cluster cooperation and development of relations, forms and mechanisms of interaction of the cluster with the external environment;

2) the content of the criterion does not create any obstacles to establishing quantitative indicators on its basis or to its evaluation with the help of expert surveys;

3) the task of quantitative measurement is set without the prevalence of the principle of “maximizing behavior”, although it is assumed that cluster members may seek to obtain profit with the lowest costs or expect to receive the highest net positive effect.

Thus, the model-based representation of the configuration of efficiency criteria shows that there can be no single criterion (for instance, economic criterion) when determining the efficiency of cluster-based spatial development. In turn, the systemic-institutional factor and the cluster’s link with the external environment,

which the institutionalists call “friction”, do not speak in favor of the neoclassical efficiency criterion. Therefore, in the elaboration of regional cluster-based development programs, when designing the territorial structure of clusters, one should take into consideration a system of criteria similar to the criteria-based configuration that we propose, based on the understanding of efficiency as a quality determinant of the cluster system that takes into account both the interests of participant firms and the needs of society.

Conclusion

Studying the category of efficiency from the hermeneutic standpoint in many respects proves the relativity of this concept. It is corroborated by the diversity of approaches to the interpretation of efficiency, definition of its types and criteria based on many features that synthesize different aspects of social relations. However, modern science in the course of evolution of scientific knowledge about efficiency, from the mechanical picture of the world to neo-classicism and other trends, has developed such a methodology that makes it possible to analyze the efficiency of different socio-economic systems from system and institutional-evolutionary positions on the basis of modification of qualitative determinants of development. This aspect of analysis was realized in our study of efficiency on the example of territorial clusters.

Thus, when studying clusters as complex self-developing systems, qualitative characteristics associated with the complexity of intra-cluster relations and formation of new mechanisms and forms of interaction with the external environment become crucial.

Thus, efficiency becomes the most important qualitative characteristic of a cluster-type system.

The efficiency of functioning of regional clusters is shown on the basis of the configuration of five criteria that reflect the system nature of cluster-based interaction of participant firms. The model of criteria-based configuration in the form of a stratified pyramid sets a certain order of institutional, administrative, economic, innovative and social performance criteria, reflecting their relative positions, correlation, interdependence, and integration in the cluster system.

The configuration that we propose creates prerequisites for the development of the cluster theory for the organization of economic systems

not only in theoretical but also in practical aspects. It helps simulate five interrelated sections of a high-performance cluster on the example of a particular cluster or cluster initiatives and projects.

In the future, the hermeneutics of the category of efficiency and the proposed criteria-based configuration will form the basis for elaborating the classification of efficiency of cluster-based spatial development and a system of indicators to assess the performance efficiency of regional clusters. An important aspect of future research consists in the development and improvement of state policy aimed to support and cultivate efficient cluster structures and identify qualitative determinants of this institutional technology.

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Creating Competitive Strategies of Industrial Enterprises from the Standpoint of Corporate Social Responsibility



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Abstract. The relevance of the research lies in the development and strengthening of the institutions of the civil society amid globalization of the world economy, which determines the necessity of domestic business meeting the requirements of international standards and raises the issue of ensuring competitiveness of industrial enterprises to a qualitatively new level in terms of corporate social responsibility. The purpose for the research is to assess competitive strategies of companies in fuel and energy complex (hereinafter – FEC companies) in the framework of the new techno-economic paradigm with the growing importance of corporate social responsibility. Based on comparative analysis of the traditional theory of competitiveness of an enterprise and competitiveness in the framework of the concept “Industry 4.0”, it has been revealed that the global level of competition involves consideration of the company’s activities in the context of its socio-environmental environment focused on forming long-term competitive advantages. This became the rationale for creating the authors’ model of the impact of corporate social responsibility on company’s competitiveness, which indicates the influence of corporate social responsibility in five key options, providing additional opportunities for increasing company competitiveness. The authors present a modified method of identifying company’s competitive strategies in the aspect of importance of funding corporate social responsibility. The results of identification strategies of competitive behavior FEC companies have demonstrated that the integration of corporate social responsibility into company’s strategic management reinforces the importance of socially responsible business in the process of competition. The use of the author’s method of identifying competitive strategies helps identify the company’s strengths and weaknesses and, in contrast to the previously existing methods, consider the opportunities for financing corporate social responsibility with the purpose of forming competitive advantages for industrial enterprises. The research results can be used by regional and municipal authorities and business leaders when designing documents on strategic development, implementing modern concepts of social responsibility; by investors for assessing investment attractiveness of companies; and by educational institutions at various levels for implementing academic disciplines in the field of complex socio-economic analysis of enterprise activity. The promising area of further research is the development of a mechanism of providing competitiveness of enterprises with respect to corporate social responsibility in the framework of a new techno-economic paradigm.

Key words: socially responsible activity, corporate social responsibility, competitive behavior strategy, competitive advantages, enterprise competitiveness, investment, non-financial assets.

Amid neo-industrialization, the techno-economic paradigm is characterized by increased attention to building social progress and forming a relatively new phenomenon such as impact investing [11]. The concept of social progress is being actively developed not only in sociology but also in economics and public administration. The level of countries’ social development is characterized by the so-called social progress index – a composite indicator of the international research project “The Social Progress Imperative”, which measures countries’ achievements in terms of their social development [7]. The social progress index which does not take into account any cost parameters including GDP, is estimated using more than 50 indicators grouped in three categories taking into account human needs, foundations of their well-being and development opportunities. According to the

ranking of world countries by level of their social progress 2014, Russia ranks 80th out of 132. Such low rates were the consequence of poor quality of healthcare, personal security, personal rights and tolerance [4]. By the end of 2017, Russia rose to the 67th position out of 128 possible [7]. Responsible conduct of business, especially large corporate structures, is a mandatory precondition for the social progress of the society. The establishment of a new techno-economic paradigm which takes into account the changing foundations of economic development and the increasing tensions of competition inevitably determines the evolution of corporate social responsibility. Its area of responsibility includes new non-economic factors; the spatial aspect of social responsibility is expanded. Companies are now responsible not only for the results of production and economic activity, but also for other aspects such as environment, social programs, education, healthcare etc., i.e. they are forced to be socially responsible. The development and strengthening of civil society institutions amid globalization of the world economy demands that domestic business practices meet the requirements of international standards, which raises the issue of ensuring competitiveness of industrial enterprises of a qualitatively new level.

The evolution of the social responsibility of separate companies and the entire business environment goes through a series of development stages of development, starting from simple forms and ending with full integration of social responsibility into the activities of economic entities. The introduction of the principles of corporate social responsibility (the principles of consistency,

comprehensiveness, specificity, hierarchy, information security, etc.) [5, pp. 138–139] into the practice of Russian companies expands the range of opportunities for the formation of long-term competitive advantages within the philosophy of “Industry 4.0”. The following main factors in “Industry 4.0” development are distinguished [6, 21, 23]: digitalization, Internet of everything, additive technology, fully automated cloud storage.

Experts from industrialized countries, primarily the USA and Germany, believe that the Fourth industrial revolution will provide many advantages. However, negative changes are expected associated with the disappearance of blue-collar occupations, increased unemployment in developing countries and increased gender disparity. According to the report published for the 46th World Economic Forum in Davos, Switzerland [26], these changes have already begun since 2015.

Within the new industrial paradigm intellectual resources become the main resources of companies, changing competitive advantages [2, 16]. Future structural changes in the industry stimulated by the transition to the new techno-economic paradigm lead to the fact that amid neo-industrialization a major role in shaping the competitiveness of a modern company will belong to intellectual capital. There are empirical studies confirming the influence of intellectual capital on the company’s performance. Examples of these studies are presented in *Table 1*.

Despite the increasing role of intellectual resources, key decisions of owners, managers and investors are made based on company’s financial statements; this leads to undere-
stimation of risks and benefits related to

Table 1. Empirical studies of the impact of intellectual capital on company's performance

Authors	Research results	Sampling features
N. Bontis, W.C.C. Keow, S. Richardson, 2000 [18]	The link between intellectual capital and company's performance is significant and positive regardless of the industry.	107 Malaysian companies in various industries
M. Subramaniam, M.A. Youndt, 2005 [24]	A positive impact of intellectual capital on innovation activity	93 US companies
C.J. Huang, C.J. Liu, 2005 [22]	Non-linear positive dependence of capital returns on intellectual capital.	297 companies in Taiwan
E.V. Popov, M.V. Vlasov, 2006 [10]	A positive impact of investment in generation of new knowledge on enterprise's profitability.	Large enterprises of the Urals region
A.A. Bykova, M.A. Molodchik, 2011 [3]	Positive link between the value of intellectual capital and enterprise's revenue growth rate.	401 enterprises in Perm Krai

Table 2. Comparative analysis of the traditional theory of company's competitiveness and competitiveness in the framework of the concept "Industry 4.0"

Description	Traditional theory of company's competitiveness (resource-based method)	Competitiveness in the framework of the concept "Industry 4.0" (cognitive method)
Key competitive advantage	Material resources	Human (intellectual resources)
Reproductivity of key competitive advantage	Reproductive (copied) competitive advantages	Unique company's competences which are impossible to fully reproduce
Competitive analysis of a company	Considering the company's position in the industry (M. Porter's five forces model)	Considering the company in the context of the social and ecological environmental (surroundings)
Primary addressee of measures aimed at increasing competitiveness	Consumers, suppliers, partners, investors	Stakeholders in the broad context
Company's main goal	Maximize owners' wealth by company's appreciation	Increase the value for all company's stakeholders
Level of implementation of competition	Regional, global to a lesser extent	Mainly global
Time horizon of activities to improve competitiveness	Tactic (staying ahead of current competitors, creating barriers to industry access)	Strategic (creating long-term advantages)

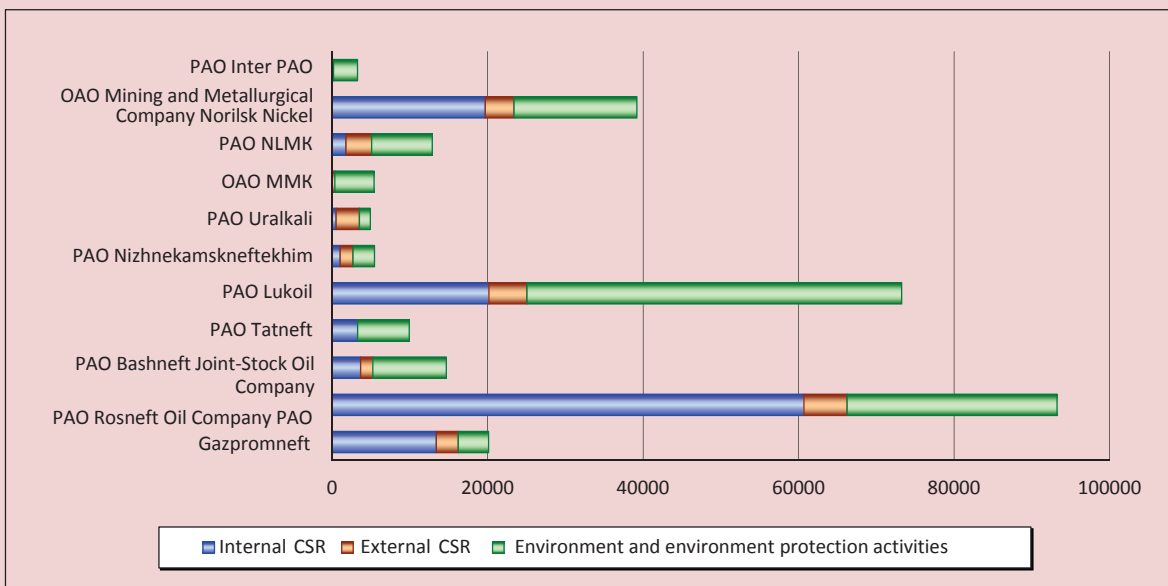
intellectual capital. Thus, the traditional way of generating competitive advantages is replaced with the cognitive one. The traditional approach is associated with the use of material resources while the cognitive one primarily focuses on using competences and intellectual potential of the company. The results of comparative analysis of the traditional theory of company's competitiveness and competitiveness in the framework of the concept "Industry 4.0" are reflected in *Table 2*.

Global competition implies consideration of the company's activities in the context of the socio-ecological environment based on

the increasing importance of intangible resources; it aims to create long-term competitive advantages. This is evidenced by the results of research of foreign authors. The research revealed that intangible assets serve as a mediator in relation to the social and financial efficiency as an enterprise's competitive advantage.

The research objects were 599 industrial companies. As a result, we confirmed the hypothesis that intangible assets such as intellectual capital, reputation and culture have a positive impact on financial results. The authors point that there is no direct link

Figure 1. Companies' cost of CSR activities in 2015, million rubles



between corporate social performance and company's financial performance, describing it as mediated, regulated by company's intangible assets [25].

The concept of corporate social responsibility (CSR) has undergone significant transformations: from the normative contradictory definition of H. Bowen – the “father of corporate social responsibility”, defining the social responsibility of a businessman as “the implementation of policy, decision making or conduct which would be desirable from the standpoint of goals and values of the society” [19], and ending with the core universal standard ISO26000:2010 “Guidance on social responsibility”.

Despite the fact that in Russia, CSR is in its infancy, in recent years, public interest to assessing corporate social responsibility of domestic enterprises has increased. This is explained as follows: more and more Russian companies enter international markets where

they face the fact that at the global level there are standards of social responsibility for economic entities. The costs of financing activities promoting corporate social responsibility of domestic industrial companies, which are the carriers of the best practices, are presented in *Figure 1*.

The distribution of funds reflects company's CSR priorities. For example, PJSC LUKOIL, PAO Bashneft Joint-Stock Oil Company, and PAO NLMK Group prioritize costs of financing activities aimed at protecting the environment. PAO Rosneft Oil Company, OAO Mining and Metallurgical Company Norilsk Nickel, PAO Gazpromneft give preference to measures of internal CSR, and PAO Uralkali – aims to develop the region where it operates – external CSR.

The data from Figure 1 highlight companies of the fuel and energy complex as leaders in financing CSR activities. We identified the distinguishing features of running a socially

responsible business (hereinafter SRB) from the standpoint of sustainable development of a business entity. The essence of the SRB concept should be considered through social, environmental, economic, and political aspects [13] accounting for interaction of all stakeholders. The structure of SRB including production, management and investment components should be analyzed at micro-, meso-, macro - and mega-levels.

- At the micro-level, socially responsible business includes economic efficiency of enterprise's activity, considering the quality of products and competence of labor resources, and clearly realizes its responsibility to its employees.

- At the meso-level (sectoral level), partnership relations are established based on analysis of external and internal environmental factors.

- At the macro-level, socio-economic relations are formed: they concern the conduct of business at the state level when interacting with various business structures and public organizations.

- At the mega-level, conditions for creating transnational corporations are created, which increases the country's competitiveness at the international level.

At the same time, CSR in Russia is complicated by the volatility of the national economy and imperfect regulatory framework regulating socio-economic relations. In particular, the problem resides in public reporting and slow progress from free reporting to systematic reporting (including international standards), as well as in changing environmental reporting to comprehensive reporting in the sphere of sustainable development [15].

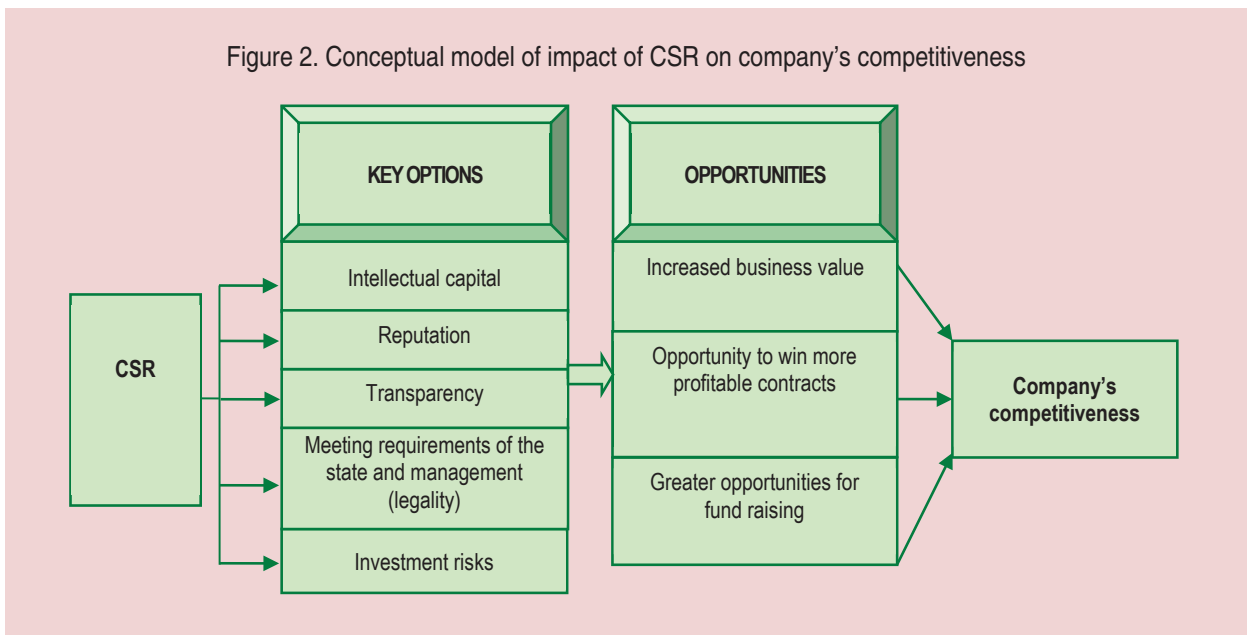
It should be noted that CSR provides the evolutionary transition from socially responsible investing to impact investing, which involves solving both social and environmental issues through new investment tools in investments areas [14].

The role of CSR and its impact on the company's performance is quite ambiguous. American experts express contradictory views on the impact of CSR on competitiveness [13]. Some authors believe that CSR tools will undoubtedly have a positive effect on the enterprise's techno-economic indicators, others hold the opposite opinion. The third group of experts relies on the fact that social activities are managed by departments and offices of one type, while industrial, economic and technical tasks are regulated by other units. Moreover, the goals and objectives of these units should not interfere [17]. It is worth noting that the disagreements between researchers are due to the fact that the concept of "competitiveness" in modern conditions loses its purely economic value and acquires a broader meaning reflecting the impact of business on the civil society.

We attempted to determine the effect of social responsibility on company's competitiveness through designing a conceptual model of the impact of corporate social responsibility on competitiveness (*Fig. 2*).

The model presents five key features of the impact of corporate social responsibility: intellectual capital, reputation, transparency, legality and investment risks, which creates additional opportunities for creating competitive advantages with the aim of increasing company's competitiveness. However, it is necessary to mind that the costs of CSR are ambivalent since their influence

Figure 2. Conceptual model of impact of CSR on company's competitiveness



is indirect and recoverability of investments in CSR can only be reached during a prolonged period which defines long-term competitive advantages.

The formation of company's competitive advantages from the position of CSR creates additional opportunities for the development of the strategic potential:

- strengthening company's position in socio-economic issues to ensure company's image;
- increased productivity and efficiency, innovative activity, etc.;
- management of financial and non-financial risks in terms of CSR;
- attracting qualified personnel, ensuring their professional growth, introduction of material and moral incentives;
- increasing market share and opportunities to attract new consumers;
- creating sustainable partnerships with regional bodies, local communities, trade unions, civil institutions, the media;

– implementation of best practices demonstrating great civil and social responsibility to the state and the society [1, 8, 12].

The comparison of the above mentioned advantages offered by the use of CSR and components of strategic potential affecting company's competitiveness indicates that they largely coincide or interfere. However, for social costs in realization of opportunities provided in CSR to fully become an effective investment they need to be actively promoted by the state as business social projects affect both enterprise's performance indicators and the society as a whole. Only the state along with businesses can bring social focus to the economy; that is why the state should stimulate, regulate, and determine the vector of priorities for social investment. Thus, these features are the basis for the formation of a new strategy of enterprise competitiveness in the framework of corporate social responsibility.

To assess the increment of company's competitive advantages and form the strategy of competitive behavior we propose a CSR competitive index ($I_{C.CSR}$). It is an integrated indicator presented as the geometric mean of the product of reasoned metrics. The indicators reflect the areas of GRI ("Global reporting initiative") and, in turn, are comprised of three metrics selected using principal component analysis. The metrics of the economic indicator are as follows: revenues (R), profit (P), market capitalization (MC). The metrics of the social indicator are as follows: cost of personnel training and development (PT), work safety and industrial security (WS), and social package (SP). The metrics of the environmental indicator are as follows: cost of atmosphere protection (AP), cost of water protection (WP), cost of land protection (LP).

We present local indices in dynamics, which reflects the change in metric values:

$$I_x = \frac{\text{metric}(X)}{\text{metric}(X_0)} \quad (1),$$

where I_x – index of change of the chosen metric (X) of the indicator;

metric (X) – the chosen metric of the indicator;

metric (X_0) – the selected metric of the indicator in the previous period;

(X) metric can be any metric of the proposed economic (P, R, MC), social (PT, WS, SP) and environmental (AP, WP, LP) indicators.

The calculation formula for CSR competitive index ($I_{C.CSR}$) is the geometric mean of the product of local indices of economic, social and environmental performance, which is the most "sensitive" to the value of the indicators used in its calculation:

$$I_{C.CSR} = \sqrt[3]{I_{env} \times I_s \times I_{ec}} \quad (2)$$

An example is companies occupying leading positions in the country's economy. Particularly important among them are companies of the fuel and energy complex (FEC) which are among the leaders in CSR. Table 3 presents the values of $I_{C.CSR}$ of leading fuel and energy companies.

To describe competitive strategies we used the method of competitive strategy analysis characterized by high information content and visual expression [9, 20]. According to this method, the enterprise uses all of its efforts (I) to resist three types of external effects: stress (S – stress-tolerant), violations (R – ruderal), and competitors (C – competitive):

$$I_s + I_c + I_r = 100\% \quad (3)$$

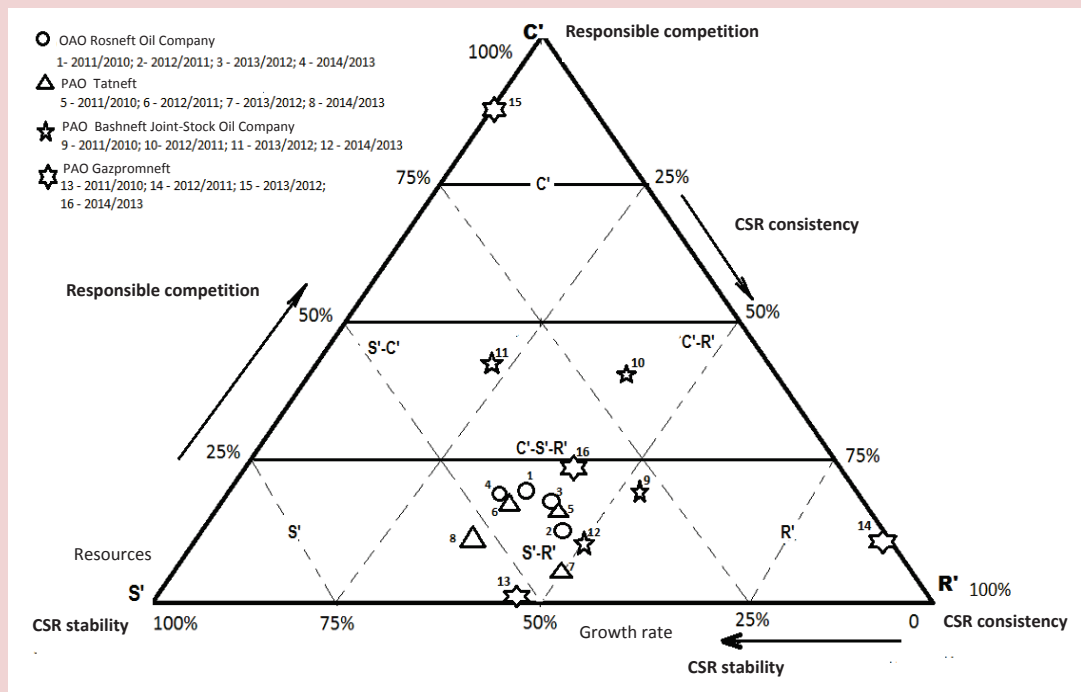
where I – intensity of efforts to implement S, R and C.

Time series of annual values of $I_{C.CSR}$ served as initial data for constructing the diagram (Fig. 3).

Table 3. CSR competitive index

Companies	2011/2010	2012/2011	2013/2012	2014/2013	2015/2014
PAO Gazpromneft	-	0.966	4.066	1.485	1.493
OAO Rosneft Oil Company	1.353	1.157	1.290	1.320	0.949
PAO Tatneft	1.289	1.297	0.942	1.210	0.609
PAO Bashneft Joint-Stock Oil Company	1.384	2.141	2.201	1.111	1.575

Figure 3. Classification chart of competitive strategies of fuel and energy sector in 2010–2015



A relative increment of $I_{C.CSR}$ is calculated as the second index (%).

$$I_{C.CSR}' = \frac{100(I_{C.CSR} - I_{C.CSR-1})}{I_{C.CSR-1}}, \quad (4)$$

where $I_{C.CSR-1}$ – value of CSR competitive index of the previous year¹.

On order to analyze the competitive behavior of companies in terms of socially responsible activities, we propose amending the classification structure of strategies for competitive behavior which would reflect the performance of their positions relative to each other focusing on the characteristics of socially responsible behavior as an element of both external and internal environment

¹ Due to the absence of the data for 2016, the value of the last range (2015–2014) is not reflected since the increment is determined by two values (see Fig. 3).

of the company. Identification of the proposed strategies for competitive behavior of the companies in CSR and the variety of combinations of its secondary strategies are presented in *Table 4*.

The figure (*Fig. 3*) demonstrates the distribution of values of the CSR competitive index in the dynamics for enterprises of PAO Bashneft Joint-Stock Oil Company, PAO Tatneft, OAO Rosneft Oil Company, PAO Gazpromneft.

The scale of the figure corresponds to the range of annual values of $I_{C.CSR}$ and its increment $I_{C.CSR}'$. The obtained index values and its increment are measured on respective axes of the chart; the intersection of these values defines the location of the analyzed companies according to their competitive behavior strategy in terms of C'R'.

Table 4. Identification of strategies for competitive behavior of companies in CSR

Traditional methodology		Modified methodology	
Strategy	Strategy for companies' competitive behavior	Strategy	Strategy for companies' competitive behavior in CSR
R (ruderals)	Monopoly on production and sale of innovative goods or significant outrunning of competitors in both development of new products and their market launch. Such a strategy helps obtain high return on invested capital even with a small market share.	R' (CSR consistency)	Ensuring the effectiveness of the implementation of CSR functions and directions based on the principles of integrity, accountability, targeting, and transparency.
C (competitors)	Effective mechanisms of resource locking and production intensification. Finding ways of producing a unit of commodity consuming less labor and materials.	C' (responsible competition)	Prevention of violation of the rights of other economic entities or unfair competition.
S (stress-tolerants)	They survive because they avoid frontal price competition by creating their own unique niche inaccessible to others. They are adapted to existing in conditions of considerable resource scarcity.	S' (CSR stability)	To preserve and maintain social stability and economic security.
C-R (competitors-ruderals)	Adapting to markets with low impact of stress and competition restricted to medium-intensive violations.	C'-R' (responsible-consistent competition)	Adapting to markets with low stability in the implementation of CSR.
R-S (ruderals-stress-tolerants)	Adapting to non-productive medium-violated markets.	R'-S' (consistent-stable competition)	Adapting to markets with a relatively low degree of responsibility in CSR.
C-S (competitors-stress-tolerants)	Adapting to relatively violated markets with medium-intensive stresses.	C'-S' (responsible-stable competition)	Adapting to markets, implementing non-systematic events in CSR.
C-S-R (competitors-stress-tolerants-ruderals)	Adapting to markets where the competition is limited to medium-intensive stress and violation.	C'-S'-R' (responsible-consistent-stable competition)	Adapting to markets with responsible competition restricted to medium-intensive stability and consistency.

According to the figure, almost all enterprises mainly implement the R'-S' strategy, thereby showing resistance to stress, i.e. they use their monopoly on production. Companies adapt to markets with a relatively low degree of responsibility in CSR, in other words, they demonstrate consistently moderate social activity.

According to the chart, this is most evident for OAO Rosneft Oil Company. The implementation of this strategy for companies of OAO Rosneft Oil Company takes place in terms of consistency and stability in spite of changing economic conditions. The low rate of implementation of investment programs explains the accumulation of points mainly in the lower part of the chart closer to the R'-S' axis. For example, for lack of data on expenditures on environmental protection for PAO Tatneft, its competitive strategy tends to moderate social stability. This presumably indicates insufficient financial resources for the implementation of the company's non-core activities.

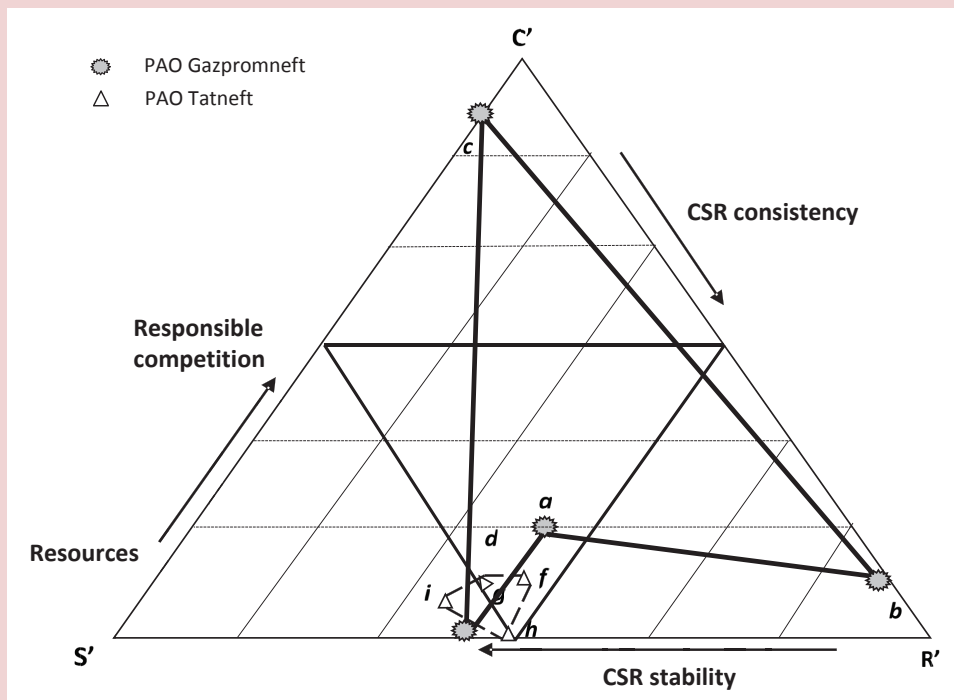
In 2011, according to the chart, PAO Gazpromneft was implementing a systematic CSR strategy (point 14) characterized by high instability in the external environment compensating it by intense activity in the company's internal environment. It should be noted that this strategy carries high risks. For example, the company had to pay heavy fines for violating environmental management; the company's activities probably were carried out bypassing environmental standards, however, it made it possible to leave many competitors behind. In 2013, PAO Gazprom implemented its C' strategy – responsible competition (point 15), having effective mechanisms for locking

resources and production intensification. Thus, in the framework of the Year of Ecology declared by the company, 300 diverse environmental activities were implemented, which exceeds the average number of such events and initiatives 10 times compared to the previous year. PAO Bashneft Joint-Stock Oil Company in 2011–2013 (points 10, 11) demonstrated socially responsible competitive behavior characterized by medium-intensive stability and consistency, i.e., the wish to achieve a responsible competitive position. The most successful socially responsible competitors will to the right of the dashed lines, least successful – to the left.

The difficulty in plotting the chart of identification of competitive strategies of fuel and energy companies lies in the heterogeneity of data contained in company's non-financial company reports. The modified methodology for identifying competitive strategy of an industrial enterprise helps assess the competitive status of an economic entity in dynamics and make necessary changes to the structure of the company's investment policy taking into account both social and environmental sphere.

Considering the figure for identifying competitive strategies of companies of PAO Tatneft and PAO Gazpromneft during 2010–2014 (trajectories *abcd* and *gghi* (Fig. 4), there are two diametrically opposed strategies of competitive behavior. PAO Tatneft mainly implements the S'R' sub-strategy. All points, *gghi*, reflecting the position of PAO Tatneft in the chart are concentrated in a certain zone which occupies a small area. This confirms the fact that the company does not significantly change its competitive strategy for 2010–2015 in the part of socially responsible behavior.

Figure 4. Trajectory of change in model competitive behavior of fuel and energy companies*



* PAO Gazpromneft: a – 2011/2010; b – 2012/2011; c – 2013/2012; d – 2014/2013. PAO Tatneft: f – 2011/2010; g – 2012/2011; h – 2013/2012; i – 2014/2013.

Regarding PAO Gazpromneft, it is fair to say that the *abcd* trajectory occupies a significant part of the graph $S'C'R'$ on the right. This suggests that the company is dramatically changing its competitive behavior within the framework of socially responsible behavior of a business, in particular, this concerns measures for environmental protection, as noted earlier. This emphasizes the growing importance of real investment in the company's non-tangible assets.

Thus, using the modified method of identifying the competitive strategy of an industrial enterprise in the framework of their socially responsible behavior, we can determine its weak and strong points and assess the competitive status of the economic entity

in dynamics. Identification of competitive strategies of leading fuel and energy companies in the context of CSR financing, which takes into account the reaction of the company's internal environment to the impact of environmental factors, makes it possible to position companies relative to each other.

The establishment of a new techno-economic paradigm and "Industry 4.0" necessitates the formation of company's competitive advantages based on its intellectual capital in the framework of socio-environmental responsible activities, which in the long term becomes the foundation for an enterprise's sustainable development. The developed conceptual model of the impact of CSR on company's competitiveness

demonstrates the influence of CSR on five key options, creating additional opportunities for creating competitive advantages. The ambivalent nature of investing in CSR implies only a long-term repayment, which defines long-term competitive advantages. Integration of CSR in the company's strategic management reinforces the importance of socially responsible business in the process of competition.

The obtained results can be used by regional and municipal authorities and heads of companies implementing the modern concept of social responsibility, as legitimate elements of the mechanism of competitiveness in the context of corporate social responsibility, as

well as control and analytical tools to justify the actual behavior of economic entities based on the natural laws of competition. Analysis of retrospective data in dynamics helps assess the company's position against competitors with the purpose of amending companies' development strategy. For example, theoretical and methodological provisions of the research were applied in the practice of PAO Gazprom in the development of proposals aimed at implementation of the plan for the socio-economic development of PAO Gazprom for three years. In the interests of investors, the research results can be used as ranking tools to rank companies according to the degree of their investment attractiveness.

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Assessment of Options for Logistics Objects in the Region Using Multi-Criteria Optimization (Case Study of the Republic of Tatarstan)



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Abstract. The article proposes a scientific and practical approach to solving the problem of optimizing the regional transport-logistics structure by creating a reference network of logistics facilities of different class and purpose on the basis of criterion assessment of logistics capacity of each district of the region. The methodologies used by most researchers help objectively assess the logistics potential of the region at the level of either macro-systems or micro-systems assessing logistics capacity at the level of transportation with a certain number of participants and stable freight turnover. The proposed method of multi-criteria optimization helps not only identify the opportunities of logistics resources of each administrative and territorial of the region, as well as promote its active integration as a constituent entity of the Russian Federation in domestic and international transportation corridors, creating new opportunities for the

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strategy of its economic development. The most frequently used mathematical methods of site selection for logistics centers (hierarchy analysis, “gravity center”, theory of graphs and flows in networks and others) are certainly applicable when it is necessary to determine the location of objects with a certain number of customers and suppliers, stable inflows and outflows, but in the case of dynamic, unstable in time and volume of freight traffic, heterogeneous structures they do not give reliable results. The proposed calculation of comprehensive ranking assessment of each region is based on the implementation of multi-objectives taking into account both qualitative criteria and quantitative statistical and calculated values using the generated lists of alternatives (management decisions – districts of the Republic) of structured weighted criteria which are taken into account in calculating the comprehensive ranking of each management decision (of a particular area of the region). Determining the location of a logistics facility at the final stage of the project implies participation of subjects interested in its deployment: regional administration, representatives of business units. The proposed software package involves accelerated selection of deployment options through impacts on a number of criteria indicators. The project is at its final development stage; databases are being completed allowing to graphically show the proposed logistics facilities on the map considering their type.

Key words: logistics potential, logistics center, comprehensive ranking assessment, multi-criteria decision-making objective.

The results of scientific research we present are obtained in the framework of the development of a major research project which aims to improve the transportation and logistics framework in the Republic of Tatarstan (RT). In cases where it is necessary to place logistics centers in major economic zones, one faces many comparable options, the number of which increases, not only due to a large number of potential locations for logistics facilities, but also due to the possibility of multiple streamlining the management of material flows which in turn depend on the level of economic activity of the territories; therefore, integrated criteria-based assessment is based on logistics capacity of each the municipal districts of the Republic.

The research set the following objectives:

- to identify the main indicators for assessing logistics capacity of the region’s

administrative divisions, collect objective quantitative statistical data and justify the choice and evaluation of quality indicators;

- to compile a comprehensive ranking of the region with highest logistics capacity based on the collected data, using author’s and software packages, through the implementation of multi-criteria objective of decision-making;

- to develop a software package and adapt it to Windows. The package helps quickly make design decisions with the participation of regional administration (at all levels) and interested business structures, and interactively shows the objects for placement on the map.

When choosing the methodological approach to solving the specified problems we revealed that the existing numerous methods objectively assess the region’s logistics capacity either at the level of macro-systems, defining its role in national and international transport and

logistics system (TLS), or systems evaluating logistics capacity at the industrial level [16; 8; 10] or at the level of unimodal transportations [21; 22]; a very small number of publications present methods taking into account the integrated approach to the organization of transport and logistics systems within Russia's constituent entity [7; 9]. A detailed analysis of existing methodological approaches to the assessment of the region's logistics capacity is presented in [12]. To make the assessment of logistics capacity of the region's administrative division (AD) more objective we applied combinatorial mathematical modeling according to which statistical data were collected and necessary calculations performed relative to the entire set of criteria for each of the 43 districts of the region among which were:

1. Quality binary linguistic criteria (348 indicators) which were expertly assessed according to the principle of advantageous / disadvantageous; presence/absence, including:

- central position relative to the regional center;
- position relative to international transport corridors;
- position relative to the intersection of federal highways;
- position relative to major regional highways;
- deficit of storage platforms;
- proximity to river ports;
- proximity to airports;
- proximity to railway stations and terminals.

2. Statistics and quantitative design criteria (645 values) expressed in relevant units of measurement including:

- district's area;

- district's production potential;
- total length and density of land communication lines;
- length of railway lines;
- length of highways and paved roads;
- availability of built logistics centers including corporate ones;
- turnover of transshipment cargo through the territory of districts;
- cargo carriage volume and freight turnover by all means of transport;
- cargo carriage volume and road freight turnover;
- cargo carriage volume and rail freight turnover;
- cargo carriage volume and seaborne freight turnover;
- amount of existing storage space;
- index of cargo flow density;
- index of freight activity.

The next phase of the project was the identification of areas in RT with highest logistics capacity according to the requirements in the form of a list of R criteria. To achieve this we developed a unique technique for calculating ranking evaluation of each district based on the implementation of a multi-criteria decision-making objective (MC DMO) underlying the following calculations and their interpretations.

The relevance of applying the author's approach to solving the multi-criteria problem of this type is based on the fact that the existing mathematical methods and models of choosing the location of logistics capacities such as the method of "gravity center", simplest models of linear programming [2], models of queueing systems, methods of the theory of graphs and network flows [5] helps obtain optimal reliable results when it is necessary to determine the

location of logistics centers (LC) for a single object with a limited number of known customers and suppliers with known static incoming and outgoing material flows. These methods are traditionally implemented when creating a corporate centralized supply network of industrial enterprises and trading companies.

When selecting locations of logistics objects with a large number of participants in extensive logistics chains with connections difficult to track, these methods become ineffective due to the large dimension of the issue and a large number of objective economic, geographical, occupational and other factors influencing the adoption of optimal decisions. In this case, it is advisable to use the methods of multi-criteria selection which traditionally include: methods based on quantitative measurements (multi-criteria theory of utility); methods based on qualitative measurements the results of which are converted into a quantitative form (methods of hierarchy analysis (MHA), and methods based on the fuzzy set theory); methods based on quantitative measurements using several indicators when comparing alternatives (group of ELECTRE methods); methods based directly on qualitative measurements without moving to quantitative variables at the time of measurement and registration (verbal decision analysis).

Among all these methods the mostly used when selecting locations of logistics centers are MHA [8, 10, 16], when the level of region's attractiveness is evaluated by comparing the rating of competitiveness of the studied area with the assessment of competitiveness of the reference region (actual or notional) with best performance. The disadvantage of this method is that it requires the presence of a standard

for assessment and working only with quality indicators for integrated assessment provided by the expert, which is rather subjective. To convert qualitative information to an interval scale in MHA we use the verbal-numerical ratio scale which puts in line certain numbers with the degree of preference of one indicator over another. However, the conversion of verbal measurements into numbers has no sufficient justification since pair-wise comparisons of factors are made in terms of the dominance of one parameter over the other, the significance of one of the other is determined in the solution process by an expert by results of processing of its antisymmetric expert matrices with mandatory verification of their contents to the requirements of transitivity.

The proposed methodological approach works both with qualitative and qualitative objective measurements, estimating realistic quality indicators at the same time (on a binary linguistic scale convenient to the expert), and with objective quantitative statistical data given on the traditional interval scale. Since the vast majority of MC DMO are designed to consider a variety of purposes (indicators, criteria) we use a "detailed" MC DMO model which can be represented as the following data tuple [3; 19]:

$$\langle t, X, R, A, F, G, D \rangle . \quad (1)$$

where t – statement (type) of an objective; X – a set of acceptable alternatives (management decisions, variants of actions); R – a set of criteria for assessing the degree of achieving established goals; A – a set of criteria scales (nominal, ordinal, interval, ratio scales); F – mapping of a set of acceptable alternatives in multiple criteria evaluations

of their effects (outcomes); G – a system of preferences of a decision maker (DM); D – decisive rule reflecting the system of preferences of a DM. We also note that in the case of group decision-making (G system type – reflects the preferences of one or a group of experts) model (1) must be supplemented by the following elements: $E(f)$ – group preferences function and L – principle of individual preferences consistency, the most natural form of which can be the method of expert estimation followed by verification of initial estimates by known non-parametric statistical methods which consist in calculating the relevant parameters and comparing them with known boundary values.

Specification of the “detailed” (1) type MC DMO model can help obtain the models for real problem situations and by moving it into a fuzzy environment where X , R , F and G are fuzzy. The preparation involves the selection of statistical indicators according to the research objectives according to certain criteria indicators, R (according to the list of criteria). It is also necessary to compile a list of management decisions (researched alternatives) X – region’s districts as administrative divisions (AD). To create the parent matrix it is only necessary to construct a mapping of a set of R criteria on the set of X alternatives. The work array $C = \{c_{ij}\}$ is a consequence of creating the mapping τ_1 :

$$\tau_1: R \rightarrow X. \quad (2)$$

where $X = \{x_i\}$, $i = 1, m = 43$ – the cardinality of the set of AD in the Republic of Tatarstan, which is presented as a list in the nominal scale of its constituent districts,

$R = \{r_j\}$, $j = 1, n = 24$ – the cardinality of the set of values (criteria) considered in the list (list on the nominal scale). Then the mapping of the (2) type can be represented as a two-dimensional set measured in linguistic and physical units in the interval matrix $C = \{c_{ij}\}$, $i = 1, n = 43$; $j = 1, m = 24$ sized $m \times n = 24 \times 43$, which represents the formalization of available statistical information of initial data at the time of the study.

The technique of addressing MC DMO includes the following steps:

1. Structuring the list of criteria indicators with obtaining a hierarchical “tree of objectives” (TO) in the form of fishbone diagrams by Professor Ishikawa [18].

2. Successive weighting of TO branches at each hierarchy level with calculating the weight of terminal branches of the tree ω_j , $j = 1, mw$ (where mw – the number of branches at each hierarchy level, which from the position of weights as a unit fraction represent a complete group of events) to implement unweighted model and weighted model.

3. Calculating two-dimensional vector of local priorities $U = \{u_{ij}\}$ as the mapping to the method τ_2 , AK&M [4; 18] taking into account the semantics of criteria of the two types (with the increasing criterion values the quality increases; with the increasing criterion value the quality is reduced):

$$\tau_1: C \rightarrow U. \quad (3)$$

The mapping (3) is carried out by means of two ratios (4) and (5):

$$u_{ij} = \frac{c_{ij} - c_{ij}^{\min}}{c_{ij}^{\max} - c_{ij}^{\min}} \cdot 100\%, \quad (4)$$

$$u_{ij} = \frac{c_{ij}^{\max} - c_{ij}}{c_{ij}^{\max} - c_{ij}^{\min}} \cdot 100\% . \quad (5)$$

Moreover, formula (4) is used when increasing the value of a particular criterion the quality increases, formula (5) – when increasing the criterion value reduces the quality.

4. The calculation of the vector of global priorities $V = \{v_i\}$, $i = 1, n$ for additive convolution:

$$v_i = \sum_{j=1}^m u_{ij} \cdot w_j . \quad (6)$$

5. Finding the best element of the vector of global priorities and the numbers of an optimal alternative:

$$v^{\text{opt}} = \max\{v_i\} \rightarrow i^{\text{opt}} \rightarrow x^{\text{opt}} . \quad (7)$$

6. Finding the set of quasi-optimal alternatives by forming a cluster (based on the formation of equivalence relations) in the Republic of Tatarstan objectively close to the area of LC location as the most optimal (here x^{opt} – Tukayevsky district in the Republic of Tatarstan as the leading one by production potential as a result of the research).

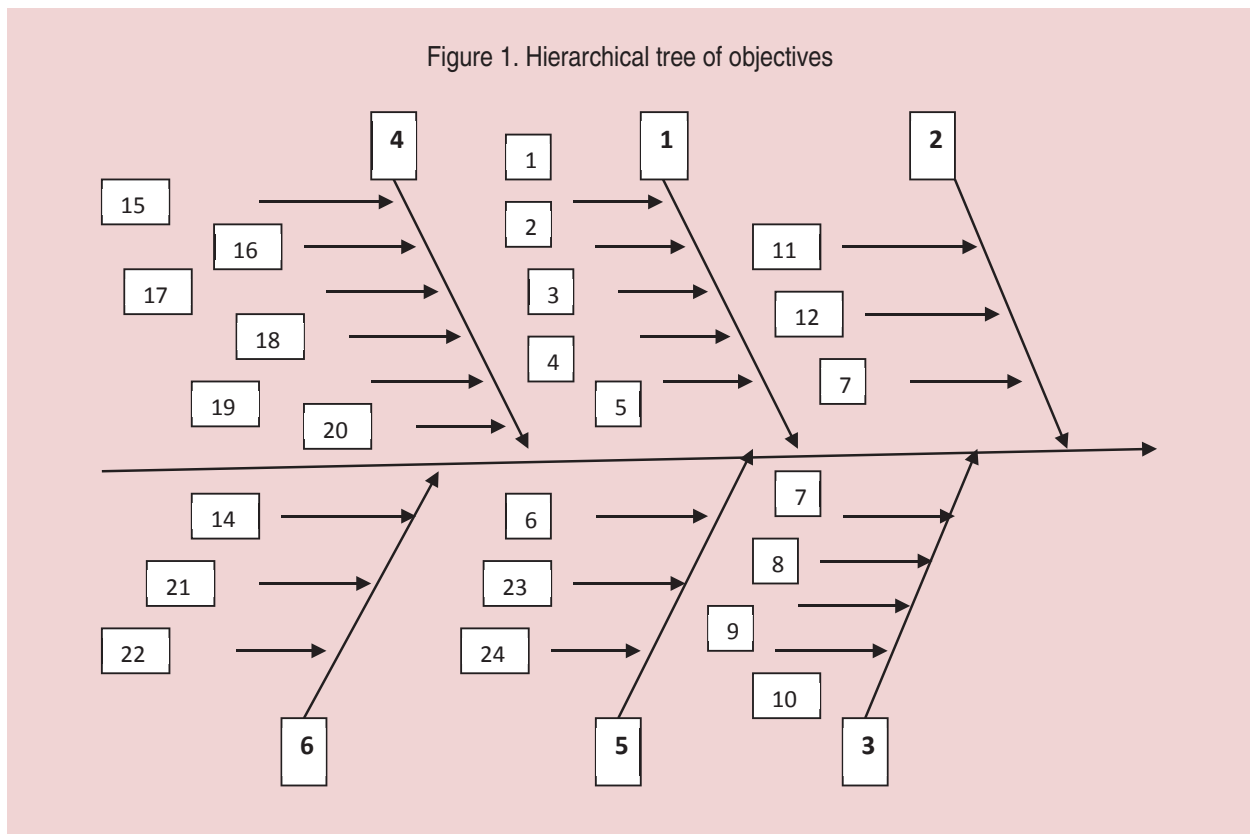
The structuring of the list of criteria indicators may be performed using formal (one of the possible methods used in the research is the author's approach by A.M. Shikhaleva [20] based on fuzzy frames) and phenomenological methods. The latter is of particular interest because it gives an opportunity for particular interested representatives of the district (investors, administration) to participate in operational simulation together with the working group of researchers. Then the first

approximation is presented to the interested representatives of the district by the following structure of the “tree of objectives” (TO) in *Figure 1*.

The criteria were combined at the first hierarchical level into groups, their constituent criteria – separate branches represented the second level of hierarchy for each group. The process of building a TO is based on the content of criteria indicators themselves, giving them equally or non-equally significant weights at each level of the hierarchy is the subsequent stage. Since groups are formed by researchers, they are given summarizing name criteria. The process of building a TO is demonstrated with equally significant criteria at every level of the hierarchy, where all branches of the TO are of equal importance. Along the way, we phenomenologically create respective groups of structured criteria-based indicators.

In the first approximation, we take the equal significance of groups and equal significance of criteria inside each group and we receive the following weight indices w_{ij} (given in parentheses), where $i = 1..6$; j – number of criterion indicator from the general list of criteria (r_j):

Group 1 (hereinafter, groups in *Figure 1* are highlighted in the squares in bold) “Region's geographical position” ($v_1 = 0.1667$; here and below: all 6 groups of criteria have the weight $= 1 / 6 = 0.1667$); we assigned 5 criteria to this group, therefore, the weight of each of them will be in relative units of $1 / 5 = 0.2$: $r_1 =$ “Size of region's territory”, square kilometers ($w_{1,1} = 0.2$); $r_2 =$ “Central position relative to the regional center (Kazan)”, close/far ($w_{1,2} = 0.2$); $r_3 =$ “Position in relation to the



intersection of international transport corridors (ITC)”, favorable/unfavorable ($w_{1.3} = 0.2$); r_4 = “Position relative to the intersection of federal highways”, favorable/unfavorable ($w_{1.4} = 0.2$); r_5 = “Position relative to the intersection of major regional highways”, favorable/unfavorable ($w_{1.5} = 0.2$);

Group 2 “Proximity to ports and stations” ($v_2 = 0.1667$): r_{11} = “Proximity to river ports”, yes/no ($w_{2.11} = 0.3333$); r_{12} = “Proximity of airports”, yes/no ($w_{2.12} = 0.3333$); r_{13} = “Proximity to railway stations and terminals”, yes/no ($w_{2.13} = 0.3333$);

Group 3 “Length of communication lines” ($v_3 = 0.1667$): r_7 = “Length of land communication lines”, kilometers ($w_{3.7} = 0.25$); r_8 = “Length of railway lines”, kilometers ($w_{3.8} = 0.25$); r_9 = “Length of roads”, kilometers

($w_{3.9} = 0.25$); r_{10} = “Length of paved roads”, kilometers ($w_{3.10} = 0.25$);

Group 4 “Through transportation” ($v_4 = 0.1667$): r_{15} = “Cargo carriage volume by all means of transport”, million tons ($w_{4.15} = 0.1667$); r_{16} = “Road cargo carriage volume”, thousand tons ($w_{4.16} = 0.1667$); r_{17} = “Rail cargo carriage volume”, thousand tons ($w_{4.17} = 0.1667$); r_{18} = “Seaborne cargo carriage volume”, thousand tons ($w_{4.18} = 0.1667$); r_{19} = “Rail freight turnover”, million tons per kilometer ($w_{4.19} = 0.1667$); r_{20} = “Road freight turnover”, million tons per kilometer ($w_{4.20} = 0.1667$);

Group 5 “Production potential and generalized communication parameters” ($v_5 = 0.1667$): r_6 = “Region’s production potential (volume of industrial and agricultural

products)", million rubles $\times 100$ ($w_{5,6} = 0.3333$); r_{23} = "Road density", b/r ($w_{5,23} = 0.3333$); r_{24} = "Index of cargo flow density of each municipal district", b/r ($w_{5,24} = 0.3333$);

Group 6 "Storage facilities" ($v_6 = 0.1667$): r_{14} = "Availability of built logistics centers (including corporate distribution centers), units. ($w_{6,14} = 0.3333$); r_{21} = "Amount of existing storage space including corporate distribution centers", thousand square meters ($w_{6,21} = 0.3333$); r_{22} = "Deficit of storage platforms". presence/absence ($w_{6,22} = 0.3333$).

The selected groups of criteria presented as initial data in the created hierarchy will have the following kind of a fishbone diagram (see *Fig. 1*).

In the presented TO, the numbers of branches of the second hierarchical level are taken from the table of initial data (column 1). The names of criteria indicators corresponding to the number are given in column 2 of the same table. The numbers of criteria groups (first TO hierarchical level correspond to the numbers of groups generated by DM during semantical (situational) analysis.

Then the weights of all 24 criteria indicators ω_i , $i = 1, k = 24$ are calculated according to the known rule for hierarchical "trees" – as the product of the weight of the group on and the weight of criteria indicators included in each group, designating the results as the following expression (8):

$$\omega_i = v_i \cdot w_{ji}, \quad (8)$$

where $j = 1, 1 = 6$ – the number of branches of the first TO hierarchical level; $i = 1, k_i$ – the number of branches of the second TO hierarchical level: for the branch of the first TO

branch – $k_1 = 5$; for the second branch, $k_2 = 3$; for the third – $k_3 = 4$; for the fourth – $k_4 = 6$; for the fifth – $k_5 = 3$; for the sixth – $k_6 = 3$. In total, the number of branches equals the number of criteria indicators given in *Table 1*: $k_1 + k_2 + k_3 + k_4 + k_5 + k_6 = 5 + 3 + 4 + 6 + 3 + 3 = 24$. Thus, with the known weights of the TO branches of the first hierarchical level v_j and weights of the second hierarchical level $w_{j,i}$, the weight of each criterion for further calculation can be calculated according to formula (3). The sum of the weights of all 24 terminal branches (TO leaves) ω_i , $i = 1.24$ will strictly equal to one.

Taking into account the total list of criteria divided by six substantively different groups and placing respective criteria indicators, we get a structured two-level TO, which with the use of formula (8) will give an opportunity to get many degrees of criteria priority (weights) for an equally significant scenario (which is methodologically important further), which for convenience purposes will be summarized in the following expression (9):

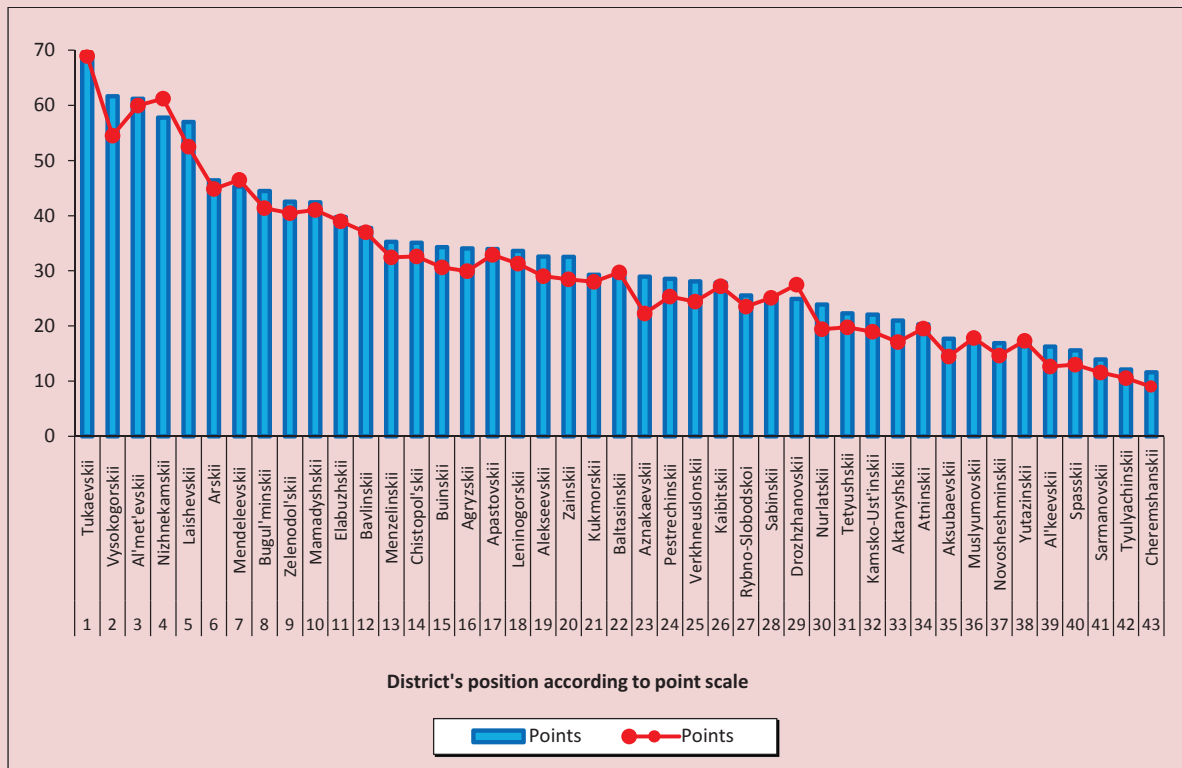
$$\begin{aligned} \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = 0.0333; \quad \omega_6 = 0.0556; \\ \omega_7 = \omega_8 = \omega_9 = \omega_{10} = 0.0417; \quad \omega_{11} = \omega_{12} = 0.0556 \\ \omega_{13} = \omega_{14} = 0.0556; \quad (9) \\ \omega_{15} = \omega_{16} = \omega_{17} = \omega_{18} = 0.0278; \\ \omega_{19} = \omega_{20} = 0.0278; \\ \omega_{21} = \omega_{22} = \omega_{23} = \omega_{24} = 0.0556. \end{aligned}$$

The results of the first phase of solving MC DMO which implements dependences (3)–(7) of the two options of criteria weighting are presented in Table 1 and in detail in *Figure 2*.

Table 1. Multi-criteria ranking of districts of the Republic of Tatarstan, points
(for equally significant and partially weighted criteria)

District	Equally significant criteria		Weighted criteria	
	Rank	Points	Rank	Points
Tukaevskii	1	68.91	1	68.98
Vysokogorskii	2	61.67	4	54.54
Al'met'evskii	3	61.18	3	59.97
Nizhnekamskii	4	57.76	2	61.22
Laishevskii	5	57.00	5	52.56
Arskii	6	46.42	7	44.86
Mendeleevskii	7	45.29	6	46.52
Bugul'minskii	8	44.44	8	41.41
Zelenodol'skii	9	42.54	10	40.51
Mamadyshskii	10	42.41	9	41.03
Elabuzhskii	11	39.76	11	38.99
Bavlinskii	12	37.74	12	37.04
Menzelinskii	13	35.23	15	32.47
Chistopol'skii	14	35.08	14	32.61
Buinskii	15	34.30	17	30.67
Agryzskii	16	34.04	18	29.95
Apastovskii	17	33.96	13	32.94
Leninogorskii	18	33.59	16	31.34
Alekseevskii	19	32.59	20	29.04
Zainskii	20	32.53	21	28.50
Kukmorskii	21	29.29	22	28.01
Baltasinskii	22	29.18	19	29.76
Aznakaevskii	23	28.95	29	22.27
Pestrechinskii	24	28.53	25	25.34
Verkhneuslonskii	25	28.11	27	24.45
Kaibitskii	26	27.88	24	27.24
Rybno-Slobodskoi	27	25.55	28	23.52
Sabinskii	28	25.13	26	25.15
Drozhzhanovskii	29	24.89	23	27.49
Nurlatskii	30	23.90	32	19.42
Tetyushskii	31	22.28	30	19.78
Kamsko-Ust'inskii	32	22.03	33	19.00
Aktanyshskii	33	21.00	36	17.13
Atninskii	34	20.31	31	19.55
Aksubaevskii	35	17.69	38	14.49
Muslyumovskii	36	17.08	34	17.85
Novosheshminskii	37	16.87	37	14.64
Yutazinskii	38	16.70	35	17.36
Al'keevskii	39	16.28	40	12.65
Spasskii	40	15.57	39	12.99
Sarmanovskii	41	13.95	41	11.57
Tyulyachinskii	42	12.13	42	10.59
Cheremshanskii	43	11.62	43	9.01

Figure 2. Comprehensive ranking of districts of RT with equally significant and weighted criteria indicators (in conventional points)



The simulation results with finding optimal and quasi-optimal alternative regions in RT after the implementation of the third variant of criteria weighing, i.e., weighting criteria at all levels of the generated TO, are presented in Table 2.

When comparing Table 1 (equally significant, unweighted structured TO) and Table 2 (non-equally significant TO), the feasibility of the chosen approach to the solution of the problem becomes obvious because during the study there is a possibility to evaluate the “weight” of the non-equally significant (weighted) scenario of TO (see Fig. 1): differentiation of the degree of priority of criteria indicators considerably swaps the

elements (i.e., RT districts) of the ranked set, which is clearly demonstrated in Figure 3.

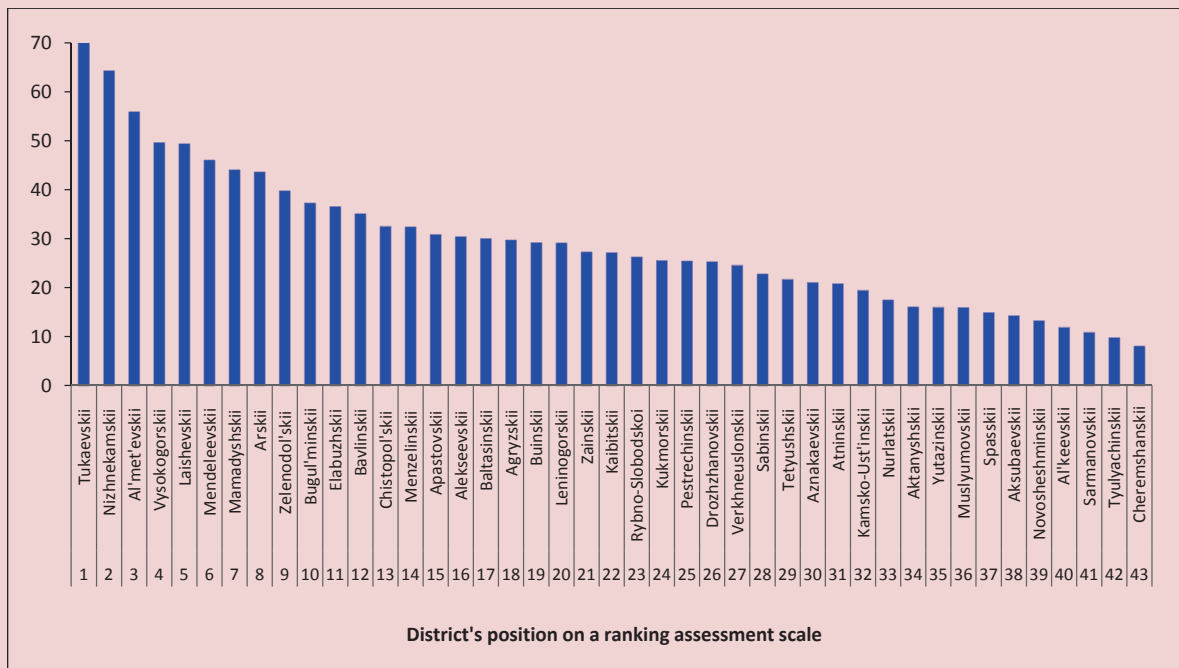
The weighting of criteria at different levels of the hierarchy was performed using both expert methods – ranking the preferences in the rank (ordinal) scale as more preferable [3; 11] with further mapping of the results according to Fishburn [20] into the interval scale, and selective correlation analysis as a means of ensuring relative independence of concepts expressed in the form of TO branches to ensure the required property of additivity.

At the next stage of project design, an opportunity is provided for targeted intervention of the representatives of the region and district

Table 2. Multi-criteria ranking of districts of the Republic of Tatarstan, points (for weighted criteria)

Rank	District	Points	Rank	District	Points
1	Tukaevskii	72.51	23	Rybno-Slobodskoi	26.17
2	Nizhnekamskii	64.25	24	Kukmorskii	25.49
3	Al'met'evskii	55.89	25	Pestrechinskii	25.35
4	Vysokogorskii	49.55	26	Drozhzhanovskii	25.23
5	Laishevskii	49.33	27	Verkhneuslonskii	24.50
6	Mendeleevskii	46.02	28	Sabinskii	22.75
7	Mamadyshskii	43.98	29	Tetyushskii	21.60
8	Arskii	43.58	30	Aznakaevskii	20.99
9	Zelenodol'skii	39.68	31	Atninskii	20.74
10	Bugul'minskii	37.18	32	Kamsko-Ust'inskii	19.37
11	Elabuzhskii	36.48	33	Nurlatskii	17.42
12	Bavlinskii	35.02	34	Aktanyshskii	16.02
13	Chistopol'skii	32.46	35	Yutazinskii	15.91
14	Menzelinskii	32.31	36	Muslyumovskii	15.85
15	Apastovskii	30.78	37	Spasskii	14.82
16	Alekseevskii	30.37	38	Aksubaevskii	14.18
17	Baltasinskii	29.99	39	Novosheshminskii	13.14
18	Agryzskii	29.64	40	Al'keevskii	11.84
19	Buinskii	29.14	41	Sarmanovskii	10.81
20	Leninogorskii	29.09	42	Tyulyachinskii	9.71
21	Zainskii	27.20	43	Cheremshanskii	8.00
22	Kaibitskii	27.06			

Figure 3. Comprehensive ranking of RT districts with structured weighted criteria indicators (in conventional points)



(administration, investors, other stakeholders) in terms of separate district's approaching to a leading position.

The study identified 16 leading districts. The mapping assessment of districts by amount of logistics potential is presented in *Figure 4*.

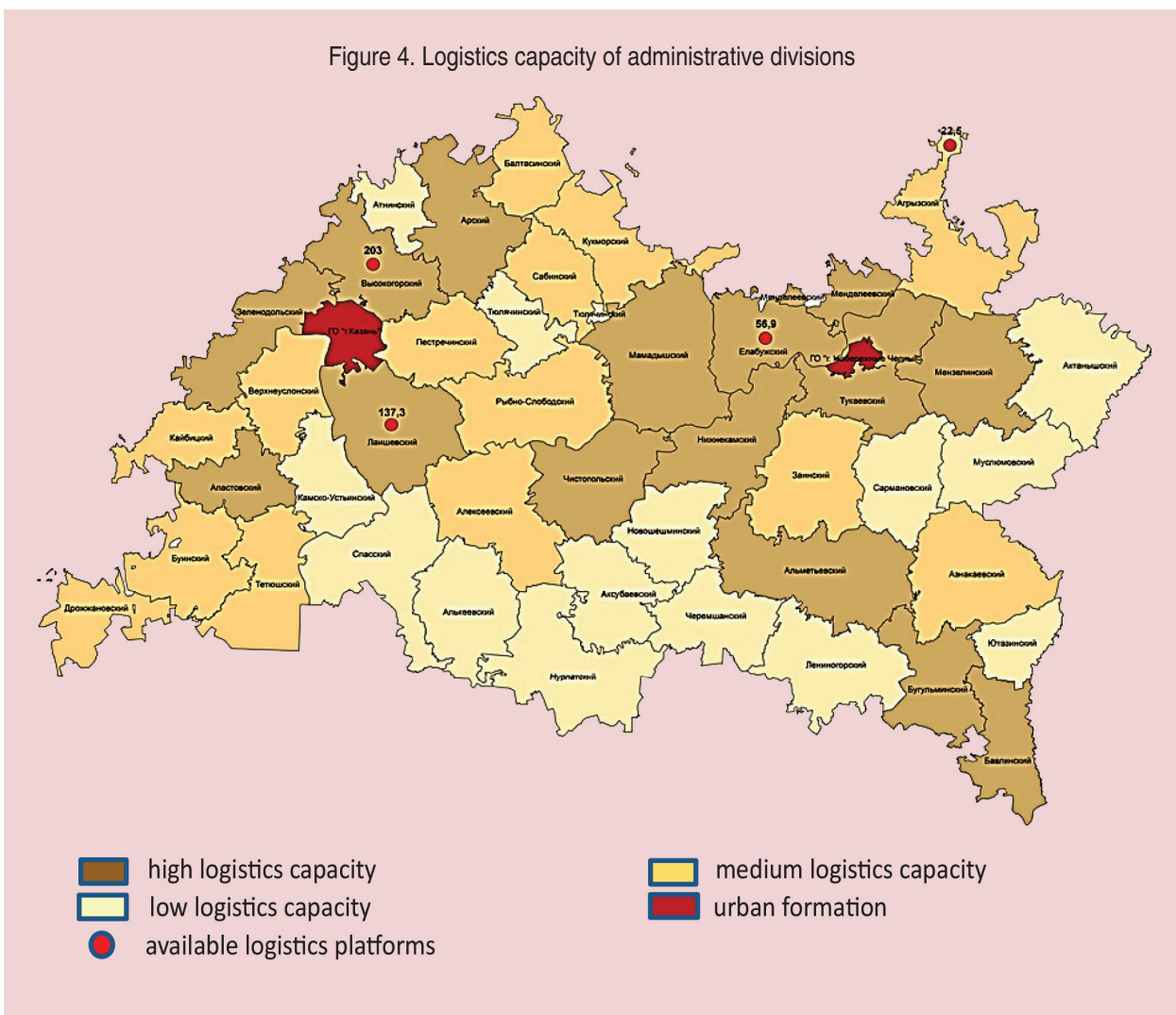
The mechanism of interaction of region's administration with the working group of project developers can be visually illustrated by the following example consisting of problem formulation and ways of its solution with output visualization of the projected management.

Suppose that a representative of one of AD (their district is ranked 11th in the ranking list)

wants to improve the ranking of the district as a place for appropriate location of logistics facilities. However, they may have funds in the amount of Q million rubles. The question is: what criteria indicators must they have an impact on to achieve maximum effect increasing the district's logistics attractiveness. In fact, the formulation of this objective can be divided into two aspects. First: which criteria indicators are possible to be influenced from the management point of view? Second: what is the most efficient way of using available resources?

In terms of the implementation of the first aspect of the participation problem, it is clear

Figure 4. Logistics capacity of administrative divisions



that the representative of an AD has no power over the size of the territory (criterion r_1 measured on an interval scale, km^2). They also have no authority in relation to the objectively recorded degree of centrality of location relative to the regional center (criterion r_2 measured in a binary linguistic scale “close – far”); however, there are some criteria which are possible to be administratively influenced in varying degrees by a representative of an AD or of the region as a whole (or both) (for example, increasing production capacities, traffic volumes by various means of transport, length and quality of communications lines, etc.).

For further certainty, let the representative of the district for, say, one year will be able to raise “District’s production capacity, million rubles” (criterion r_2) by, say, 6 %; during the same period increase “Length of land roads, kilometers” (criterion r_7) by 52 km; increase “Road cargo carriage volume, thousand tons” (criterion r_{16}) by 5–7 %. This, according to the district’s representative, is where the district’s potential for the next year is exhausted; the representatives are not required deeper understanding of the process of design and software development, their resource capacity; they report it the way they find it most convenient. The statement of the problem is finished.

The working team of developers before starting the simulation process specifies the price (cost) equivalents of units of quantitative indicators of criteria which require improvement; they may vary from region to region. The results are recorded in a temporary data file (in particular, in this case, in FoxPro for Windows environment in a .dbf file;

other software products can also be used) in the form of point or interval estimates. The district’s representative participating in the computational experiment is offered the whole list of criteria which are possible to be administratively influenced (in this example, the representative selected the impact on criteria r_2 ; r_7 and r_{16}).

The total estimated cost of special software crucial module with the .prg extension is calculated and formed; a new working table is built which has the following form: second, third and fourth lines are filled with the selected criteria, the first line is the allocated sum computed by the program with an option of a grade by q_1, q_2, \dots, q_k , expressed in million rubles ($\sum q_k = Q$ million rubles). Then this software module generates the so-called “utility function” in the form of a matrix of the appropriate size (in this case, $3 \times k$). The first row of the new working table, as mentioned, represents funds in million rubles: q_1, q_2, \dots, q_k – the total – k columns.

Now we formulate the objective: how to distribute the available funds between improving criteria r_2 ; r_7 and r_{16} most efficiently (as effectively as possible – for maximum promotion of values of the initial ranking to higher ranking)? In econometrics, to address the problems of this kind there is an efficient method of Bellman’s discrete optimization – dynamic programming equation [4; 6; 15]. The designed and refined software module tested on model examples helps in the framework of the method of reverse run perform the stage of conditional and then unconditional optimization with consistent calculation of state equations using the elements of the first row in

the new table. As a result, we will obtain new criteria values for r_2 , r_7 and r_{16} which will help use the district's available Q sum as efficiently as possible.

The former criteria characteristics of the program are duplicated and modified according to the results of solving the optimization problem of dynamic programming, the solution of MC DMO on the duplicated (modified) data file is performed again and other things being equal (the image for the rest of them – 42 districts – remains the same) the studied district is moved, say, from 11th place in the initial (weighted) solution to, for example, 8th or 5th place, thereby increasing its reserve ranking of logistics capacity and opportunities of locating a logistics facility on its territory. The problem is solved. However, it is quite possible that the same representative of the simulated district may not be fully satisfied with the results. Then their intentions are specified and optimization problems and MC DMO in general are solved again as many times as necessary. After the final series of computational experiments the results of which are stored in a special data file the district's representative is offered the best one.

A computer program is currently being written and debugged; it aims to create a user working table in an interactive (dialogue) mode with obtaining discrete values of utility functions depending on arguments in the form of options of investment influence with the gradation of the form q_1, q_2, \dots, q_k for Bellman optimization scheme (which will be used for the implementation of the MC DMO for calculating vectors of priority based on district's real financial capacity rather than on model values).

At the same time, efforts are being made to geographically visualize the possible location of logistics facilities in a dialog mode within the leading districts and districts having the greatest production growth potential including agricultural. By now, experts have identified the places of location of logistics facilities in particular districts with regard to surveys of all responsible decision-makers in leading administrative divisions (official survey was conducted with the assistance of the Ministry of Transport and Roads of the Republic of Tatarstan), as well as taking into account assessments of experts of the working group by all initially established criteria. Approximate coordinates of location (geographical and rectangular) are identified, as well as the type of logistics facilities; recommendations are proposed on the size of the occupied territory, classes and types of located storage facilities, rational use and mutual influence of existing and planned centers both on the territory of the Republic of Tatarstan and in nearby regions.

The proposed visualization of location of logistics centers in districts, as one of the options, can be supplemented with known gravity models. However, preliminary conducted calculations indicated the inappropriateness of applying these models in determining the specific coordinates on a specific territory; the accuracy of gravitational methods in the case of a large number of diversified cargo traffic linking various consignors and consignees, including transit cargo traffic, has led to criticism from many researchers [14; 17].

For districts leading in the assessment of logistics capacity we performed statistical forecasting of ground cargo carriage volume,

as well as production capacity of districts by extrapolative methods and based on neural intelligent trainable networks for a three-year forecast horizon. The forecast has revealed positive dynamics by main indicators: production capacity and ground cargo carriage volume, which finally confirmed the leading position of districts and helped recommend the location of logistics facilities on their territories (a detailed description of statistical forecasting is presented in [13]).

The obtained results help draw the following conclusions:

1. The proposed authors' method of multi-criteria optimization with the evaluation of options of locating logistics facilities in the district takes into account both existing opportunities of logistics capacity of each administrative division and any dynamics (positive, negative) of changes in criteria indicators of the district's logistics attractiveness from its area and length of communication lines

to changes in production capacity and cargo turnover capacity (by any means of transport).

2. The use of the authors' approach to the implementation of a multi-criteria decision-making objective provides an opportunity to improve transport and logistics infrastructure in the region in practice by arranging freight traffic with direct participation of all stakeholders, namely authorities at all levels of regional administration, representatives of cargo carriers, industrial business units and potential investors.

3. The proposed software, including the author's program adapted to Windows, implies accelerated selection of options for locating facilities through influence on criteria indicators of logistics capacity taking into account the financial capacity of each region's administrative division.

The pilot project is under consideration to be implemented on the territory of the Republic of Tatarstan.

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Enhancing the Efficiency of Dairy Farming through Improving the Regional System of Fodder Production



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Abstract. Addressing the issue of increasing the efficiency of dairy cattle breeding, increasing the volume of milk and dairy products is closely linked to the strengthening and development of fodder supplies. The State program of agriculture development and regulation of markets of agricultural products, raw materials and food for 2013–2020 implemented in the Vologda Oblast, as well as other legal documents do not fully promote intensive fodder production. This results in poorly developed meadow and field fodder production, fodder crop breeding and fodder seed production, harvesting, storage, and use of fodder negatively affects the efficiency of dairy cattle breeding in general and determines the range of the existing system problems. In this regard, the purpose for the research is to develop and scientifically substantiate the ways of improving the system of fodder production to increase the efficiency of dairy cattle breeding in the region. In accordance with the intended purpose we have met a set of objectives. Thus, based on materials of the Vologda Oblast, we conducted a brief analysis of the dairy cattle breeding for 2000–2016 which revealed that the overall situation in sub-sectors since 2013–2016 has stabilized: cattle stock is maintained, there is an increase in cow productivity and the total volume of milk produced, etc. We also presented the results of the assessment of fodder production potential and its development in modern conditions. We found that the region possesses quite large reserves for increasing fodder production. It is noted that the increase in crop areas and intensification of regional systems of fodder production, including the improvement of species and variety composition of fodder crops, development of resource-saving technology of their cultivation and harvesting, will increase the total fodder production. The development of efficient fodder production should be based on the maximum use of climatic resources, biological and environmental factors in the region. To develop the ways of improving the system of fodder production in the Vologda Oblast, we analyze the situation in terms of an economic leader – AO Plemzavod Rodina – with the aim of replicating its experience and practice in the farms of the Northwestern Federal district as a whole. It has been revealed that the use of modern scientific research results will help agricultural producers harvest fodder with higher concentration of metabolic energy up to 10–10.5 MJ per 1 kg of dry matter and increase the content of crude protein by more than 14 %, and decrease the consumption of concentrated and protein feeds. In conclusion, it is noted that the implementation of complex measures on the improvement of the system of fodder production development with regard to the above areas, latest scientific achievements, and experience of advanced farms will help increase the total production of high-quality fodder in the Vologda Oblast 1,5–2 times. The theoretical and methodological framework of the research includes fundamental works of domestic scholars and economists, general scientific research methods (abstract-logical, system approaches, generalization, economic and statistical, etc.), statistical (grouping, sampling, comparison, generalization), and graphical and tabular methods of data visualization. The practical significance of the obtained results is determined by their further use by specialists and farm managers, researchers in the field of dairy cattle breeding and fodder production in order to develop areas and measures to overcome the current situation in the sub- industry.

Key words: dairy cattle breeding efficiency, improving the system of fodder production, technology, fodder crops, fodders, efficiency.

In modern economic conditions the most important part of the food security issue is providing the population with affordable milk and dairy products in sufficient amounts. Despite the fact that in recent years Russia has witnessed an increase in the volume of agricultural production, in animal husbandry production growth of rates, particularly in dairy farming, remain quite low. Thus, the volume of milk production in the country in 2016 amounted to 30.8 million tons (below the level of 2015 by 0.1% and the 2000 level by 4.7%). Every year the consumption of milk and dairy products is reduced, which in 2016, according to the Ministry of Agriculture, amounted to 239 kg per capita (71.7% of the recommended consumption¹). By consumption of dairy products² Russia lags behind many European and CIS countries. For example, according to Rosstat, in Azerbaijan, per capita consumption of dairy products (when measured in terms of milk) in 2015 amounted to 272 kg, in Armenia – 258 kg, in Belarus – 254 kg, in Ukraine – 210 kg. In Europe, this figure is about 306 kg per capita, while in Germany it exceeded 349 kg, in the US – about 269 kg, in New Zealand – 601 kg. We believe that the reason for such dynamics is the change in Russians' consumer preferences by reducing the purchasing power of their incomes (with

the remaining nominal wages at higher prices and inflation) and higher prices for dairy products³.

In Russia, the level of profitability in dairy cattle breeding remains low, production costs are increasing, the acute issue of lack of own funds remains, annual reduction in cow population takes place, the volume of milk production is reducing, livestock diet is not balanced, lack of fodder is observed, along with their poor quality, and a number of other negative trends. One of the main reasons for the current situation in the industry is unsatisfactory condition of fodder supplies.

According to experts [11], commercial characteristics (efficiency index, performance, etc.) of cattle approximately 25–35% dependent on genetic characteristics (i.e. on the breed), 10–20% – on welfare, and more than 50% – directly on the quality of fodder and nutrition. It follows that for effective dairy cattle breeding it is necessary to create sustained, balanced fodder supply base to ensure uninterrupted supply of quality fodder for farms. In this regard, the issue most relevant to agricultural science and practice is the development and scientific substantiation of areas of improving the system of fodder production to raise the efficiency of dairy cattle breeding, which determines the purpose for the article.

¹ According to recommendations of the Ministry of Health published in 2016, the standard rate of dairy products consumption in Russia is 325 kg per person per year, including milk, kefir, yogurt, butter, and cheese.

² Consumption of milk in Russia is reducing. Available at: <https://agrovesti.net/news/indst/potreblenie-moloka-v-rossii-snizhaetsya-a-tseny-prodolzhayut-rasti.html>

³ According to the Ministry of Agriculture of Russia, average consumer prices in 2016 were: pasteurized milk – 51.45 rub/kg (+ 8.3% from the beginning of the year), butter – 477.24 rub/kg (+ 19.4), cheese – 460.89 rub/kg (+9.9%).

There are many works devoted to issues of improving economic efficiency of fodder production and the industry as a whole by domestic and foreign economists, including V.R. Boev, N.I. Kovalenko, A.I. Kostjaev, E.N. Krylatykh, A.N. Semin, V.N. Surovtsev, I.G. Usachev, A.A. Shut'kov, J. Bennewitz, A.J. Heinrichs, O. Harel and others [25, 26, 28–33]. Issues related to rational dairy cattle feeding based on significant improvement of fodder supplies, increase in productivity and lowering production costs are reflected in works by A.S. Emel'yanov, N.G. Grigoriev, A.P. Kalashnikov, V.M. Kosolapov, Yu.F. Lachuga, I.S. Popov, L.K. Ernst, and others [8, 12, 13, 17].

According to the results of analysis of the Russian literature on the subject, in Russia studies on the development of detailed standards of feeding cattle based on qualitative improvement of forage supplies were completed back in 1983. Scientists made a transition to the evaluation of fodder energy power in metabolic energy and proposed “Standards and diets for livestock animals” for its further implementation; they were approved at the meeting of the Bureau of the Department of Animal Husbandry of Lenin All-Union Academy of Agricultural Sciences. In 1985, a handbook “Standards and diet of livestock animals” was published, edited by A.P. Kalashnikov and N.I. Kleimenova. In 1993–1995, it was revised and published in three volumes; in 2003, the revised and expanded third edition was published, edited by A.P. Kalashnikov [17].

In conditions of the Vologda Oblast – the area of risk farming – dairy farming is a

priority sub-sector. Its products historically and geographically have a competitive advantage over products from other Russian regions; the region possesses necessary material and human resources; considerable farming areas sufficient to provide industry with fodders; livestock population consisting of adapted dairy breeds; and modern livestock farms [1, 2].

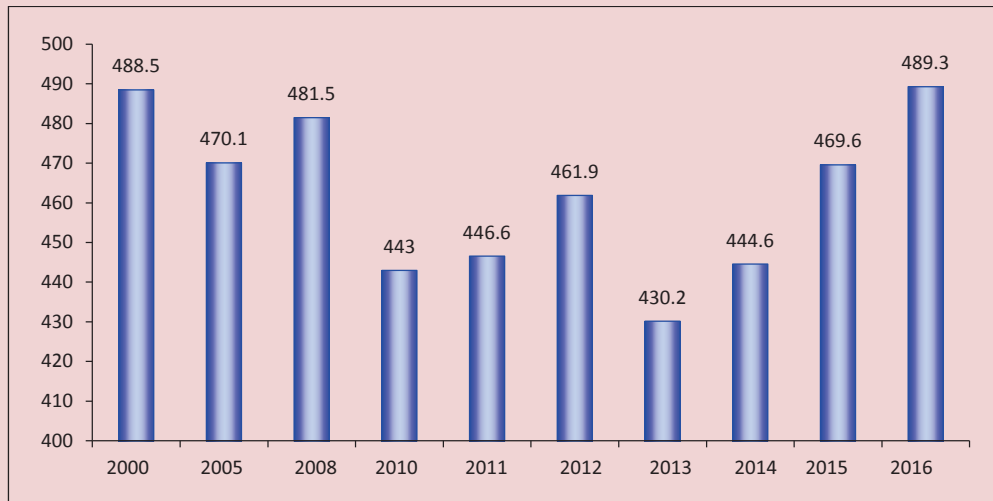
In 2016, the Vologda Oblast ranked second in the list of constituent entities of the Northwestern Federal district in livestock (including cows) population and gross milk yield. The region ranked fourth in dairy flock production (in 2010–2012, 2014 – ninth, 2015 – sixth). Agricultural producers provide the population of the region with milk according to with recommended standards⁴. In addition, more than 200 thousand tons of milk and dairy products are exported annually.

In 2016, all types of households produced 489.3 thousand tons of milk, which is 19.7 thousand tons more than in 2015 and 0.8 thousand tons more than in 2000 (*Fig. 1*).

With regard to livestock population dynamics, it decreased by 151 thousand animals (47.6%) in all types of households in 2000–2016, including cows – 74.7 thousand (49.7%) (*Fig. 2*). However, since 2013 the decline has slowed down. It should be noted that the share of breeding stock in the total livestock population of the region is increasing every year. The share of breeding cows in the total flock in 2016 amounted to about 60%.

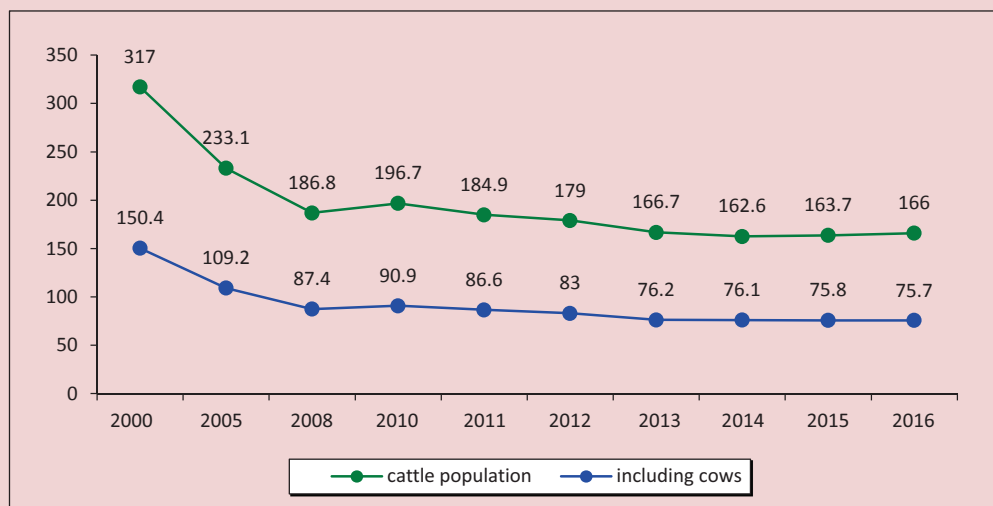
⁴ On Approval of Recommendations for rational standards of food consumption which meet modern requirements of healthy eating: Order of Ministry of Health and Social Development of the Russian Federation No. 614, dated 19.08.2016. Available at: <http://www.garant.ru/products/ipo/prime/doc/71385784/>

Figure 1. Gross milk production in the Vologda Oblast, thousand tons, all types of households



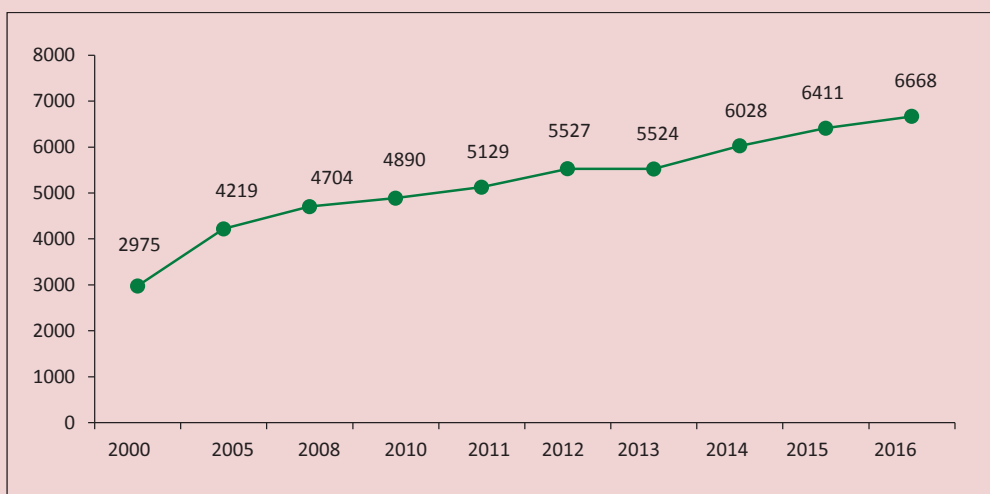
Source: official statistical data of the Unified Interdepartmental Information-Statistics System (EMISS). Available at: <http://fedstat.ru>

Figure 2. Dynamics of livestock population in the Vologda Oblast, thousand animals, all types of households



Source: official statistical data of the Unified Interdepartmental Information-Statistics System (EMISS). Available at: <http://fedstat.ru>

Figure 3. Cow productivity in the Vologda Oblast, kg of milk per cow per year, all types of households



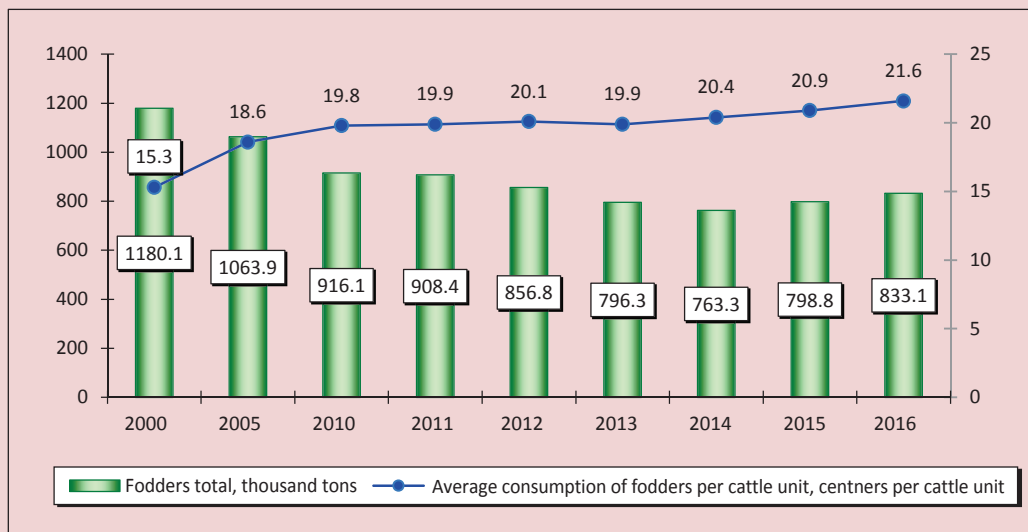
Source: official statistical data of the Unified Interdepartmental Information-Statistics System (EMISS). Available at: <http://fedstat.ru>

It should be noted that the increase in milk production in 2016 compared to 2015 by 4.2% (in 2000 – 1.1%) was achieved due to increased cow productivity (4.0%). Thus, the average milk yield per cow in agricultural organizations of the oblast in 2016 amounted to 6,668 kg, which is 4.0% more than in 2015 and 2.2 times more than in 2000 (*Fig. 3*).

Among region's farms the leading one in cow productivity in the past years has been CKhPK Prisukhonskoe (Prisukhonskoe Agricultural Production Co-Operative) in the Vologodskii District – 10,838 kg/cow (+682 kg compared to 2015), the second one is SPK Vologodskii (Vologodskii Agricultural Production Co-Operative) in the Vologodskii District (8,936 kg, +46 kg), the third – OOO Pokrovskoe in the Gryazovetskii District (8,900 kg +395 kg) [2].

One of the factors in growing productivity in dairy cattle breeding is the improvement of animal diets and fodder supplies as a whole. In 2016, 833.1 thousand tons of fodder (4.3% above the level of 2015) of forage (without grain fodder) were procured – 266.6 thousand fodder units or 21.8 centners of fodder units per 1 livestock unit (4.0 % below the level of 2015), grain fodder – 157 thousand tons (*Fig. 4*) [2]. In 2016, per one livestock unit, 36.0 kg of fodder units (including grain fodder) were procured, in 2015 – 38.9 centners of fodder units. We should note that every year the average consumption of all fodder types is increasing: in 2016 21.6 centners of fodder units of all types were consumed, which is 3.4% above the previous year's level and 41.2% compared to 2000 [2, 4, 17].

Figure 4. Fodder supplies in the Vologda Oblast



Source: Official website of the territorial body of the Federal State Statistics Service in the increasing Vologda Oblast. Available at: www.vologdastat.ru

Thus, according to the results of analysis of a number of indicators of efficiency of dairy farming functioning in the Vologda Oblast, during the research period, the overall situation in sub-sectors has stabilized by 2013–2016, livestock population remained stable; there is an increase in cow productivity and total volume of milk production etc.

We emphasize that to develop and scientifically justify areas of improving the system of fodder production in order to improve dairy cattle breeding efficiency it is necessary to assess the existing capacity and determine the level of its development in modern conditions.

First, it is required to assess the agro-climatic conditions and soil fertility. The territory of the Vologda Oblast is located in the North of the European part of Russia, in the sub-zones of middle and southern taiga, and refers to the zone of risk farming.

The climate of the region is characterized as moderate continental with short springs, short relatively warm and humid summers, damp autumns and long, cold, snowy winters with stable snow covering. The vegetation period lasts 145 days in the northern regions, up to 160 days – in the north. The duration of a frost-free period – from 95 days in the south-east to 125 days in the south of the central part of the oblast.

The oblast is located in the zone of over-wetting: annual precipitation is 500–650 mm. The highest precipitation in summer is in July (8–74 mm) with 13–14 days with precipitation. The sum of active temperatures (over 10°C) in most of the oblast's territory is in average 1550°–1650°, and in the west it increases to 1700°–1800°.

According to the conducted agro-climatic assessment, in the oblast's territory heat is

provided to crops such as rye, barley, early oat, wheat and peas varieties, potatoes, many cultures and varieties of perennial grasses.

The soil covering of the territory of the Vologda Oblast is quite varied: the northern part is dominated by podzolic soils, the south – by sod-podzolic soil, bog soils are present in some places. Bog-podzolic soils in the agronomic context are the most low-fertile and require liming, fertilizing and control of the air and water regime. They are prevalent in the western part of the oblast. In general, soil fertility in the oblast is low. The average content of humus in the soil is 2.5 %. More than half of the cultivated (arable) soils have a high degree of acidity, many are subject to erosion and waterlogged.

Currently, low- and mezo-podzolic soils (87%) are mostly cultivated. Light loams and light loamy sand are cultivated for field crops, with the most favorable air and water regime; soils of heavier mechanical texture are used for hayfields and pastures.

Second, an important step is the state analysis of fodder production in the region. In general, the cultivated area of agricultural crops in all types of households in 2016 was 373.1 thousand hectares (45.6% less than in 2000 and 0.2% more than in 2015). Among constituent entities of the Northwestern Federal district, the Vologda Oblast had the highest share of farmland usage – 29 %, the second was the Pskov Oblast (18%) and the third – the Leningrad Oblast (16%; *Tab. 1*).

Table 1. Cultivated agricultural lands in all types of households in the Vologda Oblast, thousand ha

Constituent entities of the NWFD	Year									2016 to 2015, %	2016 to 2000, %
	2000	2005	2010	2011	2012	2013	2014	2015	2016		
Republic of Karelia	64.8	46.9	38.4	34.4	31.5	32.1	32.3	32.5	33.5	103.1	51.7
Komi Republic	80.0	52.7	40.5	39.5	38.8	38.5	41.1	40.7	39.4	96.8	49.3
Arkhangelsk Oblast	206.8	134.5	104.4	97.1	97.0	89.8	87.0	77.0	73.6	95.6	35.6
Vologda Oblast	686.1	541.6	451.8	445.9	428.8	395.2	376.5	372.4	373.1	100.2	54.4
Kaliningrad Oblast	257.9	217.9	148.1	143.6	166.7	183.7	222.2	245.6	261.9	106.6	101.6
Leningrad Oblast	373.2	293.3	250.5	246.2	237.8	231.4	226.8	229.9	240.3	104.5	64.4
Murmansk Oblast	11.5	7.8	7.1	7.4	7.3	7.3	7.3	7.7	7.2	93.5	62.6
Novgorod Oblast	270.3	180.6	181.4	191.0	191.0	175.3	177.0	178.5	181.5	101.7	67.1
Pskov Oblast	539.2	365.3	275.5	257.3	238.3	244.9	244.7	245.3	244.0	99.5	45.3
<i>Northwestern Federal district, total</i>	<i>2490</i>	<i>1841</i>	<i>1498</i>	<i>1462</i>	<i>1438</i>	<i>1398</i>	<i>1415</i>	<i>1430</i>	<i>1455</i>	<i>101,7</i>	<i>58,4</i>
<i>Share of the Vologda Oblast in the Northwestern Federal district, %</i>	<i>27.6</i>	<i>29.4</i>	<i>30.2</i>	<i>30.5</i>	<i>29.8</i>	<i>28.3</i>	<i>26.6</i>	<i>26.0</i>	<i>25.6</i>	<i>98.5</i>	<i>92.8</i>
<i>Position of the Vologda Oblast among constituent entities in NWFD</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>-</i>	<i>-</i>

Source: compiled by the author based on official statistics from the Unified Interdepartmental Information and Statistics System (EMISS). Available at: <http://fedstat.ru>

In the structure of cultivated lands in the Vologda Oblast, the highest share is traditionally occupied by fodder crops (in 2016 – more than 60%) since there is the need to provide livestock farming with own-produced fodder; the share of grain crops amounted to 31.2% (Fig. 5). Among constituent entities of the Northwestern Federal district the Vologda Oblast in 2016, as well as in the previous year, ranked second in the area of grain crops in all types of households.

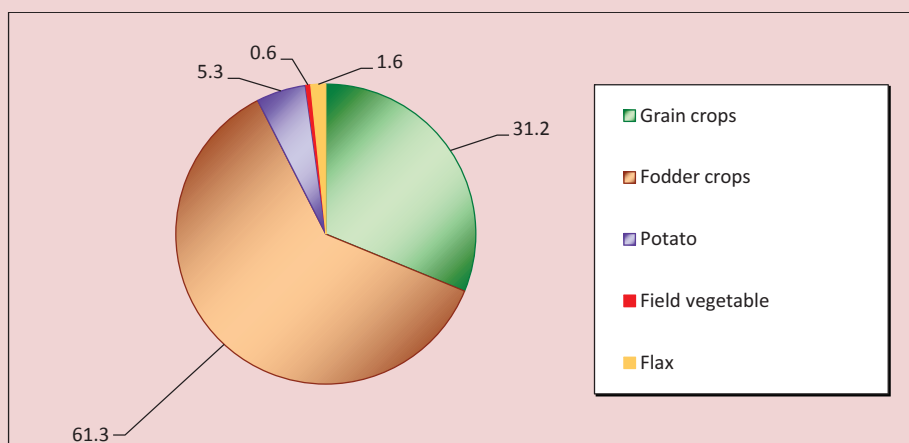
In region’s agricultural enterprises in 2016, the structure of cultivated grasses by ripeness was as follows: early ripening– 6.0%, mid-ripening – 38.0%, late-ripening – 56%. Early ripening grasses are represented by eastern galega, orchard grass and phalaris; mid-ripening include double-crop red clover, alfalfa, Lotus corniculatus, meadow fescue, awnless brome, festulolium, oat-grass and mixtures; late-maturing crops consist of a mixture of single-crop red clover and Timothy-grass, Timothy-grass and wild grasses (Tab. 2). Just

like in previous years, the structure of grasses by ripeness is dominated by late-ripening grasses with lack of early-ripening herbage [5, 7, 9, 12].

As far as the cultivation of crops is concerned, pea crops in single-crop sowing and in the mixture with barley (oats, wheat) on grains remains an important element in fodder production. They are much superior to other grains by yield (1.5–2.0 times) and more valuable for balanced livestock feeding [5, 6, 14, 19, 21]. All in all in 2016, the yield of grain crops in the Vologda Oblast amounted to 19.8 centners per ha, which is 10% below the level of 2015 and 45.6% above the level of 2000 (Tab. 3). The yield of perennial grasses during the research period did not change significantly, of annual grasses – decreased by 53.8% compared to 2000.

One of the factors reducing crop yields in the region is low land fertility. To overcome the current situation the households annually apply organic and mineral fertilizers. However, in

Figure 5. Structure of cultivated areas of major crops in the Vologda Oblast, all types of households, 2016, %



Source: official statistics of the Unified Interdepartmental Information-Statistics System (EMISS). Available at: <http://fedstat.ru>

Table 2. Composition of grasses in the agricultural enterprises of the Vologda oblast, %

Structure	Year						
	2010	2011	2012	2013	2014	2015	2016
<i>Culture</i>							
Perennial grasses, total	100	100	100	100	100	100	100
- legume and legume-grass	42.5	39.3	37.8	42.6	39.7	42.0	44.6
- grain crops	57.5	60.7	62.7	57.3	60.3	58	55.5
<i>Ripeness</i>							
Perennial grasses, total	100	100	100	100	100	100	100
Including early-ripening:	7.9	7.7	8	7.6	7.0	7.0	6
- mid-ripening	31.7	31.7	31	27.7	31.0	36.0	38
- late- ripening	60.6	60.6	62	64.7	62.0	53.0	56
<i>Years of usage</i>							
Perennial grasses, total	100	100	100	100	100	100	100
- 1st–3rd year of usage	40.0	40.9	40.0	39.9	44.4	43.6	48.8
- 4th year of usage and older	60.0	59.1	60.0	61.1	55.6	56.4	51.2
Source: compiled by the author based on departmental statistics of the Department for Agriculture and Food Supplies of the Vologda Oblast.							

Table 3. Crop yields in the Vologda Oblast in all types of households (per harvested area), kg/ha

Culture	Year									2016 to 2015, %	2016 to 2000, %
	2000	2005	2010	2011	2012	2013	2014	2015	2016		
Legume and legume-grass	13.6	16.4	15.9	19	18.6	15.7	22.1	22.0	19.8	90.0	145.6
Oats	15	16.7	13.4	19.5	20.3	15.8	19.1	20.3	16.6	81.8	110.7
Barley and wild barley	no data	no data	17.6	19	18.3	15.6	23.6	23	21.2	92.2	-
Peas	23.1	25.1	32.7	30.3	31	27.4	35.6	32.9	25.5	77.5	110.4
Perennial grasses (total for hay)	no data	19.7	19.1	19.3	19.3	18	15.4	17.2	17.2	100.0	-
Annual grasses (total for hay)	18.6	7.8	28.4	53.1	6.5	no data	11.4	13	8.6	66.2	46.2
Corn for silage, green fodder and haylage	no data	no data	243.2	310.2	204.2	no data	no data	264.8	350.1	132.2	-
Source: compiled by the author based on official statistics from the Unified Interdepartmental Information and Statistics System (EMISS). Available at: http://fedstat.ru											

recent years, the removal of nutrients from the soil is not compensated for by applying mineral and organic fertilizers as their amounts significantly decreased in 2016 compared to 2000 (*Tab. 4*).

In general, in 2016 mineral fertilizers were applied in 53.3% of the cultivated area of agricultural crops, organic – only in 4.2% of the entire area under cultivation. The share of mineral and organic fertilizers applied to 1 hectare of agricultural crops amounted to 38.4 kg and 3.7 t of application rate respectively. Fodder crops were applied 18.0 kg of application rate of mineral fertilizers and 1.6 t of organic fertilizers, which is 5 or more times below the necessary amount [3, 9, 11, 14, 15].

Despite the difficulties in fodder production, a number of leading households in the Vologda Oblast are still making progress. One of such leading households in the region is AO Plemzavod Rodina⁵. The household possesses 9,224 ha of agricultural land, including 6,681 ha of arable land, 1,685 ha of hayfields, and 861 hectares of pastures. Due to the fact that cattle are not grazed, part of pastures and grasslands are ploughed and used for sowing.

The structure of sown areas of the household in 2016 included 60% of grains, 33% of perennial grasses, and 7% of annual grasses (*Tab. 5*). Grain crops mostly include barley varieties such as “Sonet”, “Zazerskii 85”,

Table 4. Fertilizer application for crops in agricultural organizations of the Vologda region

Indicator	Year										2016 to 2015, %	2016 to 2000, %
	2000	2005	2010	2011	2012	2013	2014	2015	2016			
Mineral fertilizers applied (per 100 % of nutrients) total, thousand tons	26.3	14.2	13.7	15.8	12.5	9.5	10.9	11.7	11.1	94.9	42.2	
Per 1 ha, kg of application rate	42.0	28.5	34.0	41.5	34.3	28.9	36.9	36.7	38.4	104.6	91.4	
Including for cultivation:												
- grains	75.0	67.5	71.3	79.4	66.9	64.3	71.2	69.1	70.8	102.5	94.4	
- fodders	26.0	11.8	11.6	19.1	17.2	11.5	18.6	17.3	18.0	104.0	69.2	
Share of fertilized area in the total cultivated land, %	55.8	37.4	47.7	58.3	53.4	40.1	51.4	52.2	53.3	-	-	
Total organic fertilizers applied, thousand tons	1653	1238	922	936	857	856	920	1008	1055	104.7	63.8	
per 1 ha, tons	2.6	2.5	2.3	2.5	2.4	2.7	3.1	3.4	3.7	108.8	142.3	
Including for cultivation:												
- grains	6.1	6.4	5.6	6.1	5.6	6.3	6.8	7.2	7.4	102.8	121.3	
- fodders	1.2	1.1	0.7	0.7	1.0	1.0	1.4	1.4	1.6	114.3	133.3	
Share of fertilized area in the total cultivated land, %	3.4	3.1	3.1	3.4	2.7	3.3	3.7	3.8	4.2	-	-	

Source: compiled by the author based on official statistics from the Unified Interdepartmental Information and Statistics System (EMISS). Available at: <http://fedstat.ru>

⁵ Since 1987, the household is headed by General Director AO Kolkhoz Rodina, an Honored worker of Agriculture of the USSR, G.K. Shilovskii.

Table 5. Cultivated lands of AO Plemzavod Rodina, ha

Year	Cultivated land (total)	Including			
		grains	perennial grasses	annual grasses	open sowing
2010	6883	2848	3338	-	697
2011	6703	3700	2810	-	193
2012	6638	3700	2738	-	200
2013	6678	3800	2738	100	-
2014	7076	3900	2917	-	256
2015	6681	3950	2731	-	-
2016	6681	4000	2191	490	-

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

“Nur” and spring wheat “Torridon”, with no crops of oats. The mown area of perennial grasses amounted to 2,191 ha, including 290 ha of hay, 2,341 ha of green mass and 50 ha of seeds.

Perennial grasses are represented mainly by double-crop red clover mixed with Timothy-grass. In the structure of grasses by species composition, 63% are legumes and legume-grass mixtures, 37% – grain and grass-legume mixtures. Herbage belong to mid- (63%) and late-ripening (37%) by time of ripeness. In 2016, 1,177 of herbs of the first year of usage were harvested in the household (54% of the total cultivated area); of the second year of usage – 949 ha (43%); third year – 65 ha (3%); there is no old-aged herbage. Overgrassing is performed annually in the range of 20–25% of the available herbage.

The yield of fodder crops in 2011–2016, compared to 2006–2010 declined, including perennial grasses harvested for hay – 7%, green mass – 10%; however, it is higher than the average yield in household of the Vologda Oblast (*Tab. 6*).

As already noted, the growth of productivity of grain and forage crops to a certain extent depends on sufficient application of mineral and organic fertilizers. However, over the past 10 years the volume of organic and mineral fertilizers in agriculture has declined by more than 30% (*Tab. 7*). Higher amounts of fertilizers are applied to grain crops: in 2016, 93.5 kg/ha of mineral fertilizers were applied, including nitrogen – 38.7 kg/ha, phosphorus – 27.4 kg/ha, and potash – 27.4 kg/ha. 28 kg/ha of mineral fertilizers were applied for fodder grasses, including 28 kg/ha of nitrogen. This suggests that that applied doses of fertilizers and the ratio of nutrients do not provide heavy stable yields. For example, 121–137 kg of nutrients were inhibited per 1 ha of grain crops in the household in recent years, considering application of fertilizers and bio-nitrogen, which is almost 1.5 times lower than their depletion with the harvest.

Harvesting of hay and silage is important in creating sustained fodder supplies. In 2016, the household harvested 1,941 tons of hay (2.4 times more than in 2010), 41,645 tons of silage (101.5 %), and provided 10,249 tons of grain fodder animals (173.7 %; *Tab. 8*).

Table 6. Yield of crops in AO Plemzavod Rodina compared to households in the Vologodskii District, kg/ha

Year							Average	
2010	2011	2012	2013	2014	2015	2016	2011–2016	2006–2010
<i>1. Grains</i>								
23.8	24.2	23.2	22.0	32.2	30.8	31.6	27.4	27.9
21.1	23.9	22.8	19.3	27.7	27.1	25.0	24.3	24.5
<i>2. Perennial grasses for green mass</i>								
165.6	116.8	202.0	189.4	108.6	271.8	226	185.8	199.7
148.3	118.2	145.0	135.3	96.2	150.9	151	132.8	143.9
<i>3. Perennial grasses for hay</i>								
41.0	30.2	31.4	52.4	36.7	58.7	59	44.8	50
25.6	21.9	41.0	24.4	27.7	23.8	24	27.2	24.7

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

Table 7. Application of fertilizers in AO Plemzavod Rodina

Year	Organic fertilizers, t/ha	Mineral fertilizers, kg/ha rate of application			
		nitrogen	phosphorus	potassium	total
2006	6.6	70.1	24.3	24.3	118.7
2008	6.2	59.6	30.1	30.1	119.8
2010	2.5	27.9	14.5	14.5	56.9
2011	4.0	25.3	20.3	20.3	65.9
2012	4.5	33.3	17.6	17.6	68.5
2013	4.5	29.4	15.6	25.3	70.3
2014	2.7	29.2	28.4	21.6	79.2
2015	3.6	49.2	16.4	16.4	82.0
2016	3.0	55.7	18.4	18.4	92.5

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

Table 8. Amount of harvested fodders in AO Plemzavod Rodina, tons

Name	Year							2016 to 2015, %	2016 to 2010, %
	2010	2011	2012	2013	2014	2015	2016		
Silage	41019	33300	41350	41005	33135	51823	41645	80.4	101.5
Haylage	-	875	-	-	-	-	-	-	-
Hay	800	1422	1097	1485	1487	2359	1941	82.3	2.4 times
Grain forage	5900	8938	7272	6035	10339	10000	10249	102.5	173.7
Total, tons of fodder units	14095	15977	16091	14978	17709	20895	19500	93.3	138.3

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

Given grain forage, 19,500 tons of fodder units were harvested, 5.79 of fodder units per cattle unit, which is significantly higher (1.6 times) than in the oblast (Tab. 9).

However, the harvested fodders are of insufficient quality (Tab. 10). In 2016, silage of first and second grade amounted

to 29.2 to 68.7%, hay – 0–41.9%. It should be noted that about 91.7% of harvested hay was off-grade, the harvested silage was mainly first and second grade (68.7%).

The share of harvested off-grade silage is significantly lower than in previous years – 11.8%.

Table 9. Fodder supplies in 2016

	Fodders harvested, thousand tons of fodder units	Cattle population, thousand animals	Per cattle unit, tons of fodder units	%
AO Plemzavod Rodina	19.5	3.37	5.79	160
Vologda Oblast (total)	442.7	123.3	3.59	100

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

Table 10. Quality of fodders at AO Plemzavod Rodina, %

Name	Year	Verified, thousand tons	Graded, %			
			I	II	III	off-grade
Hay	2010	800	15.8	-	67.5	16.7
	2011	1472	-	7.5	72.1	20.4
	2012	1097	-	-	17	83
	2013	1485	-	11.6	25.2	63.2
	2014	1487	-	41.9	35.2	22.9
	2015	2030	-	-	-	100
	2016	1247	-	-	8.3	91.7
Silage	2010	41015	2	27.2	50.6	20.2
	2011	33300	13.3	31.8	28.9	26
	2012	41350	3.2	59.6	23	14.2
	2013	41050	34	29.6	20.1	16.3
	2014	33135	10.9	39.1	39.6	10.4
	2015	50183	27.6	40.3	23.8	8.3
	2016	28384	24.2	44.5	19.6	11.8
Haylage	2010	787	-	-	-	100
	2011	875	-	14.3	-	85.7
	2012	893	-	-	100	-
	2013	240	-	100	-	-

Source: compiled by the author based on monographic study of AO Plemzavod Rodina.

To improve fodder and fodder production in general AO Plemzavod Rodina carries out a set of operations including:

- purchasing modern agricultural equipment and tractors;
- increasing the volume of mineral fertilizers per 1 ha (in the last 3 years – by 11%);
- production of seeds of grain crops and perennial grasses for own needs;
- timely overgrassing;
- compliance with technology requirements in silage harvesting, which provides high-quality fodder;
- maintenance of hay drying towers to store part of the harvested hay; concrete silage trenches with a capacity of 45,000 tons of silage, etc.

In our opinion, the positive experience of AO Plemzavod Rodina can be used by region's households and the Northwestern Federal district as a whole in order to improve fodder production efficiency.

First of all, the Vologda Oblast requires the development of scientifically justified system of fodder production⁶. It must include:

1. The development and implementation of a rational structure of fodder crops areas taking into account agro-climatic and soil conditions, aimed at meeting animals' need for high-quality fodder [7, 17]. According to the calculations, it is necessary to increase cultivation of most productive cost-efficient crops and meeting animals' needs for nutrients [3, 12]. It should

⁶ The system of dairy cattle farming development based on modern milk production technology taking into account fodder production, feeding and cattle breeding in the European North of Russia, providing the productivity of more than 7 thousand kg of milk per cow per year: research report for 2011–2016. Vologda: SZNIIMLPKh.

be noted that with increased cow productivity the structure of fodder crops areas changes towards significant expansion of areas occupied by crops and reduction of areas under perennial and annual grasses and pastures [13, 19].

2. The development of a rational structure of fodder crops areas conducted according to planned orders of households for fodders, taking into account the level of cow productivity, systems and methods for their maintenance, the achieved or planned level of fodder crops productivity [9, 10].

3. Accounting for logistics, condition of soil fertility, and climatic conditions.

It must be considered that the heaviest yield of fodder units per 1 ha of arable land is provided by grain crops, perennial grasses for green mass. Since production costs of annual grasses are significantly higher than that of perennial grasses and they rank below perennial grasses in productivity, the areas of their cultivation must be optimized to minimum [9, 20, 21].

We note that the species composition of fodder grasses in conditions of the Vologda oblast is mainly represented by a wide range of perennial legumes and grass species, annual legumes, grain and cruciferous crops.

Based on the research results⁷, the sowing pattern of perennial grasses would be appropriate to calculate based on their species composition, ripeness and duration of herbage usage. We need to expand the cultivation of legumes and legume-grasses to 60–70%,

⁷ Development of methodological provisions for dairy farming management taking into account natural adapted systems of fodder production, feeding and breeding in the economic conditions of the European North of Russia: research reports. Vologda: SZNIIMLPKh.

the structure must have up to 30 % of early-ripening, 40% of mid-ripening and 30% of late-ripening herbage. Herbage must be used for not more than three years (not less than 70% of the available lands under herbs).

To produce early-ripening grasses⁸ the following crops may be used: orchard grass, eastern galega, ultra-early ripening varieties of red clover, *Lotus corniculatus*. Mid-ripening herbage⁹ is based on varieties of double-crop red clover, meadow fescue, *festulolium*, awnless brome, early-ripening varieties of alfalfa. Late-ripening crops include single-crop red clover mixed with Timothy-grass. The harvesting of the grass mixture begins from June 25th and continues up to July 10–15th. Most perennial grasses should be mowed twice per season, alfalfa – three times. We note that to develop an optimal structure of grasses annual overgrazing is required at the level of at least 20–25% of available herbage.

The structure of fodder crops areas should include not more than 5–6 % of annual grasses. The most common are peas with oats, vetch with oats, peas, oats and sunflower, peas, oats and rapeseed (oil radish), vetch with oats and annual oat-grass. In well-watered and fertilized plots it is possible to sow annual oat-grass in single-crop sowing; in this case, it gives two full mowings. We note that in households with a high level of agricultural technology it is advisable to sow early-ripening corn hybrids for silage in single-crop and mixed sowing with legumes (yellow lupin or fodder beans).

⁸ Mowing ripeness of early-ripening herbage begins in average of May 25th–June 15th.

⁹ Mowing ripeness of mid-ripening herbage begins in average of June 15th–June 25th.

In the composition of grain and leguminous crops by ripeness, in our opinion, should include mid-ripening crops (50%), early-ripening (30%) and late-ripening (20%). To produce high-grade fodder grains, the composition of grain crops must include not less than 60% of barley, 15% – oats, 12% – wheat, 3–4% – winter crops and 8–10% – legumes [7, 10].

It should be noted that optimization of the composition of fodder crops is possible due to the expansion of areas under peas. Field pea is of great economic value in animal feeding as its seeds, leaves and stems are high protein [5, 6, 20, 23]. It does not deplete the soil, enriches it with nitrogen, having an ability to use atmospheric nitrogen through root nodule bacteria. Peas are able to use poorly soluble forms of phosphates, which after necrosis of root residues become available for other plants. Its cultivation in crop rotation provides a 20% reduction in consumption of mineral fertilizers for basic crops without reducing their productivity.

To provide cattle with fodders and ensure seed production of grain crops and perennial grasses, we recommend that the composition of fodder crops areas have about 55% of perennial grasses, at least 40 % of grains and 5–6 % of annual grasses (*Tab. 11*). The yield of grain crops needs to be at the level of 25 kg/ha, perennial grasses for green mass – 200 kg/ha.

Depending on the household's adopted cropping system it is feasible to sow crops in fields appropriate according to a specialized crop rotation system. Species diversity of fodder grasses and their areas must ensure continuous flow of plant raw material.

Table 11. Recommended composition of fodder crops areas, %

Composition	Composition, %
<i>General composition of fodder crops areas</i>	100
- including grains and grain-grasses	40
- fodder grasses	60
- of which perennial grasses	55
- annual grasses and silage	5
<i>Composition of crop patters for grains and grain-grasses</i>	100
of which winter crops	3
spring crops (total), including	97
- barley	60
- oats	15
- wheat	12
- grain legumes	10
<i>Source: compiled by the authors.</i>	

In our opinion, the raw material conveyor for harvesting winter fodder crops has the following features:

- mowing grasses is advisable to start in earlier phases (budding – initial blossom);
- extension of the species composition of grasses at the expense of sowing eastern galega, alfalfa, *Lotus corniculatus*;
- arranging line flow of green mass of clover due to the use of varieties of different ripeness;
- arranging line flow of green mass of annual fodder crops in order to fill the lack of grass from mid-July to the first decade of August;
- achieving the share of early-ripening grasses of up to 30 %, mid-ripening – 30 %, late-ripening – 40 %.

The area of each crop in the system of raw and green forage chains is determined based on the volume of forage, daily needs of animals for

green forage at the farm-and-pasture animal housing, taking into account the planned yields.

The optimal range of forage crops helps obtain full-value feeding ground from late May till first frosts. The expiration date of one crop overlaps the beginning of usage of another, which helps harvest high-grade fodder for livestock.

Raw material lines can be created based on varieties of red clover of different ripeness sown together with other grasses (late-, mid- and early-ripening). Late-ripening varieties of clover include: “Vologodskii”, “Volosovskii”, “Kirovskii 159”, “Falenskii”, “Vityaz”; mid-ripening include: “Falenskii 86”, “Orfei”, “Dymkovskii”; early-ripening include: “Trio”, “Martum”, “Kudesnik” [18, 14, 27].

The Vologda Oblast by its natural and climatic conditions is favorable for developing pasture farms [2, 22]. However, in the past decade zero grazing has been widely practiced.

The share of grazed cows and young cattle has decreased to 13%. This led to the reduction in the total area under pastures. An effective tool for increasing the efficiency of livestock farming production is the use of cultivated pastures, since compared to stable keeping, total costs of produced fodders are reduced 2–3 times. Pasture forage is 2–3 times cheaper than feeding green mass from feeders, and 4 times than the all-year feeding of silage and other stable fodders [15,16].

Due to the fact that soils with low fertility prevent full realization of potential of the cultivated crop varieties, improving soil fertility includes liming and phosphorite application of sour soil, rational use of fertilizers according to the annually compiled balance of nutrients, and maintenance of crop diversification at their optimal structure.

Standard nutrient consumption rate in sod-podzolic soils providing an increase in their content in 1 kg of soil is: phosphorus – 50–60 kg in sandy soil and sandy loam, 70–90 kg in loamy soil and 100–120 kg in clay soils; potassium – respectively, 40–60, 60–80 and 80–120 kg. Doses of nitrogen fertilizers are determined depending on the degree of soil cultivation. The need for organic fertilizers is not less than 8–10 tons per 1 ha of arable land, provided that perennial grasses comprise at least 40 %. This will ensure a positive balance of humus and its increase [5, 9, 18, 20].

The research has revealed that with intensive dairy farming management bulky fodders need to have average energy nutrient value not less than 10 MJ ME (0.82 fodder units) in 1 kg of dry matter with more than 14 % of crude protein. Achieve such results is possibly through application of more advanced and effective

technology of making fodders of perennial grasses, annual legume-grasses and other crops [4, 12].

Thus, analysis of the dynamics of fodder production development in the Vologda Oblast suggests the following conclusions:

1. The economics of agricultural enterprises depends on the quality and amount of harvested forage.

2. The most relevant objective today is improving the quality and energy value of fodders.

3. To solve this problem at the regional level it is necessary to develop a comprehensive program on the principles of public-private partnership, including areas such as:

- rational structuring of the forage crops areas;

- expansion of crops of legume species up to 60–70 %, early-ripening grass – up to 30 %;

- annual regeneration of perennial grasses up to 20–25 % of the area;

- introduction of raw material line based on cultivated grasses, as well as pastures and hayfields;

- increasing the dose of fertilizer application up to 120 kg/ha of mineral fertilizers and up to 7–8 t/ha of organic fertilizers, soil liming;

- improving the machine-tractor fleet to reduce the period of main agricultural activities.

The implementation of complex measures on improving the system of fodder production development in the Vologda Oblast taking into account the above trends and latest scientific advances will increase the total production of high quality fodder 1.5–2.0 times which is confirmed by the experience of advanced economies.

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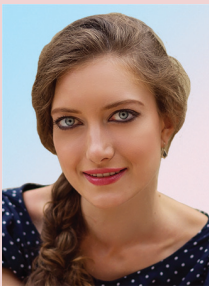
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Regional Housing Construction Savings as a Tool for Improving Housing Affordability for the Population*



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Abstract. The article is devoted to the issue of housing affordability on the Russian market. Based on official statistics, the authors reveal the main trends of the regional housing market development. The article reviews government priorities in the housing policy and presents calculations of the housing affordability index in the Vologda Oblast according to several scenarios. The authors present the results of the ISEDТ RAS population survey conducted in the Vologda Oblast concerning the level of people's satisfaction with their housing conditions. The results indicate that only 37% of the population are satisfied with their housing, 13% – rated their living conditions as bad. The authors research best practices of a number of constituent entities of the Russian Federation in order to address the shortage,

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quality and affordability of housing. Numerous studies by Russian scientists indicate the necessity of forming and introducing new tools and mechanisms to improve housing affordability in the Russian practice. The researchers emphasize that overcoming the problems of the housing sector cannot be solved solely at the expense of budget or household funds. In this regard, the purpose for this paper is to study the mechanism of housing construction savings implying the pooling of resources of all stakeholders (public funds, household funds and funds of the banking system). The article discusses the practice of its functioning in Krasnodar Krai and the Republic of Bashkortostan. It has been calculated that at the initial stage of introducing housing construction savings in the Vologda oblast, 3489 of Vologda citizens will be able to participate; they will pay a monthly fee of 3.6–7.2 thousand rubles to the bank to accumulate down payment on the mortgage. The implementation of the program will require additional costs of the consolidated budget of the Vologda Oblast worth 51–74 million rubles, which amounts to 0.9–0.13% of own revenues. The article can be used by research associates as a framework for further research; and by management bodies in making administrative decisions and in the process of training bachelor, Ph.D., and post-graduate students.

Key words. Mortgage loan, saving and loan program, housing savings bank, increasing housing affordability, saving and loan tools, housing construction savings, public mortgage.

According to the Constitution, the social policy of the Russian Federation is aimed at creating conditions for a decent life; and providing housing is one of the main criteria characterizing population's welfare. Housing is one of the core values ensuring the citizens' economic stability and security, creating incentives for efficient labor performance and to a large extent shaping the citizens' attitude to the state as it guarantees the citizens' constitutional rights to housing.

The uniqueness of housing lies in the fact that, being the most expensive commodity purchased by a person during their life, it is also the product of vital necessity. In turn, the need to meet fundamental human needs for housing gives rise to acute social problems of its deficit, unaffordability and low quality, the solution to which depends largely on government regulations of the housing sector.

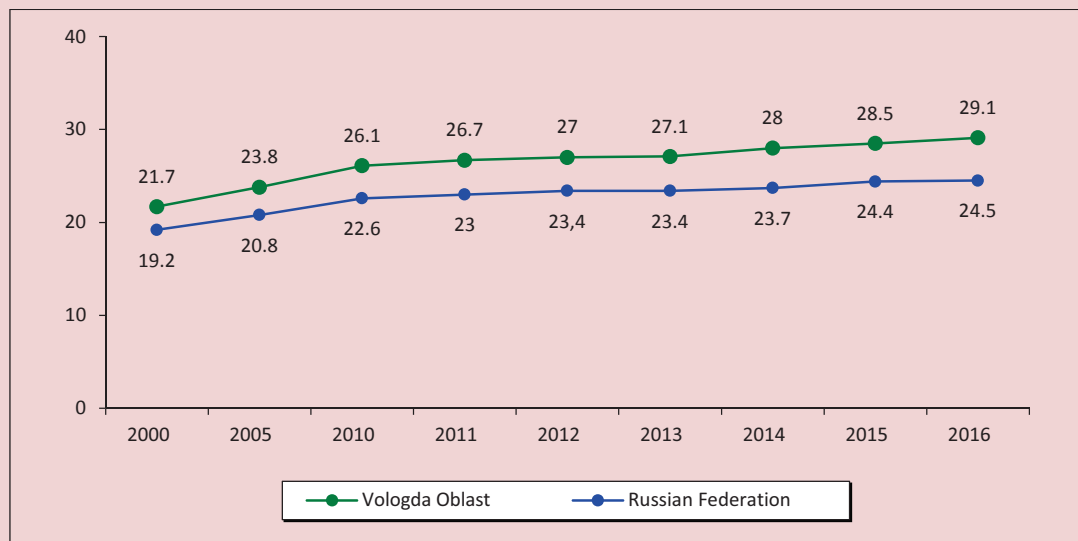
The first broad attempt to address the housing issue to an acceptable regulatory level was made in the USSR in the 1950s–1960s.

Mass industrial housebuilding resulting in the construction of five-storied dwelling houses made the housing crisis less acute and enabled about 30 million people to move from communal flats to relatively comfortable houses. In the next 70–80 years, the government was addressing the issue of expanding housebuilding to provide people with free housing by turn. As a result, in Russia at the beginning of the 21st century, the level of housing area on average per person amounted to 18 square meters, with the average European level of 35–40 square meters.

By 2017, per capita level of housing in Russia increased to 24.5 square meters, in the regional case – the Vologda Oblast – to 29.1 square meters (*Fig. 1*).

The observed increase occurred against the background of household differentiation by type and area of housing depending on the level of household income which was the result of spatial manifestation of the process of people's property stratification inherent in a market economy.

Figure 1. Average level of per capita housing, sq. m



* Calculated by the authors according to Rosstat, Vologdastat.

However, the total area indicator of residential premises per resident in Russia in general and in the Vologda Oblast has not yet reached the UN standard under which the per capita indicator should comprise not less than 30 square meters. For example, in the EU, this figure comprises 30–40 square meters, in the U.S. it reached 70 square meters¹.

Despite the fact that the value of per capita housing commissioning in the Vologda Oblast per thousand people increased by 5.7% in 2016 compared to 2000 is higher than that in Russia and in the North-West, the current housing growth rate is not sufficient. The housing fund of the region increased by 20.7% in 15 years; and at the beginning of 2017 amounted to 34 million square meters of the total area, including urban – 22 million square meters,

¹ The level of per capita housing in Russia and some other countries. Available at: <http://www.rusfact.ru/node/28>

rural – 12 million square meters. The share of dilapidated housing fund in the total housing area in 2016 amounted to 2.8% (*Tab. 1*).

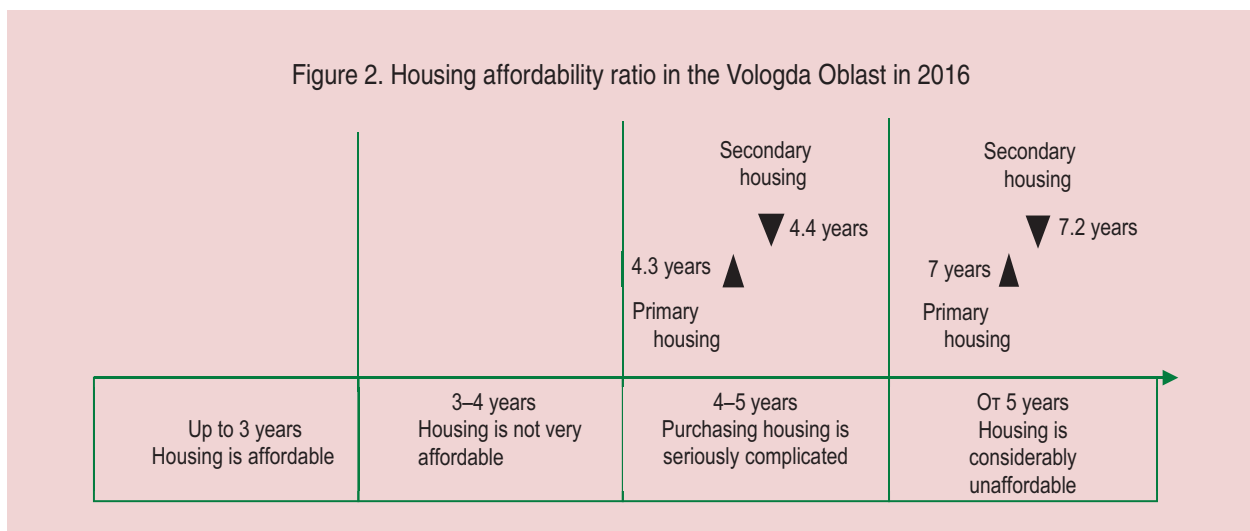
Since 2010, the share of retired and dilapidated housing decreased more than twice: from 50.8 to 22.2 thousand square meters. However, the main share of the housing fund of the Vologda Oblast was built in the late 1940s–early 1990s, which is reflected in its consumer and operational properties. Thus, according to Vologdastat, about 40% of regional and 60% of rural housing funds have depreciation amounting to 31–65%. The results of a population survey conducted during the study indicated the average level of people's satisfaction with their housing conditions. Only 37% of people are satisfied with the apartment they live in, each third respondent is only partially satisfied, and 23% are not satisfied, 13% of people rated their living conditions as poor.

Table 1. Condition of the housing fund and dwelling housing commissioning in the Vologda Oblast*

Indicator	2000	2005	2010	2011	2012	2013	2014	2015	2016
Availability of housing fund for end of year, thousand square meters of the total area	28002	29400	31317	32029	32323	32286	33305	33821	33953
Total built, thousand square meters of the total area	205	293	410	434	389	576	774	864	904
<i>For reference Russia</i>	30300	43560	58431	62265	65742	70485	84191	83810	85010
<i>For reference NWF</i>	2453	3981	5555	5810	5835	6380	8370	9042	9987
Dwelling housing commissioning, square meters of the total area per 1000 people	158	236	340	362	325	482	650	726	897
<i>For reference Russia</i>	207	304	409	436	459	491	576	572	580
<i>For reference NWF</i>	172	289	409	426	426	462	606	653	650
Share of bec dilapidated housing fund in the total area of housing fund, %	1.9	5.0	4.8	4.7	4.7	2.9	2.9	2.9	2.8
<i>For reference Russia</i>	2.4	3.2	3.1	3.0	3.0	2.8	2.7	2.7	2.7

* Calculated by the authors according to Rosstat, Vologdatast.

Figure 2. Housing affordability ratio in the Vologda Oblast in 2016



A key obstacle to displacing dilapidated housing and increasing population’s housing per capita and their satisfaction with the quality of accommodation is low housing affordability. With the development of the national priority project “Affordable and comfortable housing – for the citizens of Russia” in 2005, the main indicator of the condition of the housing market from the point of view of population’s ability to

purchase housing was *housing availability ratio*. It is expressed as the number of years necessary for a family to save money necessary for purchasing housing from their current revenues. The value of housing affordability ratio depends on variables such as housing average price and size, total annual family income, number of family members. The higher the ratio value, the lower is housing affordability.

In the Vologda Oblast, the results of calculating housing affordability ratio predicted the development of the situation according to the following scenarios:

Scenario 1.

If a family of three people allocated all their incomes to purchasing housing, it would take them 4.3 years on the primary housing market, or 4.4 years on the secondary housing market, to purchase an apartment of 54 square meters.

Scenario 2.

If the income of a family of three people is deducted the amount of the living wage the accumulation period will increase to 7.0 and 7.2 years respectively.

To interpret the obtained values we present the international classification of housing markets by affordability²:

- up to 3 years – “housing is affordable”;
- 3–4 years – “housing is not very affordable”;
- 4–5 years – “purchasing housing is seriously complicated”;
- more than 5 years – housing is considered is “substantially unaffordable”.

The obtained results (*Fig. 2*) indicate lack of financial capacity of the population of the Vologda Oblast to meet their housing demands in a market economy.

The regional experience in solving the issue of shortage of housing, its quality and affordability to the population

In order to solve the acute housing issue at the regional level consistent steps are being

taken to develop mechanisms for the development of regional housing markets.

The Sverdlovsk and Tyumen oblasts

To eliminate the deficit and the high cost of land in these regions a mechanism of land mortgage was introduced to develop land for social projects; in Perm Krai, differentiated payments for land were set.

The Republic of Bashkortostan

In order to increase the housing affordability to the population of the Republic an individual housing construction lending program was developed (providing 300 thousand rubles for 10 years at 8% per annum through the Housing Fund).

The Kemerovo Oblast

To solve the issue of increasing housing construction the experience in implementing a large-scale project on complex low-rise construction in the Kemerovo Oblast is enlightening. This region was one of the first in Russia to undertake construction of a Kemerovo satellite town “Lesnaya Polyana”. The constructed housing is purchased by young families who received preferential loans from the regional budget (interest-free, without down payment for up to 20 years). Apartments are purchased by loan debtors at a fixed price which does not change during the entire payback period. An important feature of the satellite town is that its construction is carried out with the entire infrastructure.

Khanty-Mansi Autonomous Okrug

To accelerate mass housing construction Khanty-Mansi Autonomous Okrug introduced the practice of raising funds from institutional investors (in particular, the non-state pension fund of the district) to implement 19 projects related to both spot and complex land development.

² Minchenko M.M., Nozdrina N.N. O metodakh otsenki dostupnosti zhil'ya dlya naseleniya: sravnitel'nyi analiz [On methods of evaluation the housing affordability to the population: comparative analysis]. *Nauchnye trudy: Institut narodnokhozyaystvennogo prognozirovaniya RAN* [Research papers: RAS Institute of Economic Forecasting], 2013. Vol. 11. Pp. 48–70.

To resolve the contradictions in housing matters, constituent entities of the Russian Federation assumed the responsibilities of providing social housing support for the most vulnerable population groups (the disabled, the retirees, orphans, etc.) and expanding construction and developing mechanisms to improve housing affordability among economically active population.

The Vologda Oblast

With the aim of stimulating individual housing construction in the region the oblast residents³ are provided with reimbursement⁴ for procurement of 200–300 m³ of wood for construction, capital repairs and reconstruction of individual houses;

Economically active population of the Vologda Oblast (in particular public sector employees and young families) till 2014 was supported by a few subsidized (social) programs:

1) Preferential mortgage program for young professionals⁵ working in the public sector (science, culture, health, public service) supported by OAO “Agency for Housing Mortgage Lending of the Vologda Oblast”.

³ Compensation is provided to the following population groups: people with the total area per one family member below the accounting standard established by local authorities; victims of fire or natural disasters if their houses were the only place of permanent residence; people living in houses requiring demolition, major repairs or reconstruction (resolution of the Government of the Vologda Oblast no. 1865 dated 26.12.2007 “Regulations on compensation of citizens’ expenses for the procurement of wood for construction, capital repairs and reconstruction of individual dwellings”).

⁴ According to the law of the Vologda Oblast no. 3436-OZ dated 14.10.2014 “On state support for specific population groups in the sphere of individual housing construction” and the Regulations on compensation of citizens’ expenses for the procurement of wood for construction, capital repairs and reconstruction of individual houses approved by the resolution of the Government of the oblast no. 1865 sated 26.12.2007.

⁵ Aged over 35 (inclusive) at the time of signing the loan agreement.

The main feature of the loan product was a preferential fixed interest rate of 10.6%⁶.

2) Preferential mortgage program for young teachers for subsidizing the down payment of a mortgage loan⁷. It should be noted that subsidies were granted within funds approved in the budget act. Thus, in 2013, the allocation of 7.8 million rubles from the federal budget and 6.4 million rubles from the regional budget helped satisfy 58 applications from young teachers out of 2446.

3) Preferential mortgage program⁸ for young families⁹ aimed to provide subsidies worth 200,000 rubles (for families with children, the subsidy should be increased to 100 thousand rubles for each child) for a down payment on a mortgage or loan repayment at birth (adoption) of a child. In 2013, a subsidy worth only 100,000 rubles was received by 31 young families out of 1029 applicants.

However, since 2014, due to insufficient financing from the budget of the Vologda Oblast, preferential mortgage programs have

⁶ Official website of the OAO “Agency for Housing Mortgage Lending of the Vologda Oblast”. Available at: <http://ipoteka-vologda.ru/programs/molodyie-uchenyie.html>

⁷ The Law of the Vologda Oblast no. 2884-OZ dated 25.10.2012 “On measures of state support on the payment of the down payment on a mortgage (loan) for young teachers from educational institutions in the region”. The Law was adopted on the basis of the Decree of the RF Government no. 1177 dated 29.12.2011 “On the procedure for granting and distributing subsidies from the federal budget to the budgets of constituent entities of the Russian Federation for reimbursement of expenses in connection with providing teachers of educational institutions with mortgage loans”.

⁸ Implemented according to the Decree of the Government of the Vologda Oblast no. 1013 dated 23.08.2011 “On the implementation of the sub-program “Shelter provision for young families” of the federal target program “Housing” for 2011–2015”; the Decree of the Government of the Vologda Oblast no. 623 dated 21.06.2005 “On grants for young families for purchasing housing”.

⁹ A young family is a family in which the age of each spouse registered in the civil registry offices, or the age of a parent in a single parent family does not exceed 35.

been suspended. Moreover, the calculations show¹⁰ that preferential mortgage programs operating in the Vologda Oblast include conditions which reduce the opportunities for young specialists. Such conditions include: payment of 30% of down payment (compared to 10% for conventional mortgage product of a commercial bank), the payment/income ratio does not exceed 45% (according to statistics, it did not exceed 54%).

The development of saving and loan tools as a promising area of improving housing affordability in the region

The main factors in increasing housing availability are affordable prices and the development of the loan system. In turn, the decline in housing prices can be achieved under low land cost and its developed infrastructure, increased number of dwellings, and establishing competitive prices, and relatively low cost of construction (materials, design services, administrative barriers). At the same time state support of the development of market loan mechanisms will help attract credit resources to meet the population's housing needs.

Referring to these factors, the international experience has a number of effective mechanisms to improve housing affordability, which have demonstrated positive outcomes in practice:

- Development of saving and co-operative tools;
- Introduction of new cheaper eco-friendly construction technologies;
- Development of rental housing funds.

¹⁰ Pechenskaya, M.A. L'gotnye ipotechnye kredity v Vologodskoi oblasti: usloviya predostavleniya i vozmozhnosti uchastiya naseleniya [Preferential mortgage loans in the region: conditions for granting and opportunities for participation]. *Problemy razvitiya territorii* [Problems of territory's development], 2015, no. 2(76), pp. 135–145.

Overcoming the problems in the housing sector cannot be solved only at the expense of budget or household funds. It is necessary to unite resources of all interested parties. In this case, the most effective result is possible when combining public funds (subsidies), household funds and funds of the banking system (by reducing interest rates for housing mortgage). An example of a mechanism for such kind of partnership in a number of foreign countries¹¹ and Russian regions is the so-called housing construction savings. For example, in Germany during the financial and economic crisis the number of investors on housing construction savings increased by 27%¹².

In 2011, the experiment on design and implementation of the project on housing construction savings “People’s Mortgage” was launched in Russia in the Krasnodar Oblast. The project was implemented as a joint program of Sberbank and the Oblast’s administration. For the first 18 months more than 4,000 investors¹³ participated in the program. In 2012 a similar program was launched in the Rostov Oblast¹⁴, the number of investors during the first two years amounted to 2000. Since April 2014 the Republic of Bashkortostan, in the framework of implementation of Presidential Decree “On measures to provide citizens

¹¹ Housing cooperatives exist in Austria, the UK, Belgium, Germany, Slovakia, France, Czech Republic and other European countries. [Polterovich V.M., Starkov O.M. *Formirovanie ipoteki v dogonyayushchikh ekonomikakh: problema transplantatsii institutov* [Establishment of mortgage in catching-up economies: the issue of transplantation of institutions]. Moscow: Nauka, 2007. 196 p.].

¹² Mortgage collapse. “*Domnam.ru*” daily journal. Available at: <http://domnam.ru/1news/ipotechnyi-krakh>

¹³ People’s Mortgage. *Official website of Krasnodar Krai Administration*. Available at: <https://admkr.krasnodar.ru/content/18/show/30163/>

¹⁴ People’s mortgage in 2016. Available at: <http://kreditipo.ru/narodnaya-ipoteka-v-rostove-na-donu-v-2016-godu/>

with affordable and comfortable housing and improve the quality of housing and communal services” and “the Strategy of mortgage development in Russia up to 2020”, has launched the practical implementation phase of the Republic’s program of housing construction savings¹⁵. By June 2015, 8,250 new target long-term housing savings deposits totaling over 536 million rubles had been opened. Similar programs have been launched or are planned to be launched in the Republic of Tatarstan, Khanty-Mansi Autonomous okrug, the Sverdlovsk and Kaluga oblasts.

We note that, despite the successful start, the programs do not become effective. In Krasnodar, the number of participants during 2013–2016 almost was the same, remaining at the level of 4,000 participants. In Bashkortostan, after a successful start the number of new applications reduced by 30% (data are presented in *Table 7* below). This can be explained by different reasons. State support is represented at the federal level and, due to insufficient funding, the administration sought to narrow down the program to separate categories of citizens. In particular, for the Rostov Oblast and Krasnodar Krai a necessary condition for participation is the whole family’s ownership of not more than one piece of residential property. In Bashkortostan, there were limitations during the first year, however, since February 2016, people on the affordable housing waiting list have the right to participate. Another constraining factor is bank restrictions (strict selection process, additional assessment of the borrower). There

¹⁵ Decree of the Government of the Republic of Bashkortostan no. 56 “On the Procedure for execution of activities aimed at financing housing development with the use of the system of housing construction savings at the territory of the Republic of Bashkortostan”, dated 14.02.2014.

is also the problem of affordable housing for program participants. The combination of these reasons amid crisis phenomena has led to the fact that in Krasnodar Krai since March 1, 2016, applications for participation are no longer accepted. However, despite all the problems, about 20,000 consumers took part in the housing construction savings project (HCS) in Russia; the government expects successful program continuation in two of the three regions described above¹⁶.

The gist of the “People’s Mortgage” housing construction savings project is the following algorithm:

1) During 1–6 years the depositor monthly accumulates funds in the project’s partner bank at a 1–1.5% rate per annum for the down payment on the mortgage.

2) Citizens’ savings are budgeted every month with a premium at the expense of the budget of a constituent entity of the Russian Federation in the amount of up to 30% of savings but not more than 3,000 rubles per month.

3) During 1–6 years after accumulating the required amount of money (not less than 30% from the cost of the flat) the investor receives a preferential mortgage loan at a 6–7% rate per annum from the project’s partner bank for the period up to 30 years depending on the age, average monthly basic income and monthly payment.

Amid high interest rates on mortgage loans in commercial banks (from 8.6% in the first three years and 12.4 in subsequent years) the

¹⁶ Rustem Khamitov presented state awards of the Republic of Bashkortostan to the construction sector personnel (2016). Available at: <http://www.bashinform.ru/news/882304-rustem-khamitov-vruchil-gosudarstvennye-nagrady-respubliki-bashkortostan-rabotnikam-stroitel'nogo-kom>

“People’s Mortgage” project is of particular importance, providing an opportunity of receiving a loan at an unprecedented low rate for the Russian mortgage market, which, in the current economic situation, could be the only way to purchase housing for certain categories of citizens. In addition, the housing construction savings program has the potential to link with specific projects on low-income housing construction, whose volume of commissioning was ordered to be increased by the Decree of the President of the Russian Federation No. 600 “On measures to provide Russian citizens with affordable and comfortable housing and improve the quality of housing and communal services”, dated May 7, 2012.

To study the performance of the project and implementation support a dynamic model of savings and loan programs of mortgage lending was developed [20]. It helps calculate the values of system parameters at the given exogenous parameters (influx of depositors, interest on foreign loans, reservation rate, frequency of accumulation schedule violations, likelihood of borrower default, allocation of borrowers’ monthly payments, cost of preferred flats) and control variables (values of interest rates on deposits and loans, term of savings and loans, premium rate on savings, maximum level of a premium per month). Fixed values of control variables are called *pricing plans*. It has been demonstrated that with a wide range of parameters the pricing plans with a constant flow of depositors remain stable (i.e. at some

point in time they issue contracts to customers using only program tools themselves).

Calculation of the feasibility of the project of housing construction savings “people’s mortgage” on the territory of the Vologda Oblast

The implementation of the “People’s Mortgage” project results involves several participants, so it is reasonable to determine the benefits of each participant party.

The benefit of investors as participants in the project is, first, in the increased initial capital by the amount of a regional subsidy; second, in lower interest rates on loans after the accumulation period. In turn, construction companies receive increased demand for housing under construction. As for benefits from participation of regional authorities and banking institutions, certain calculations are required.

Thus, the calculation is based on the available data on the implementation of the program of housing construction savings in the Republic of Bashkortostan and Krasnodar Krai. The initial material includes the following official statistics:

- distribution of households by income;
- number of residents in the region;
- average cost of one square meter of housing;
- number of program participants;
- distribution of program participants by contribution;
- parameters of the pricing plan of savings and loan mortgage programs.

Table 2. Deposit and loan interest rates under the program of housing construction savings in the Republic of Bashkortostan, in % per annum

Banking institution	Interest rate depending on the term of deposit				Interest rate depending on the term of loan			
	3 years	4 years	5 years	6 years	4.5 years	6 years	7.5 years	9 years
ОАО Sberbank of Russia	1.0%	1.5%	1.5%	1.5%	7.0%	7.0%	7.0%	6.0%
ОАО URALSIB	1.5%	1.5%	2.0%	1.5%	7.0%	7.0%	7.0%	6.0%

These data help calculate the following forecast parameters:

- the function of distribution of households by income;
- the average contribution of a program participant in the Vologda Oblast;
- the average number of square meters accumulated by a program participant;
- the expected number of residents who will participate in the program in the Vologda Oblast;
- the expected expenditure of the consolidated budget of the Vologda Oblast on funding the program.

The average contribution is calculated according to the data on the “People’s Mortgage” housing construction savings project in the Republic of Bashkortostan (*Tab. 2*).

We assume that project participants ultimately tend to receive the same amount of square meters. To calculate this value, we fix the parameters of the pricing plan: deposit and loan interest rates, subsidies, term of savings and loans. The basic pricing plan is considered a six-year accumulation plan. It is possible to calculate the total contract for the consumer, i.e. the funds received (savings with subsidies and a loan).

Suppose K – the ratio of the total contract and the payment for a particular pricing plan. It can be expressed through parameters of the pricing plan according to formula 1:

$$K = ((1+p)^t - 1) \times (1+p) / p + s \times t + 1/c \times (1+c)^t - 1 / (1+c)^t \quad (1)$$

where p – deposit interest rate;

c – loan interest rate;

s – subsidy percentage;

t – accumulation and loan term.

With a six-year accumulation plan, the total contract and payment ratio equals 180. The average value of the payment (V) according to Sberbank amounted to 6,191 rubles. Therefore, the consumer has an opportunity to accumulate 1,115 million rubles ($6,191 \times 180$). According to statistics, the average cost of a square meter in the Republic of Bashkortostan equals 52,664 rubles, which means that the consumer receives (conditional) 21.16 square meters as a result of participation in the accumulation program.

Note through V_C the average contribution for a particular pricing plan in the regional center, through V_p – average contribution in the region excluding the regional centre. We assume that the number of consumers participating in the program in the regional centre and the region are correlated the same way as the total number of inhabitants. Then the first ratio is as follows:

$$\lambda_C \times V_C + \lambda_p \times V_p = V \quad (2)$$

where λ_C , λ_p – the share of residents in the regional center and the region excluding the regional center respectively,

V – the average contribution for this pricing plan in the region.

With the contribution of V_C (or V_p), the participant receives $K \times V_C$ ($Q \times V_p$) amount of funds. As participants receive the same number of square meters as a result of using the pricing plan, the second ratio is as follows:

$$K \times V_C / m_C = K \times V_p / m_p = 21.16 \quad (3)$$

where m_C , m_p – cost of a square meter in the regional center and the region excluding the center respectively.

Table 3. Distribution of population by per capita monetary income in 2014

Group	Vologda Oblast	Republic of Bashkortostan	Krasnodar Krai
Less than 5 000,0	3.0	10.4	3.4
5 000,0 – 7 000	5.3		
7 000,1 – 10 000,0	11.1	10.6	4.7
10 000,1 – 14 000,0	16.1	14.1	9.1
14 000,1 – 19 000,0	17.5	15	13.0
19 000,1 – 27 000,0	19.3	17.1	14.6
27 000,1 – 45 000,0	18.7	19	17.5
45 000,1 – 60 000,0	5.1	6.5	20.9
More than 60 000,0	3.9	7.3	16.8

Table 4. Estimation of participants in Vologda based on the total number of participants in Bashkortostan

Region	Expected contribution	Per family income	Expected number of participants	Share of families able to participate
Vologda	6526	11253	1225	0.79
Cherepovets	7217	12444	1143	0.74
Vologda Oblast excluding city districts	3597	6202	981	0.97

Formula 3 helps calculate the average amount of the contribution in Vologda, Cherepovets and the Vologda Oblast as a whole:

$$V_{VOLOGDA} = 5,727 \text{ rubles,}$$

$$V_{CHEREPOVETS} = 5,108 \text{ rubles,}$$

$$V_{OBLAST} = 4,024 \text{ rubles.}$$

On the other hand, the contributions are related to the average salary. If we assume that the contributions are proportional to consumers' average salary, we have the following values:

$$V_{VOLOGDA} = 7,326 \text{ rubles,}$$

$$V_{CHEREPOVETS} = 9,326 \text{ rubles,}$$

$$V_{OBLAST} = 3,170 \text{ rubles.}$$

It is reasonable to consider the average value of contributions as the total value of contributions:

$$V_{VOLOGDA} = 6,526 \text{ rubles,}$$

$$V_{CHEREPOVETS} = 7,217 \text{ rubles,}$$

$$V_{OBLAST} = 3,597 \text{ rubles.}$$

The next step requires calculation of the share of population participating in the housing construction program. To do this we approximate the distributions¹⁷ using the lognormal distribution (*Tab. 3*).

We assume that the family consists of 2.9 people and is able to save 20% of their monthly income [21]. It follows that participation in the program requires average monthly income per family member in Vologda to be 11,253 rubles, in Cherepovets – 12,444 rubles, in municipal districts of the Vologda Oblast – 6,202 rubles. According to the calculations for housing construction savings program in the Republic of Bashkortostan, the share of program participants in the regional center amounted to 0.014, in the region excluding the center – 0.005. Using this distribution, it is possible to determine that 79% of households in Vologda, 74% – in Cherepovets and 97% in the Vologda Oblast excluding urban districts will be able to

¹⁷ The calculation method is given in [21].

Table 5. Calculation of the expected number of participants in Vologda

Parameter	April 2014 – April 2015	May 2014 – May 2015	June 2014 – June 2015	July 2014 – July 2015	August 2014 – August 2015	Krasnodar Krai
	Republic of Bashkortostan					
1. Number of program participants in the region per year, <i>people</i>	8360	7039	6113	5814	5750	3647
2. Number of program participants in the capital, <i>people</i>	3628	3054	2653	2523	2495	816
3. Average payment of a program participant in the region, <i>rubles</i>	6191					7500
4. Share of families able to accumulate the required amount of money for participation in the program, %	65 / 84					72 / 95
5. Share of residents using the program among those able to participate (regional center / region excluding the center), %	1.46 / 0.55	1.22 / 0.46	1.06 / 0.40	1.01 / 0.38	1.00 / 0.38	0.29 / 0.29
	Vologda Oblast					
6. Expected average payment in the Vologda Oblast (Vologda / Cherepovets / region excluding city districts), <i>rubles</i>	6526 / 7217 / 3597					9859 / 5408
7. Expected number of participants in the Vologda Oblast (Vologda / Cherepovets / region excluding city districts), <i>people</i>	1281 / 1187 / 1021	1079 / 999 / 859	937 / 868 / 747	892 / 826 / 710	882 / 817 / 702	155 / 138 / 476
8. Expected number of participants in the Vologda Oblast, <i>people</i>	3489	2937	2552	2428	2401	769
9. Expenditure of the consolidated budget per year, <i>million rubles</i>	74.1	62.4	54.2	51.6	51.0	21.45

participate in the housing construction savings program. Using data on the total number of participants in Bashkortostan (8,046), we can estimate the expected number of participants in the program. In Vologda, it will be 1,225, in Cherepovets – 1,143, in the remaining part of the region – 941 (*Tab. 4*).

An important part of the calculation is the determination of expenditure of the region's consolidated budget on the implementation of the housing construction savings program (*Tab. 5*). The calculations are presented in comparison with the program results in the Republic of Bashkortostan and Krasnodar Krai for the same period.

Thus, the calculations demonstrate that at the initial stage of the housing construction savings program implementation in the Vologda Oblast 3,489 Vologda residents can take part in it with monthly bank payments not less than 3.6–7.2 thousand rubles for the accumulation of the initial payment on the mortgage. In addition, the implementation of the program will require additional expenditure of the consolidated budget of the Vologda Oblast amounting to 51–74 million rubles per year, or 0.9 and 0.13% of tax and non-tax revenues.

Housing construction savings can be a tool for achieving the goal set out by the President

of the Russian Federation, i.e. creating affordable housing market in the Vologda Oblast by increasing the availability of housing loans, lowering the rates and increasing the volume of low-income housing construction. In turn, this will increase the population's assessment of the regional policy and active development of the housing market, and the banking system in the region will become the driving force of the growing regional economy as a whole. This is due to the fact that housing construction in the system of key factors for the socio-

economic growth is not only a priority but also the most capital-intensive sector, the backbone of the state economy. Since, according to Rosstat, about 15% of people are employed in housing construction and maintenance, about 25% of the total investment is allocated to housing construction. The multiplier effect of investment in housing is manifested in logical relation with construction industries integrated into it, the results are manifested in more workplaces, higher salaries and, as a result, higher consumer demand.

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Adaptation of Companies in the Republic of Karelia to the Economic Recession in Russia in 2014–2015



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Abstract. Regional companies in Russia found themselves in unique conditions of negative consequences of sanctions and reducing resource revenues in resource-driven Russian economy. Regional companies are not ready to the new economic reality, which makes it a hallmark of the economic recession in 2014–2015. Our study captures the reaction of regional companies to sharp market changes and selection of new adaptive patterns of behavior aimed at developing and sustaining business. The purpose for the study is to assess the impact of the economic recession in Russia in 2014–2015 on the adaptation of companies in the Republic of Karelia to recession conditions. The impact of events was recorded directly from the estimates and intentions of management in the process of conducting half-formalized in-depth interviews with companies' leaders. Based on the method of quota arrangement, we selected key stakeholder companies in 3 regions in the Republic of Karelia and made a list of special respondents occupying leading positions in the companies. Empirical data were collected by in-depth interview method, where the key topics were the condition of business, strategic development plans, launch of new product lines, current partnership capital. Data were analyzed using methods of condensation of meaning, topic grouping, and constant comparisons. The study created a homogeneous database of 18 quality interviews whose content analysis helped identify key categories used by the respondents and the nature of their influence on economic behavior. We formed a typological image of stakeholders depending on the pattern of behavior in the Republic of Karelia and made a conclusion about the reaction of stakeholders to the recession. The

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research results are applicable in determining the priority areas for supporting stakeholders in a factor-driven region based on the models of their economic behavior amid economic recession. We assess the readiness of international cooperation in the context of the national policy of import substitution. The study includes key stakeholder companies in several regions in the Republic of Karelia during the period of intensive changes. Knowledge about the success of the models of anti-crisis behavior is possible to be improved on the basis of qualitative sociological evaluations by comparing with business models of regional companies in the period of subsequent stabilization.

Key words: regional companies, stakeholders, economic behavior, crisis models, quality interviews.

Introduction. The economy of the Republic of Karelia is heavily dependent on its primary industries. The companies working in these industries are the largest employers in the Republic, and their tax payments collected on its territory constitute a significant share of contributions to the federal and regional budgets. In the economy of the Russian Federation in the period of its existence the primary sector of the economy and the developments in international commodity markets have become essential. “The main risk has always consisted in the dependence on the oil and gas prices” [9, p. 6].

The changes that happened in 2014 in the international markets of mineral resources, the weakening of the national currency and the change in international political conditions negatively affected the business of Russian companies, which are major stakeholders¹ [17, p. 4] in Russia’s regions. Effective demand within the country reduced rapidly, and the import prices in rubles grew. The vast majority of economic assessments of the Russian economy of 2014–2015 indicate an economic downturn with negative dynamics.

¹ *GOST R 51897-2011. Rukovodstvo ISO 73:2009. Menedzhment riska. Terminy i opredeleniya* [GOST R 51897-2011. Guidelines ISO 73:2009. Risk management. Terms and definitions]. Moscow: Standartinform, 2012. 12 p.

An important issue is the social sustainability of settlements, in which these companies are major employers, and often – backbone enterprises [7]. The unstable economic condition of these companies means the growth of unemployment, reduction of investment programs of development and modernization of production. Lingering crisis effects destroy the social stability of settlements and pose a threat to their socio-economic security. A change in the situation in the economy is an incentive to search for new models of economic behavior, development and preservation of sustainability of the business.

The impact of the events of 2014–2015 in the Russian economy on the stakeholders in environmental management of the Republic of Karelia was assessed within the framework of a subproject of the Institute of Economics of Karelian Research Center of the Russian Academy of Sciences entitled “An economic and sociological research on the subject “Evaluation of the structure and development strategies of stakeholders in environmental management of the Republic of Karelia” under an international project KARLANDS within the framework of the contract with the Center for Economic Development, Transport and the Environment for North Karelia (Joensuu, Finland).

Research methods. The goal of the project was to select key stakeholders in the given territories of the Republic, to evaluate their performance and strategic status in the region and to assess their preparedness for diversification on the basis of investment in development and international cooperation.

Muzyzersky District of the Republic of Karelia, Kostomuksha Urban District, and the city of Petrozavodsk were chosen as pilot areas for the study.

In the first, cameral, phase of the project, the information on the structure of stakeholders of the pilot areas, their trade turnover, production volume, number of employees, financial status was gathered from open sources. The data of the open sources was also used to analyze their partner contacts and cooperation experience.

Based on the analysis of the market position of the company, the key stakeholders were chosen in the selected territories on the basis of the quotas uniform in their number for the regions of the Republic of Karelia [14]. For the field phase of the study, a list of special respondents – company executives competent in the work of their organization was formed.

During the second, field, phase of the project, in-depth semi-formalized interviews with senior executives and representatives of management of the companies of the first phase were conducted. The interviews contained open-ended questions on the size of companies, their strategic investment units, and partnership capital. The key topics included those concerning the companies' plans for business development, the launch of a new, maybe a non-core, production, and readiness for international cooperation [20].

The study resulted in the formation of a homogeneous base of 18 qualitative interviews with representatives of companies operating in the territory of the Republic, the number of which is sufficient to form a typological picture [1, p. 58].

Analytical methods. The interviews were analyzed with the use of sociological methods of qualitative data analysis. The objective of these methods consists in interpreting private experience and translating it into scientific language. In each case the experience of each company we interviewed was considered with the help of individual assessments and subjective perceptions [10].

From the interviews, by highlighting the “natural units of meaning” expressed by the respondent, we formulated a set of topics present in the text. A. Giorgi calls this definition of the topics a “condensation of the sense of the interview” [5, 19]. M.B. Miles and A.M. Huberman in their work put forward 13 ways of extracting meaning from qualitative texts and its deep interpretation [21]. The allocation of topics helps see “what is aligned with what”; it is a way to achieve greater integration of the data [5]. The topics that were common and recurring in the texts of the interviews we conducted with stakeholders were structured, and the data are summarized in the *Table*.

The basic task of empirical sociological methods is to search for the knowledge about the types of social, cause-and-effect relationships that describe and explain social phenomena [12]. Common types are identified through the data analysis “from the particular to the general” with the help of logical induction method. Inductive analysis begins with cross-

Description of the types of stakeholders in the Republic of Karelia according to the topics highlighted in the interviews

Topic	Stakeholder type		
	Subsidiary companies	Loyal companies	Competitive companies
Size	Divisions and subsidiaries of large Russian and multinational groups	Small and medium companies (limited liability companies, cooperatives)	Small and medium companies (limited liability companies, cooperatives)
Market	Domestic (Russian) and external (global) markets. Dependence on the global trends in prices	Domestic market (other regions, megacities)	Domestic and foreign markets (Republic of Karelia, Russian regions, neighboring countries)
Consumers	Processing enterprises within the group of companies, including those abroad; various large Western and Russian consumers	One major contractor represented by a state monopoly or a company controlled by the state	Many private consumers, public procurement
Strategy	Formed outside the region and depends on the global plans of the group of companies	Strategy for the conservation of the order and 100% capacity utilization	Strategy for profitability and preserving competitiveness on the market
Independence	Executive director and heads of departments with limited powers and resources, restrictions on the sums of transactions	Dependence on major customers (sum of the order, volume of the order, terms of payment)	Full independence and mobility
Cross-border cooperation	As part of the core strategy of the group of companies, shipping products to foreign enterprises of the group, conclusion of international transactions through the central commercial units or with their consent	It is not interesting and it is not considered	Planning and concentration of resources in competitive markets, international cooperation, intensive search for partners (Nordic countries)
Reaction to recession	Greater stability in the presence of foreign currency earnings and favorable global market prices. Balance between reducing the costs caused by depreciation of the national currency and rise in prices of imported equipment. In the adverse scenario: failure or interruption of investment programs, reduction of production and personnel	Reduction of costs, abandonment of plans for equipment update, switching to domestic equipment and supplies	Curtailling unprofitable or unprofitable production, search of new investment opportunities, focusing the resources on new projects or directions
Source: compiled with the use of the data of the field study.			

examination of individual cases, with the further formation of groups according to similar features, where the grouped data are denoted by categories [6].

During the study, the respondents indicate their concerns using local systems of categories. To identify and refine the categories, sociology uses the technique of constant comparisons that helps formulate a theoretical description of the processes through induction repetitions [4]. In our study we did not aim to formulate

a comprehensive theoretical description, but rather to reflect distinctive regional processes. However, the method of “continuous comparative analysis”, which is part of the scientifically substantiated theory, allows us to receive relevant categories and to formulate insights and hypotheses [4, 11]. It is necessary to compare one case within the category with the previous cases in the same and other groups coded in the same category, so as to find out generalizing and theoretical properties of

the category and its relationships with other categories [18]. In our study, we compared cases from different companies and formulated explanations common to the groups, the explanations that could be identified by generalized and explanatory phrases and categories.

Results of the study. In the texts of the interviews of our respondents, grouped into topics, we recorded the negative nature of their statements as a response to the emergence of “sore spots” generated by the recession in the Russian economy since the end of 2014. In the end it turned out that the reasoning of the respondents on the vast majority of topics focused on the challenges caused by internal organization, lack of independence, and dependence on external and internal factors. The nature of the problems is generalized to the fullest extent in the “limitations” category, which was used, in particular, by respondents themselves. According to the nature of the limitations, this category was divided into the following components:

- organizational and functional limitations;
- consumer and market limitations;
- institutional and regulatory limitations;
- infrastructure and transport limitations;
- technological limitations.

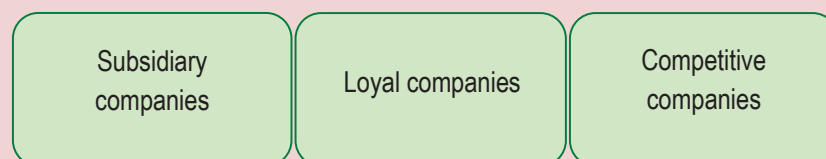
Despite the fact that the degree of influence of the given restrictions on the behavior and

processes in the companies was different, the greatest impact on the strategies of the companies was made by external causes that lie outside the region. This is consistent with the raw materials export-driven nature of the economy of the Republic of Karelia [3].

Taking the “limitations” category as a basis and considering the external nature of limitations in relation to the region and also the degree of their influence on the strategic vision of management, we divide the companies under consideration into three types presented in the Table and in the *Figure*. In the framework of our regional study it is quite difficult to consider the obtained empirical regularities typical of all regions. These types are characteristic of the Republic of Karelia and can be unstable in other regions of Russia. Therefore, in the case of the allocated three types it would be more correct to speak of a typological syndrome as an empirical regularity discovered in the process of data analysis [12, 13]. We provide descriptive generalizations for the types of companies selected.

The mining complex of Karelia ranks second in the volume of industrial production in the region after the forest industry. Karelia produces a variety of mineral products, but in large quantities it produces only iron ore pellets (black metallurgy) and non-metallic materials (crushed stone, stone, sand-gravel mixture, gravel) [16].

Types of natural resource user companies in the Republic of Karelia



The type of *subsidiary companies* includes the largest mining and processing works that provides almost all the iron ore (ore, pellets) in the region. From 2011 to 2015, the production grew by 4–5%, and the company felt virtually no impact of the coming crisis [2]. According to the strategy of the enterprise, the main risk factor was the decline in prices and demand for iron ore. As follows from the data² of the company InfoMine Inc., the iron ore prices for 2014 (rub/t) were slowly decreasing with the restoration movement at the end of the year, related to the devaluation of the ruble. The company did not experience large difficulties caused by falling prices.

The company supplies about 60% of products to the domestic market, the remaining 40% goes on export. It compensates for the fall in domestic demand at the expense of export deliveries to the enterprises of the group abroad. Out of domestic supplies, 65% of the production was shipped to the enterprise Severstal (Cherepovets).

The reduction of costs and personnel in 2014 was carried out in accordance with the plans adopted previously. The company had a business plan for a period of one year, its own development strategy for five years, and the program of technological improvement of the group for 30 years.

The director-general is authorized to make decisions the value of which does not exceed 10 million rubles. Accordingly, the investment strategy on the local and global markets was the responsibility of global management. The expansion of production is possible only after

consultation with senior management and provided that there is a resource base with relevant capabilities on site. The Karelian enterprise does not have the infrastructural capacity to increase production, because the city does not have available electric power facilities.

Diversification of activity and extension of the production cycle on the territory of the Republic was not reflected in the production plans of the group. It was planned to open its new subsidiaries, but Karelia was not considered as a site for the investment in development.

Contracts for production equipment and vehicles are concluded by Russian affiliates of foreign manufacturers of machinery and equipment (Komatsu, Caterpillar, Metso). Importers of machinery in this case are Russian subsidiaries of international companies. Export contracts for the supply of iron ore are in the competence of Central, commercial offices, while Karelian enterprise stands as one of the production units of the group.

The group of subsidiaries also includes enterprises of the Karelian forest complex, which determines specialization of the whole region and which was losing its competitive position during the past decade [15]. According to a representative of a large timber holding company, the crisis had hardly any impact on the volume of harvesting of the company in 2014. Logging is based on the involvement of contractors, which allows having a minimum number of personnel in logging units of the group with a maximum harvesting of trees at the allowable cut. Timber is delivered to processing enterprises of the group, and exported across the Russian-Finnish border.

² Data of InfoMine Inc. Available at: <http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?z=f&gf=140262.USD.t&dr=5y&cd=1>

Regional production units were controlled by the executive director, whose limit of spending per one contract without the consent of the parent company did not exceed 700 thousand rubles at the time of the interview. Investment decisions were made by Moscow executives in accordance with the national plans to accommodate new production, and depending on the forecast market volumes for each product produced by the group.

International contracts for supply of timber were concluded through the Russian representative offices of European companies involved in timber trade, or through direct deliveries to Finnish saw mills and timber companies. Such a contract requires approval of head divisions of the holding during the quarter. Issues of pricing and new contracts are resolved through a centralized sales department. Similarly, the company concludes contracts with Russian representatives of suppliers of European and American forestry equipment (John Deere, Ponsse, Volvo).

The contracts for export deliveries to the EU are limited by international requirements for sustainable forest management and trade. International nonprofit organizations provide forest certification services ensuring the possibility of international cooperation required for international trade in forest products [8].

At the end of 2014, the holding company did not plan any active investments in timber harvesting in the Republic of Karelia. The holding company considered pulp and paper industry of the region as the main object for investment. According to senior executives the company refused to develop new sawmills and wood processing industries due to the lack

of personnel, lack of demand and constraints on the possible competition with the group's companies in other regions.

In the database of the interviews on the results of the research with participation of representatives of limited liability companies and cooperatives working in the sphere of extraction and processing of non-metallic materials, we should highlight the companies that focus on the domestic market and on one major customer, with long-term contracts (large state-owned companies, federal infrastructure projects). This is the second type of companies: *loyal companies*.

Being of the leading regions of the Russian Federation on the reserves of building stone, Karelia has always been providing high-strength gravel to almost the entire European part of Russia, where there are no strong igneous rocks [18]. The important role was played by major transport and construction projects of federal and regional importance that provided a continuous increase in demand. From 2011 to 2015, the production of construction stone in the Republic of Karelia grew by 38.5%, while the production of crushed stone – by 96%, i.e. virtually doubled [2].

As subcontractors on the objects of federal significance, the companies do not adopt long-term development plans and strongly depend on the consumers of their products. Main strategic objectives of such a company consist in streamlining and loading their production by 100%. Investment in equipment depends on its condition and the availability of financial resources.

Major institutional problems are related to the federal land legislation on the use of forest land, despite the consent of leasers of forest

land. There emerge many administrative barriers. In one of the companies with a license the registration of land was not finalized within four years. In order to open a quarry, it was necessary to obtain more than 127 approvals. Great problems arose because of the requirements of fire safety, the execution of which had led to excessive costs for the additional activities and staff.

Such companies face another major problem that consists in attracting project financing to expand production, open new pits or deepen the processing.

For the companies operating in the internal market that do not have foreign exchange earnings, the depreciation of the ruble has become more of a problem of rising costs of imported equipment and consumables, rather than a benefit of increasing competitiveness due to decreased costs. In the context of the crisis, these risks were particularly pronounced in the form of refusal to purchase new equipment and sign new lease agreements. The company management recognized the problem but saw no possibility of using Russian machines and equipment instead of their foreign counterparts due to their poor quality or lack of decent analogues. Russian production facilities of Western companies are only partially localized, which results in a lower quality of “imported vehicles with Russian registration” with the increase of the ruble value of its import aspect since the end of 2014.

The dependence of production on the major customer implies the need to consider disputable situations in contracts in more detail. The actual contract situation is far from ideal. It is complicated by the investment of the contractor in expensive and specific assets for

production purposes. It is necessary to provide for the mechanisms for conflict resolution, which is very difficult in practice, in the context of the monopoly of a single large customer.

At the stage of signing the contract when using competitive procedures the victory often belongs to the company that does not have its own full-fledged production base and attracts its competitors for sub-contracts. If this practice continues for 10 years, then it can be considered a rule, to which Karelian companies are forced to adapt. Over time, the dependence of such a supplier is only strengthened.

But the company’s management considered the situation as an opportunity to solve other problems. Such problems were the delay of payments by large consumers, creating cash gaps that lasted a quarter in the budget of the supplier. As a result, there is a lack of financial resources for the execution of current expenditure obligations of the enterprise. The contract with the mediator who won the contract, by contrast, means the timeliness of payments and independence from debt markets.

Thus, the negative practice when dealing with large monopolies is considered by company management as positive, despite a loss of profit in comparison with conditions of the direct contract.

The third type is *competitive companies*, i.e. those that work with different customers, more flexible in business and ready to develop international cooperation in different directions.

Pre-crisis development of one of these companies was based on a two-year work plan, the purpose of which was to preserve the profitability of production and maintain its positions in the market.

In the crisis conditions of falling demand for crushed stone in the domestic market, the risk of shutting down the quarry at the time of the interview actually materialized. The company's management was not ready to save the loss-making business, hoping to renew the demand, as it did not meet the objectives of the company and led to the closure of the production.

Such companies were more affected by the crisis, but they were flexible in the use of the accumulated resources and in the changing profile of the business. Their crisis model of behavior was to search for possibilities to organize production of the most competitive product capable to generate profit in the medium and long term. The management of the company concentrated its accumulated investment resources in this direction.

The owners of the interviewed company were in the process of finding new opportunities for localization of competitive production of feed for the trout on the territory of the Republic of Karelia. The company at the time of the interview had both organizational and financial resources to create local production.

The problem was to find an international partner willing to provide competitive technology, access to production equipment and a brand for entry into the joint capital. Entrepreneurs looked for partners in the Nordic countries in various areas, but encountered problems with making contact or faced complete lack of interest on the part of potential counterparties.

Conclusions. In conclusion, we can state that in the context of recession, the Republic of Karelia was not considered as a platform for development and international cooperation by federal and international business groups due to a lack of personnel and a low demand, and in connection with restrictions on competition among the companies of the group in other regions (intra-group competition). Only single or already launched projects were implemented.

The companies that participated in the implementation of investment projects of state monopolies or projects of federal importance did not consider alternative opportunities for business diversification and faced the risks of sudden and massive cuts in public investment budgets.

The companies of the Republic of Karelia responded to the crisis by refusing to make major investment expenses, and by optimizing their business structure and reducing personnel costs. Some of them, having lost the demand, were forced to shut down or reduce their business dramatically.

As a result, only few of them set the goal of import substitution through the development of production of goods based on international cooperation as a crisis behavior pattern. Most companies were forced to look for every opportunity to save their business.

Our research has allowed us to expand practical understanding of the successfulness of the models of crisis behavior of regional companies of the Republic of Karelia on the basis of qualitative social assessments.

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Innovation Approaches to the Formation of Investment Policy Tools from the Perspective of a Neo-Industrial Economic Development Paradigm*



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Abstract. The current macro-environment of the Russian economy formed under the influence of its raw-materials export model does not facilitate investment activity or intensify investment in the country, which ultimately hinders the re-industrialization of the productive forces and establishes the technological and economic gap between Russia and world's developed economies. Such a situation clearly indicates the need for a transition to a new economic paradigm, the implementation of which will ensure accelerated modernization of the economy based on innovative content of investment. We are talking about the neo-industrial paradigm of modern development developed by the Russian economic school in 2007–2014. In

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this regard, the purpose for the study is to develop the theory and methodology of formation of investment of a new – innovative – type, adequate to the neo-industrial economic paradigm; to identify the factors deterring innovative accumulation of investment in modern Russia; to develop proposals aimed at stimulating investment and innovation activity of business entities of the national economy given the subordination of the country's resource and economic potential to the future neo-industrial development. The research framework is based on an integrative approach which requires analysis of historical, political, legal, economic, and other prerequisites for the development of socio-economic systems of different levels and is crucial for the analysis of the transformation of categories in the process of a paradigm shift. According to the methodological approach, the authors position the category of "investment" as one of the key categories of the hereditary (genetic) core of the neo-industrial economic paradigm; and introduce the term "innovative type of investment". Such an approach to studying investment differs from their interpretation in traditional neoclassical, Keynesian and institutional frameworks. The main priorities of innovative content of investment are: active development of the human component of intellectual capital; generation of innovative technical and technological resources; establishment of effective innovation systems; an integrated, generalizing criterion of "gross accumulation rate" which in relation to the Russian economy amid capital-intensive and innovative investment should not be lower than 28–30% of GDP. The article analyzes the performance and intensity of innovative processes development in the economy of the Republic of Mordovia – one of the leaders in improving the rank in the ranking of innovative development of regions of the Russian Federation for 2008–2015. The methodological framework of such analysis is represented by a macro-model of innovative systems proposed by D.H.C. Chen and C.J. Fuhrman, adapted to the Russian economy with the use of the method of model-oriented structuring by Glisin F. and Kalyuzhnyi V. We clustered constituent entities of the Russian Federation according to the index value of "the region's knowledge economy". We formulate offers to intensify investment activity in Russia and transform its investment policy taking into account the stimulation of innovative content of investment.

Key words: neo-industrial economic paradigm, investment, innovative content of investment, de-industrialization, investment policy, "knowledge economy" index.

1. Introduction

An unexpected yet universally recognized global financial and economic crisis of 2008–2009 focused the attention of scholars and practitioners on the search of mechanisms to overcome it with regard to the changing economic conditions, and recalled the previously relevant concept of paradigm shift put forward in the 1960–s by an American historian and philosopher T.S. Kuhn [10]. According to the concept, a "paradigm is a widely recognized scientific achievements

which for a certain time provide the society with a model of problem statement and their solutions" [11, p. 120].

It should be noted that the current paradigm (liberal, market) predominant in the world economic science, which was formed back in the 18–20th centuries, no longer meets modern needs of economic and social progress. In this regard, it is appropriate to recall the statement by M. Porter who in 1990 in his book "The Competitive Advantage of Nations", wrote: "...the world is increasingly convinced that the

current paradigm of economic success... no longer meets modern requirements” [15, p. 38].

Nowadays, both in the scientific community and at the level of governments of leading world countries [9; 19], there is a gradual rejection of the post-industrial economic paradigm with its emphasis on the shift from production of goods to expanding services [1; 20; 25]; from neoliberal ideas about equal importance of all forms of activities in the context of globalization and absolute efficiency of market self-regulation [26]. In economic science there is a trend of paradigm shift towards the concept of neo-industrialization, whose supporters (A.A. Amosov, A.V. Buzgalin, S.D. Bodrunov, S.Yu. Glaz'ev, S.S. Gubanov, R.S. Grinberg, A.E. Karlik, A.I. Kotov, S.V. Kuznetsov, V.I. Kushlin, V.I. Mayevsky, V.T. Ryazanov, etc.) justify its subordination to objective laws and leading trends of the modern stage of social development [5].

A recognized founder of such a paradigm is Professor S.S. Gubanov, who set forth his fundamental program of neo-industrialization in the monograph named “Breakthrough of the Power. Russia’s Neo-industrialization and Vertical Integration” (2012) and a series of articles. Neo-industrialization is referred to as “a historically logical process of development of productive forces, ...based on the technotronic triad: aggregate employee – electronic computing machine – automated means of production... The quality measure of neo-industrialization is progressive changes in the nature of labor and structure of employment accompanied by the declining share of manual labor and increasing share of mental labor; establishment of mental labor

as mass and dominant; labor saving...The social consequence is embodied in the forming foundations of a new society, which prioritizes human reproduction and quality of life, rather than profit” [6, pp. 31–32].

The key role in implementing the neo-industrial formula of the national economy development belongs to the policy of accumulation and innovation-based expanded reproduction [5]. At the same time, it is known that the complexity of the adjustment mechanism of the reproduction process manifests itself in the category “investment”. Despite high prevalence, its definition is ambiguous in the literature being a controversial scientific issue.

Based on criteria features it is possible to present the following classification of definitions of the latter:

1. Investment as a resource, which implies the consideration of production factors and conditions of reproduction (S. Fischer, R. Barre, G.M. Keynes), or as relations concerning the provision of production with economic resources (O. Donichev, R. Samuseva).

2. Study of investment in static – as resources (C.R. McConnell, S.L. Brue) or in dynamics – as a process, act of creating (E. Hansen, V. Daskovskii, V. Kiselev).

3. Investment (in the broad sense) as allocation of funds to any assets which produce results (J.F. Sinki, W. Sharpe, G. Alexander, D. Bailey); in the narrow sense – material resources for production support (M.A. Chepurin, E.A. Kiseleva).

Based on systematization and generalization of the most known definitions of the category

“investment”, we can conclude that this definition includes the whole complex of conditions for the implementation of reproduction, uncertainty, risk, multivariance of choice. This is, in our opinion, the reason to consider investment as one of the key categories of the genetic (inherited) core of the paradigm (industrial, neo-industrial, or post-industrial) reflecting the new quality of economic and institutional conditions and factors in social reproduction and economic growth, as well as the role of a human in the modern world.

During the process of economic paradigm shift of Russia’s development, the issue raised by some researchers (V.I. Kushlin, E.B. Linchuk, V.K. Senchagov, K.I. Pletnev) about the necessity of forming investment of a new quality, adequate to the idea of neo-industrialization – high-tech and knowledge-intensive – seems timely and important [17, p. 204]. In addition, economic science and economic practice currently need constructive suggestions to overcome the current investment policy inadequate to the requirements of system innovative modernization of the national economy of Russia [21, p. 156].

2. Research methodology

The research is based on the integrative approach which requires analysis of historical, political, legal, economic and other prerequisites for the development of socio-economic systems of different levels and is crucial for analyzing the transformation of categories in the process of a paradigm shift. According to this methodological approach, the authors define “investments” as one of the key categories of hereditary (genetic) core of the neo-industrial economic paradigm and

introduce the term “innovative investment”. Such an approach to studying investment differs from its interpretation in the traditional neoclassical, Keynesian and institutional concepts.

Moreover, the article presents the *author’s technique of assessing the efficiency of the regional innovation system*. Its methodological framework is based on the macro-economic model of innovation systems proposed by Chen D.H.C. and Dahlman C. J. [22]. It was adapted to the Russian economy with the use of the method of model-target structuring by F. Glisin and V. Kalyuzhnyi [3]. This technique made it possible to conduct a comprehensive analysis of innovation processes in a specific Russian constituent entity – the Republic of Mordovia – with the help of a large number of indicators with different dimensions based on the resulting indices. At the same time, to perform the clustering of Russia’s constituent entities according to the KEI value the method of k-means was used.

3. Research results

According to the concept of neo-industrialization proposed by the Russian economic school, the modern stage of socio-economic development is characterized by entering into a new – neo-industrial – era “... historically higher, where the composition of combined labor forces of the society is dominated by highly skilled intellectual workers and science acts as a direct productive force” [2, p. 13]. Such a society is characterized by genuine “knowledge economy” with knowledge and innovation being the main source of development, and intellectual capital – the underlying factor in social production.

Figure 1. Decomposition of intellectual capital

Intellectual capital	<i>Human capital</i> – the active part of human potential	Knowledge; skills; creativity; culture; moral values; intellectual activity
	<i>Organizational capital</i> – provides fuller realization and development of human capital in an organizational environment	Technology; processes; inventions; organizational structure; organizational culture etc.
	<i>Consumer (client) capital</i> – quantity and quality of constant clientele of an economic structure	Information about customers; customer relations; customer loyalty; trademark; brand etc.

The accumulated knowledge on intellectual capital made it possible for scientists to define common approaches to its structure and forms of its manifestation by the end of the 20th century (Fig. 1).

It should be noted that intellectual capital has a lot in common with physical capital: both are the result of investment of resources (money, material resources, knowledge, qualifications, etc.) in production of goods and services; bring profit to their owner; are a maintained and sustained resource [13, p. 308]. From this viewpoint, investment should be considered as one of the key categories of the genetic (inherited) core of the neo-industrial economic paradigm [24].

It is clear that today attention should be focused on a qualitatively new – innovative – type of investment, adequate to the criteria of the neo-industrial paradigm. Such investment, in our view, represent long-term investment in the development of intellectual capital and innovative sectors of the national economy, providing for the re-industrialization and creation of science-intensive, high-tech and digital productive forces, growing labor productivity, effective use and strengthening of human potential.

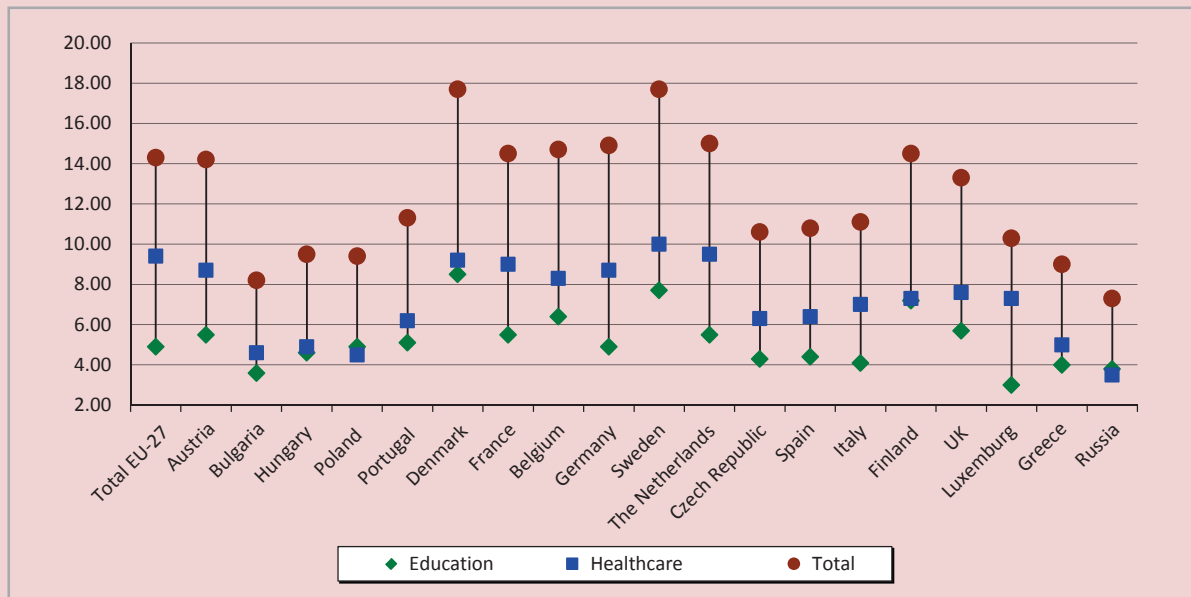
In the context of the concept of neo-industrialization, it seems possible to identify the following priorities for innovative content of investments, reflecting the leading trends of the modern stage of socio-economic development:

- human capital development;
- formation of high-tech investment resources in order to effectively implement and strengthen human resources;
- creation of dynamic and effective innovation systems (national and regional), which are sometimes referred to as the “triple helix” [4, p. 50] implying a mechanism of close cooperation between government, business and science (research institutions) in the scientific-technological sphere.

The main priority of the innovative content of investments is, undoubtedly, the human component of intellectual capital. It is the human component that, being one of the forms of labor resource development, has the ability to create new knowledge and transform it into new scientific and technological solutions with practical value and hence intensify the innovative processes in the economy.

Human capital development is impossible without mobilization of public and private

Figure 2. Share of expenditures on education and health in GDP in selected EU countries and in Russia in 2011–2015, %



Compiled from: Rossiya i strany mira. 2016: stat. sb. [Russia and world countries.2016: statistics book]. Rosstat. Moscow, 2016. 379 p.

resources. According to the UN Development Programme, only in the first decade of the 2000-s, accumulated investment in human (or human capital) amounted to 64% of total wealth, compared top 16% of physical capital. In many developed economies this share reaches 80%. For reference: in Russia the situation is different: 72% is the share of the materials sector and only 14% – human capital [13, p. 314]. *Figure 2* presents data illustrating the high level of aggregate expenditures on education and health in selected EU countries.

It seems obvious that effective transformation of new scientific knowledge into innovation and its successful transformation into a qualitatively new product, including investment resources, growth of components of creative labor in the economic system,

solving the problem of resource efficiency with reference to best international practices, etc. is impossible today without creation of an appropriate technological investment resource and a high-tech complex (HTC) in the national economy.

In this context it seems appropriate to draw attention to the opinion of J. Stiglitz and his co-authors that the current period is characterized by “a new intellectual consensus” where the value of industrial policy is recognized by politicians and academics on different poles of the ideological spectrum [18; 27, p. 2].

In this regard, we share the position of famous Russian scientists (S.Yu. Glaz’ev, N.A. Novitskii, V.K. Senchagov, etc.) concerning the fact that the most important prerequisite for innovative content of investment is attainment of rational (threshold)

criteria for secure innovative and investment activities and creating a favorable macro-environment for the latter [21, p. 157]. Experts in economic security distinguish the following criteria [21, pp. 162–163, 281]:

- the share of gross accumulated investment in GDP (above 25% of GDP; taking into account the development of knowledge-intensive industries and introduction of nanotechnology in the Russian economy – up to 28–30%);

- ratio (excess) of investment and GDP growth rates (taking into account the momentum and the growing capital intensity of innovation in the Russian economy to produce 1% of GDP growth it is necessary to provide 2–3% of additional investment growth;

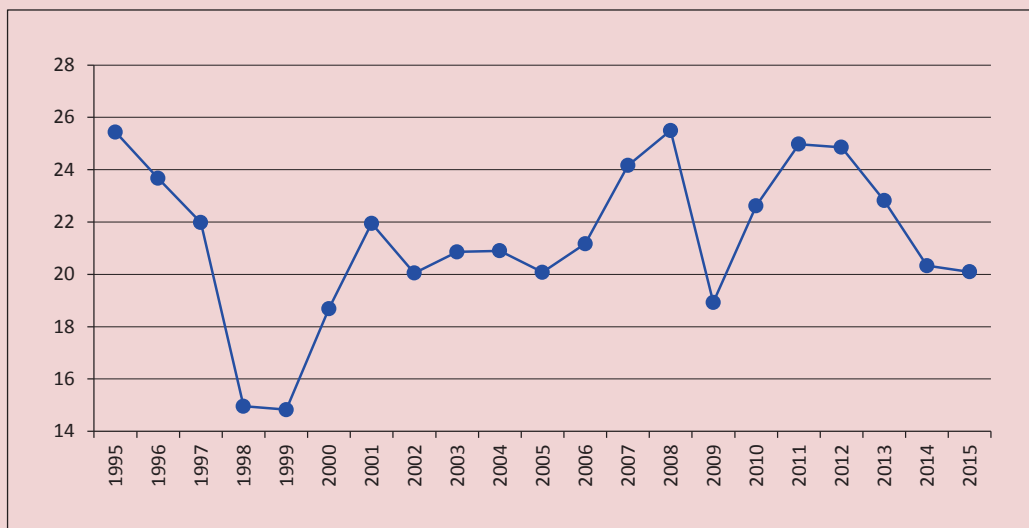
- excess of investment in renewal of fixed assets over the reimbursement of their disposal in relation to the initial cost (not less than 50%);

- ratio of economic viability and the level of interest rates, which implies the excess of the former over interest rates, which, in turn, should exceed the level of deposit rates, and the latter must be above inflation to provide real return on deposits.

It is regrettable that the current investment policy in Russia is poorly focused on these criteria; the state of technological investment resource and the country's innovation system does not correspond to the level of its human potential development. For reference: in 2015, the value of Russia's HDI amounted to 0.798; according to this indicator, Russia ranked 50th among 188 countries with high HDI.

At the same time, analysis has revealed a noticeable developmental delay in the Russian economy from industrialized countries in indicators such as gross capital formations rate (*Fig. 3*). In Russia, under the influence of the transformational recession of the 1990-s and radical changes in the investment pattern

Figure 3. Performance of the share of gross capital formation in Russia's GDP in 1995–2015, %



Source: compiled from: Rossiya v tsifrakh. 2016: krat. stat. sb. [Russia in figures. 2016: brief statistics digest]. Rosstat. Moscow, 2016. 543 p.

Table 1. Key indicators of condition and renewal of fixed assets (FA) in the Russian economy in 1970–2015

Indicator	Years							
	1970	1980	1990	1995	2000	2005	2010	2015
FA renewal rate	10.2	8.2	5.8	1.6	1.4	3.0	3.7	3.9
FA disposal rate	1.7	1.5	1.8	1.5	1.0	1.1	0.8	0.8
FA depreciation rate, %	25.7	36.2	35.6	38.6	39.4	43.5	47.1	50.5

Source: compiled from: Rossiya v tsifrakh. 2016: krat. stat. sb. [Russia in figures. 2016: brief statistics digest]. Rosstat. Moscow, 2016. 543 p.

related to the transition from financing of investment in fixed capital from the state budget towards investment mainly through own funds. The structure of GDP has also undergone fundamental changes: the share of accumulated gross investments in GDP decreased from 38.7% in 1990 to 19.5% by the beginning of 2015 in the sum of disposition, which corresponds to the level of the 1960–1970-s. Although GDP growth observed in Russia in the period between the crises of 1998 and 2009 achieved mainly due to the favorable external economic environment and improving utilization and use of pre-existing productive facilities increased the rate of gross fixed capital formation in GDP from 14.9% in 1998 to 18.9% in 2009, this value was lower than in the G–7 countries actively implementing industrial and technological modernization [14, pp. 42–43].

The current values of the indicator under review, especially given the strong depreciation of fixed assets, are clearly insufficient to overcome the autonomous recession and perform re-industrialization. It is worth recalling that advanced countries which restructured their economies had for a long time maintained a high level of investment in fixed capital. For example, in post-war Japan, it reached 30%; in China in 2010 – 47.7%; in India – 35.7%; in Vietnam – 37.9% of GDP¹.

¹ Rossiya i strany mira. 2013: stat. sb. [Russia and world countries.2016: statistics book]. Rosstat. Moscow, 2013. P. 86.

While maintaining a low share of gross fixed capital formation, there is no chance of bridging the economic and technological gap of Russia with developed and new industrialized countries. Long-term under-investment in the Russian economy has a negative impact on the condition of facilities and resources of Russia’s national economy and determines the need to intensify investment activity to replace fixed assets (*Tab. 1*).

Developed economies annually update 12.5% of fixed assets in use [7, p. 43], while in Russia this share is only 3.9%, which is clearly insufficient to overcome the upward trend of fixed assets depreciation observed over a long period. The average value of this indicator (at year end) increased from 39.3% in 2000 to 50.5% in 2015² and reached its critical value of this indicator of investment security.

Based on the economic challenge of neo-industrial transformation of productive forces of known investment security indicators, the values of FA disposal rate at 1.1 and 0.8 resulting from the current state of depreciation fund do not contribute to the replacement of deteriorated machinery and equipment, innovative workplace modernization and increase in labor productivity.

At these values of FA disposal rate it becomes impossible to reduce the average age

² Rossiya i strany mira. 2013: stat. sb. [Russia and world countries.2016: statistics book]. Rosstat. Moscow, 2013. 543 p.

of equipment. Although official Russian statistics somehow record it, the average age of fixed production assets exceeds 13 years³.

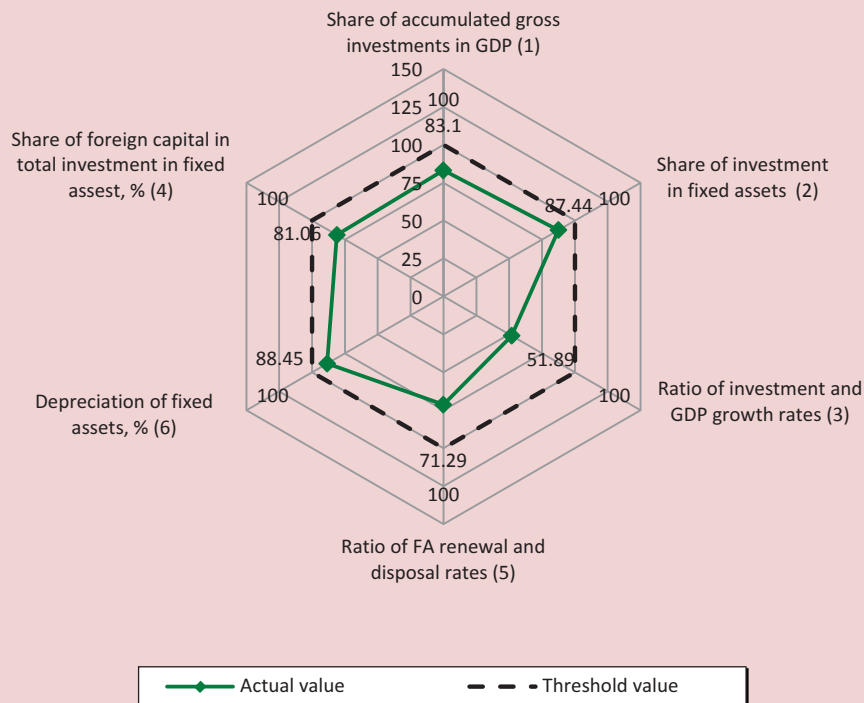
However, it is known that limiting the useful life of equipment by 8–10 years is due to the increasing costs of its maintenance, which is accompanied by declining profitability and competitiveness of products, falling demand [8, p. 12].

Thus, the long-standing problem of investment accumulation to replace deteriorated fixed capital assets, which emerged amid the commodity export model of the national economy determines the need to operate excess deteriorated equipment and, ultimately, confirms the validity of the conclusion about the contradiction between the

existing human potential and renewable fixed assets in the Russian economy.

The need to revitalize and intensify investment activity in the Russian economy to improve its condition and overcome autonomous recession is also confirmed by the results of our indicative analysis of investment security. To visualize the results we used a radar chart containing standardized indicators of Russia’s investment security in 2015 (Fig. 4). Indicators such as “FA renewal and disposal rates”, “Ratio of investment and GDP growth rates” are of greatest concern, which confirms the conclusion about low ability of the Russian economy to de-industrialize productive forces under the current development model.

Figure 4. Assessment of severity of the crisis in investment in Russia (authors’ calculations)



³ Investitsii v Rossii. 2015: stat. sb. [Investment in Russia. 2015: statistics digest]. Rosstat. Moscow, 2015. 190 p.

Thus, the current situation in investment in Russia does not promote the development of facilities and resources and human potential, has restraining influence on the performance and intensity of innovation processes in the economy of the country and its regions, and consequently, on the innovative content of investment. In this context we consider it necessary to dwell on the results of our analysis of the regional innovation system performance in the Republic of Mordovia, a recognized leader in improving the position in the ranking of innovative development among Russian regions in 2008–2015 [16].

Such characteristic of the region is not accidental. According to official statistics, during 2012–2016, industrial output in the Republic of Mordovia rose 1.2 times; 93.0% of industrial products in the region is produced in newly established companies or companies upgraded over the past 10 years. The share of innovative products in total industrial output in the Republic of Mordovia amounted to 28.3% in 2016. The region has created a modern innovation infrastructure.

However, this positive image is presented in a slightly different way if we analyze the performance of the regional innovation system reflecting, among other things, the investment and innovation activity from the position of the above indicators of economic security.

The methodological framework of such analysis is represented by a macro-model of the innovation system (MMIS) [22] consisting of four functional blocks of indicators (financial and economic, scientific and innovational, informational and communication, and educational). The information framework for the research includes data from the Federal

State Statistics Service of Russia. Based on official statistics, we determine the values of MMIS; minimum (x_{min}) and maximum (x_{max}) values of each indicator. According to the formula of linear scaling, the dimensionless x_i -th index is calculated [3, pp. 21–22]:

$$x_i = \frac{x_i - x_{min_i}}{x_{max_i} - x_{min_i}} . \tag{1}$$

Under this definition the resulting relative indices x_i are always in the interval from 0 to 1. The average range of indicators is determined by $x_i = 0.5$. The higher the excess of x_i over the average value, the more developed are the innovation processes in the region, and, conversely, when $x_i < 0$ the performance of innovation processes is not satisfactory.

The dimensionless and identical scale of measurement of relative indicators x_i helps aggregate them. The resulting discounted indicator (index) characterizing the efficiency of MMIS indicators within each of the four blocks can be determined using the arithmetic mean.

The efficiency of the innovation system of the region as a whole can be evaluated based on the region’s Knowledge Economy Index (*KEI*) which can be calculated as the arithmetic mean of indices of MMIS functional blocks:

$$Y_i = \frac{\sum_i^4 x_i}{4} . \tag{2}$$

Based on the presented methodology we calculated *KEI* for the Republic of Mordovia, the value of which in 2015 amounted to 0.322 against 0.329 in 2011 under the influence of autonomous recession in the Russian economy. *Table 2* indicates that a significant share of indicators characterizing the level of

Table 2. Effectiveness of the innovation system in the Republic of Mordovia in 2011–2015

Indicators	KEI		KEI rank	
	2011	2015	2011	2015
1. Indicators of the financial and economic block				
GRP per capita	0.080	0.070	60	66
ROI of sold goods from manufacturing industries	0.436	0.538	69	60
ROI of sold goods from electricity, gas and water supply sector	0.699	0.800	50	46
Ration of shipped goods from mining and manufacturing sectors	0.335	0.758	5	2
Labor productivity	0.024	0.036	69	69
Consumer economic security	0.239	0.326	12	17
Purchasing power of legal entities	0.298	0.315	61	54
Labor resource management efficiency	0.500	0.688	70	69
2. Indicators of the scientific and innovational block				
Academic qualifications of researchers	0.123	0.129	71	67
Share of domestic operating equipment costs	0.577	0.028	4	69
Quality of inventive activity	0.491	0.624	5	27
Efficiency of researchers' inventive activity	0.146	0.117	21	31
Efficiency of research institutions	0.018	0.025	38	47
Innovation activity of research institutions	0.354	0.645	19	9
ROI of innovation technology	0.061	0.487	47	7
Cost effectiveness of innovation technology	0.127	0.155	9	16
3. Indicators of the informational and communication block				
Number of PCs per 100 employees	0.244	0.156	49	64
Costs of ICT per capita	0.076	0.011	57	77
Share of institutions using PCs	0.365	0.531	77	67
Share of institutions using specialized software for scientific research	0.098	0.036	62	74
Share of institutions using specialized software for management of automated production or hardware	0.379	0.259	59	56
Share of institutions using specialized software for meeting administrative or economic goals	0.098	0.540	62	11
4. Indicators of the educational block				
Increase in the level of education	0.509	0.631	35	25
Ratio of the total number of specialists with primary and secondary vocational education and specialists with higher education	0.302	0.159	37	49
Number of specialists who graduated from higher educational institutions	0.425	0.033	33	48
Share of students in educational institutions per 10,000 people	0.514	0.532	20	14

innovation system development in the Republic of Mordovia is below the maximum critical value (0.5) (average value between maximum and minimum values for Russian regions).

The most problematic are indicators of the 1st (economic and financial) block “GRP per capita” and “labor productivity”. Low values of the indicator “expenditures on ICT per capita” ultimately resulted in corresponding values of indicators “use of PCs in organizations” and “use of specialized software for meeting administrative, management and other economic goals”.

In addition, the clustering of constituent entities of the Russian Federation (based on the method of *k*-means) by the criterion “KEI value” established: first, there is a significant gap between federal cities and the rest of constituent entities; second, low innovation activity in most regions in 2011–2015 remains (Tab. 3).

According to the results of clustering, the Republic of Mordovia was included in the third

cluster, the largest group by number (37) of regions. The distinctive feature of this cluster is low productivity of region’s member entities; relatively low levels of consumer economic security and academic qualifications of researchers with a high share of domestic operating equipment costs and efficiency of researchers’ inventive activity.

4. Suggestions

With regard to the current situation in Russia, it is impossible to overcome autonomous recession in the country, prevent the degradation of facilities and resources and low efficiency of the national innovation system without radical transformation of the state investment policy and stimulation of investment activity of economic entities. The central element of the investment policy should be the establishment of modernized industrial production in all vital economic sectors and areas. Simultaneously, strategic objective of the country’s development as a scientific, technological, and socio-economic

Table 3. Clustering of constituent entities of the Russian Federation by KEI (based on k-means), 2014

Cluster no.	RF constituent entities
K1 (KEI=0.502)	Moscow, Saint Petersburg, Irkutsk Oblast, Tomsk Oblast, Khabarovsk Krai, Magadan Oblast
K2 (KEI=0.342)	Moscow Oblast, Republic of Karelia, Komi Republic, Arkhangelsk Oblast, Leningrad Oblast, Murmansk Oblast, Krasnodar Krai, Republic of Tatarstan, Perm Krai, Orenburg Oblast, Sverdlovsk Oblast, Tyumen Oblast, Republic of Altai, Republic of Khakassia, Krasnoyarsk Krai, Kemerovo Oblast, Republic of Sakha (Yakutia), Kamchatka Krai, Sakhalin Oblast, Chukotka Autonomous Okrug
K3 (KEI=0.320)	Belgorod Oblast, Bryansk Oblast, Vladimir Oblast, Voronezh Oblast, Ivanovo Oblast, Kaluga Oblast, Kostroma Oblast, Kursk Oblast, Lipetsk Oblast, Oryol Oblast, Omsk Oblast, Ryazan Oblast, Smolensk Oblast, Tver Oblast, Tula Oblast, Yaroslavl Oblast, Vologda Oblast, Kaliningrad Oblast, Novgorod Oblast, Pskov Oblast, Rostov Oblast, Republic of Dagestan, Kabardino-Balkaria, Stavropol Krai, Republic of Bashkortostan, Mari El Republic, <i>Republic of Mordovia</i> , Udmurt republic, Kirov Oblast, Nizhny Novgorod Oblast, Penza Oblast, Samara Oblast, Saratov Oblast, Ulyanovsk Oblast, Kurgan Oblast, Chelyabinsk Oblast
K4 (KEI=0.285)	Tambov Oblast, Republic of Adygea, Republic of Kalmykia, Astrakhan Oblast, Volgograd Oblast, Karachay-Cherkess Republic, Republic of North Ossetia-Alania, Republic of Buryatia, Republic of Tyva, Altai Krai, Novosibirsk Oblast, Primorsky Krai, Amur Oblast, Jewish Autonomous Oblast
K5 (KEI=0.251)	Republic of Ingushetia, Chechen Republic, Zabaykalsky Krai

leader should be achieved. To achieve this goal, it is necessary to meet the following basic conditions:

1. Dynamic and large-scale improvement of a comprehensive indicator of the economic and investment security such as the share of accumulated gross investments in GDP. As noted above, this is due to the current predominance of capital-intensive (energy) industries in the country's economy, on the one hand, and the development prospects of knowledge-intensive industries (including machine building) and implementation of nano-technology, on the other hand. Amid rising capital intensity of production it seems feasible to increase the share of capital formation in GDP spent on investment from the current 20.3% to 28–30%, channeling them through the Russian Development Bank for target investment in innovation and venture business lending [21, p. 162].

To increase the share of capital formation in GDP it is also necessary to establish a reliable mechanism of transformation of funds accumulated by the population into investment by guaranteeing full return of deposits in case of any defaults, and charges higher interest when investing in securities crediting investment projects of Russia's real sector development.

2. Creation of a favorable macro-environment for radical transformation of the investment policy of Russian enterprises towards the recovery of fixed assets in use and conduct R&D in breakthrough technology in increasing technical and technological production levels. This primarily involves optimizing and reducing the tax burden on commodity producers. For Russian enterprises producing tangible products and goods, the real

tax burden is 40% against 25–30%, for example, in the US, Canada, Switzerland, Japan, which constrains investment activity in the country. The income tax rate is 20%. However, in foreign countries, income tax rate is differentiated and depends on the corporation's income. In the US, there is no VAT for business (in Russia it comprises 18%) and no property tax (in Russia – 2.2%), purchased equipment worth up to 2 million dollars a year is written off as costs; social contributions amount to 13.3% (in Russia – 30%) [23].

Special attention in this context should be given to the depreciation policy (use of amortization for the purpose intended – renovation and development). The increasing physical deterioration of equipment and technology, the exhaustion of the depreciation fund, compensated for by virtual renewal of fixed assets – through accounting procedures for their revaluation, rather than physical, – lead to the reduction in working capital and their forced replacement by costly borrowed resources, causing artificial investment hunger.

An important condition to resist devastating inflation and restore the reproduction process would be the now missing medium- and long-term credit line of business investment demand at moderate rates, following the well-known macro-financial ratio of economic profitability, interest rates and inflation.

3. Increased use of venture capital performing the function of a special investment resource in social reproduction aimed at strengthening the scientific, technical and innovation activities.

4. The stimulation of investment and innovation activity of existing and newly established state-owned corporations in order

for prior HTC development as a key source of innovative technical and technological resources in investment activities. It should be noted that Russia's current HTC requires not just update of its technological framework: it requires building a permanently updated interaction of its production sector with fundamental and applied science [12].

5. Establishment of a system of investment risk insurance. We are talking about risks which inevitably emerging in investment in economic activities in the process of capitalization and financial deleveraging caused by the necessity of capital accumulation and reproduction.

6. The creation of an industrial loan fund in the form of a state extra-budgetary fund to ensure the state order in priority sectors of the manufacturing industry. Such a fund should be created both at the federal level and in the form of territorial divisions; it should operate on the principles of subordination and coordination, transparency, control and target use of funds.

The sources of this fund could be: natural resource rent, country's international reserves, temporarily surplus funds from extra-budgetary funds and state corporations, loans from

Bank of Russia, investment resources of Vnesheconombank, Sberbank of Russia, Vneshtorgbank, etc.

5. Conclusion

Summarizing the abovementioned, we consider it necessary to note that the increment of scientific knowledge of the study is the following:

1) theoretical substantiation of the scientific idea about the need of studying the nature of investment as one of the key categories of hereditary core of the economic paradigm (industrial, post-industrial, neo-industrial);

2) theoretical justification of criteria of innovative content of investment taking into account the goals, objectives and driving forces of the neo-industrial paradigm of modern socio-economic development, as well as their achievement;

3) assessment of performance and intensity of innovation processes in the economy of the Republic of Mordovia (leader in improving the position in the ranking of innovative development among Russian regions) based on the author's technique of monitoring the efficiency of the regional innovation system.

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Co-Production Between the Provider and the Recipient, as a Method of Increasing the Performance in Educational Services



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Abstract. The paper proposes the shaping of the concept of co-production in services and specifically refers to the educational process, respectively the cooperation between the supplier and the beneficiary of educational services. A “teacher-student” partnership is considered because we want to capture the system made up of the educational services provider and the active subject of educational training. The “teacher-parent” partnership isn’t the subject of our research because we believe it may be a separate subject of research that transcends our current interest. After defining and clarifying the concept of co-production, an analysis is applied to a number of 500 respondents in education by giving concretely a questionnaire such as to provide adequate information for our purposes. The importance of the research undertaken resides in the conceptualization of the co-production between the offerer and the beneficiary in light of the elements through which it is reflected and in establishing connections between the availability of the beneficiaries to coproduce and certain elements taken into consideration such as the belief there will be some future advantages. Co-production is also one of the ways through which the European Union objective regarding the school dropout under 10% until 2020, can be reached. The results of the data analysis indicates the fact that the consumers of educational services take part in the co-production with the offerer as long as the working environment is a positive one, the communication teacher-student is at a significant level and there is the certainty of correlation with a satisfactory professional future. Conclusions reveals interesting facts, allowing both knowledge of the elements related

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to the co-production, and reassessment of resource management at stake. The beauty of the phrase “co-production in education” is confident that after the supplier and the beneficiary’s resources were put and used together, then results the product: the knowledge.

Key words: co-production, cooperation, performance, mutual adaptation.

1. Introduction and research objectives

The meaning of the concept of co-production has gained different nuances from what it represented a few decades ago. They come primarily from the different way in which it is perceived, at present, the ratio between producer and consumer, in both the goods and services sector.

In the present study we wish to assess the existing connection from co-production between the provider of educational services – teacher – and the recipient of educational services – student, on the one hand, and the individual and organizational performance, on the other. For this, the performance is taken in the meaning in which is highlighted by Annick Bourguignon: “Performance is achieving the organizational objectives” [8]. We will use the term “performance” at the same time with that of effectiveness, that includes, with more accuracy, the meaning of achieving the objectives proposed.

A “teacher-student” partnership is considered because we want to capture the system made up of the educational services provider and the active subject of educational training. Moreover, an educational system that puts the pupil first, with his needs and desires, is targeted. Of course, the family has an important role in education, but this research is centered on students and teachers as the main actors in the system, motivated and rewarded by individual progress, but also as members of society.

We will use the concept of co-production with the meaning of active, constructive participation, of teachers and students, in the work of transmitting, receiving, deepening, consolidating and putting into practice the educational services.

The essence of knowledge is transmitted when it returns in the economy as professionals in the areas for which they have specialized [4]. The study indicates that the recipients of knowledge – students – influence to a large extent the quality of the product, i.e. of education. To develop a strategy in order to increase the efficiency of education is a challenge, but what we are trying to achieve is to assess the co-production between teachers and students from the perspective of the elements through which is reflected and of the changes that which each of these components can induce to the educational activity.

We also have in view the essential difference between immediate, medium and long-term results, respectively between *output*, *outcome* and *impact*. Educational output is reflected in the immediate results and we have in view the prizes, students’ participation in olympics and other school competitions. The *outcome* is to be found in the number of high school graduates who attend a college, as well as in the small/large number of students choosing a particular educational institution or later, in the number of graduates employed in job positions for which they have specialized. Third indicator, namely the *impact*, is that

in which are to be found the investments in human capital calculated on the basis of lifetime earnings and of the educational level of the population (e.g., a system of values to which they refer).

In the educational sector, performance perceived in terms of outcome or impact can be considered more important than the performance perceived as output, having serious consequences highlighted in the economic calculations. In this paper we aim to observe the influence that co-production between the provider and the beneficiary has on achieving performance.

The special nature of our approach consists in (1) detailing of the elements through which co-production is reflected and (2) the nuance that delimits the meanings of the two terms: *cooperation* in education and, more specific, *co-production* in the educational process. This stage of research is limited to studying coproduction from the perspective of the beneficiaries of educational services, the students. A future research is taken into consideration, about questioning educational service providers. For this reason it is important the highlighting of the strengths and limits of the research as an additional objective.

The article is structured as follows: components by which co-production is reflected are described in Section 2. Sections 3 and 4 analyze the data sources and applied methodology, with the descriptive analysis of the questions of interest. The analysis and verification of the hypotheses are done in Section 5. Section 6 includes the strengths and limits of the research, and Section 7 the conclusions and future papers.

2. Components by which co-production is reflected

In the case of educational services, their peculiarity of not always having a commercial character does not also mean an essential differentiation from other services. Beneficiaries come with certain expectations, while the providers have, from the beginning, clearly defined objectives, transformed in terms of performance of students. Performance, as we said, can be interpreted in terms of achieving short, medium and long-term goals. The achievement of common objectives depends, to the greatest extent possible, on the physical and spiritual presence of beneficiaries, their contribution to the progress, in the best possible conditions, of each of the stages. From the case study which we will present below it can be seen that respondents understand “working together” as being one of the tasks specific to co-operation (“working together” taken not in the meaning of “working side by side”, but in the meaning of communication, mutual support, share of knowledge in order to achieve the planned educational objectives).

Co-production requires **cooperation**; but, as compared to co-operation, which is a way of action, co-production is by itself a *process*, which follows certain specific stages (as a “production” process, but, in our case, with elements specific to learning/education), a process which must be reflected, after it was carried out, turned into a *plus of usefulness*. This result, the newly created extra value consists, in the case of education, in training (additional, as compared to the previous states of every moment in the process, or formative stage, in part), is represented by the education level (superior to the starting level): this is the stake

of the teaching services and of all processes relating to the education system.

Co-involvement of the beneficiary of educational services in the activity of teaching – learning – evaluation depends, to a high level, on the importance that he gives to the education institution, generally, and to the educational discipline, particularly. Although specific by the peculiarity about which we made a reference above, educational services operate with market relations, speaking ultimately, still about supply and demand. It is a sort of educational marketing, in which the provider of education promotes and sells its “product”. Co-involvement of the provider and beneficiary is based on a binary relationship in which the availability of collaboration is applied to a first level, such as an initial investment of attention, time and other resources of the two parties.

Co-planning refers to the participation of providers and beneficiaries in the development of study topics, to the programming of activities and even to the teaching methods to be used. It is important for the beneficiaries of educational services, that their responsibilities to be clearly identified. Co-planning strengthens the trust between providers and beneficiaries, creating an environment favorable to professional communication. Planning together, the needs of the beneficiary will be better understood, this being one of the most important aspects in any collaboration. Among other aspects, co-planning must include the development of strategies to deal with unforeseen situations.

Co-management of time admits that the most important external resource must be managed together, by the provider and the beneficiary. And does not relate only to the time spent in hours, but also to the individual

time, but which was, previously, organized together. Considering the sharing of time [9], which is an individual resource, means an efficient operation. Co-management of time involves a succession of processes which are parts to a whole: organization, naming of priorities, the delegation.

Co-learning (intellectual co-training) depends, to the greatest extent possible, on the teacher’s ability and the student’s favorable disposition to listen and to collaborate. It is about a form of mutual adaptation, in which the provider and the beneficiary of education base their actions, on the joint consideration of problems. Co-learning means changes of behavior determined by communication and by assimilating the essence of new issues, but also mutual changes of expectations and of actions of each of the parties. Co-learning is the stage which depends to the greatest extent on the teacher’s ability to deliver educational services, but the student’s ability and willingness to listen to him and to participate actively in the learning process should not be ignored. Co-learning is a form of intellectual co-training through which knowledge and skills are actively and methodically transmitted through the systematic participation of the provider and of the beneficiary in the work of achieving performance.

Co-evaluation is a central activity of the learning process, providing the necessary information for self-adjustment and for making future decisions. Co-evaluation means:

- The evaluation of students by teachers;
- Self-evaluation, a process of self-appreciation by which the student learns to become self-aware, having many implications at motivational level;

- Mutual evaluation of students;
- The evaluation of teachers by students.

Co-evaluation is considered one of the evaluation methods with wide training purposes, allowing the product's evaluation, but also that of the process, from the inside, in which the recipient of educational services shall exercise his role as a participant in his own training.

Mutual adaptation is a phrase taken from Whitaker's *mutual adjustment*, which in 1980 defined co-production under three dimensions: assistance, cooperation and mutual adjustment [1]. Adapted to the educational sector, mutual adjustment occurs through cooperation and mutual change of expectations, states and actions of the parties. Is a form of adaptation, a mobilization, a permanent effort made by the provider and by the beneficiary in an attempt to fill the gaps and to achieve balance in the complex process of teaching – learning – evaluation. In education, more than in other sectors, mutual adjustment is felt at high levels

because the “product” that results after the production process and of co-production is the knowledge, involving theoretical concepts, but also conduct, behavior, attitude.

3. Data sources and evaluation methods

For the analysis that we show here, it was important to note to what extent the co-production between the provider and receiver is one of the causes of activity's effectiveness and of the subsequent performance at the level of the two actors. The case study on education has a special note by the fact that is a public service, for which the recipient does not pay directly (especially as we approached the pre-university education). It produces a few major consequences, as well as the perception of gratuitousness as an obligation or as a favors.

The research starts from a set of hypotheses which are designed to achieve a direct connection between co-production from the provider and the recipient of educational services, on the one hand, and the effectiveness

Table 1. Study sample

No.	Education unit	Locality	County
1.	Theoretical High School “J.L. Calderon”	Timișoara	Timiș
2.	Technical College “Emanuil Ungureanu”	Timișoara	Timiș
3.	Technical College “I.C. Bratianu”	Timișoara	Timiș
4.	National College “Coriolan Brediceanu”	Lugoj	Timiș
5.	National College “Iulia Hasdeu”	Lugoj	Timiș
6.	Technical College “Valeriu Braniște”	Lugoj	Timiș
7.	Theoretical High School “Traian Vuia”	Făget	Timiș
8.	Theoretical High School Recaș	Recaș	Timiș
9.	National College “Traian Doda”	Caransebeș	Caraș-Severin
10.	Greek-Catholic Theological School “Timothy Cipariu”	Bucharest	Ilfov
11.	Technological Highschool Dorna Candrenilor	Dorna Candrenilor	Suceava

of the two actors in the educational process. In order to achieve the intended purpose, we have conducted a survey based on a questionnaire, addressing to a number of 501 students in the 12th grade from different areas of the country. We have taken into account some features of the co-production term between producer and consumer, used in particular in the goods sector, but which match to our study and among these we have found the need for participation (otherwise, specific to services, in general), the mutual use of assets, *a meeting of minds who come together to find a common solution* [15].

The importance of this research is given by the fact that each recipient of educational services can provide essential information about the factors that make up the stages of co-production. Thus, from the questionnaire are obtained information on how co-involvement, co-planning, co-management of time, co-learning, co-evaluation and mutual adaptation are perceived and how the connection between education and performance can be anticipated. The questionnaire applied consists of 33 questions, of which, questions with ranked answers, open questions and closed questions, including also identification questions.

In order to avoid creating confusion, the term “co-production” has been used only once, in question Q1, because it is less commonly used in the current language, its meaning being outlined by the way in which the other questions were formulated.

The research methodology has provided for the conduct of questionnaires, which necessitated the construction of a representative sample: the sample of students. Persons to

whom the questionnaire is addressed are 501 students aged between 17–19 years. The decision to involve, exclusively, students from the last year of high school has been taken into account the fact that they have the level of maturity, age, cognitive abilities and accumulated knowledge necessary to capture the connections of interest as accurately as possible. The assimilation of knowledge and the shaping of abilities and skills to the students in the last year of high school enable them to have a systematic and objective vision on the questionnaire’s theme.

The research starts from the common vision on education, in the meaning that it takes into account, through hypotheses, an usual meaning on the progress of the educational process (especially at pre-university level). Namely, we have decided to check the following hypotheses:

H1: Cooperation between the provider and recipient of the educational services is a prerequisite for a good co-production of the values specific to education (educational).

H2: The commitment of the beneficiary of educational services in the co-production with the provider is positively related with the conviction in the professional success.

H3: The higher the level of co-production between the provider and the recipient of educational services, the greater is the satisfaction perceived emotionally.

H4: The decision to co-produce together with the provider of educational services varies among recipients, depending on their geographical area of origin.

H5: The decision to co-produce together with the provider of educational services varies among recipients, depending on gender.

The software used to analyze the data obtained was a specialized tool for analyzing quantitative data: SPSS. The motivation for choosing this software was that SPSS is adapted to analyze the data we obtained as a result of our field research. In a concrete way, for the statistical analysis we used operations of the type: the numerical and percentage statistical interpretation, the statistical mean interpretation, the analysis of frequencies and the analysis of the correlations between the variables.

4. Descriptive analysis of the questions of interest in the questionnaire – questions addressed to students

Some answers to the questions in the questionnaire are worthy of consideration.

For example, with regard to what performance means in school, the highest proportion of students considers that performance in school means the effectiveness of teachers, followed by the results obtained subsequently by students, in the future, at college and at the

workplace (*Fig. 1*). Educational management should take this into consideration when proposing its axiological foundations.

Question Q3 is an open question, of the word association type. Most of respondents have associated the teacher-student cooperation with mutual understanding (52.9%), followed by communication (30.5%) and achieving performance (9%) (*Fig. 2*).

Regarding the enhancement of school performance, the most motivating thought is, according to the answers received, that in the future will be obtained a better place of work, followed by obtaining good marks and the idea of going to college. The last places, as regards motivation, are the participation in school competitions and the competition with colleagues.

Question Q6 refers to the first three things suggested by the enhancement of school performance. As seen in the illustration below, 46.91% of respondents associate the enhancement of school performance with

Figure 1. Views of the beneficiaries of educational services with regard to what performance means in school

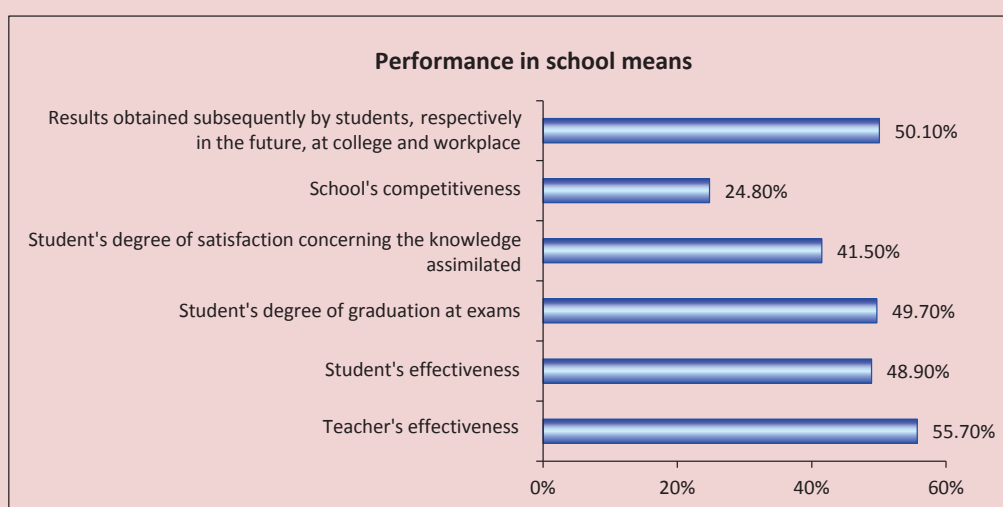


Figure 2. If you are considering the teacher-student cooperation, which are the first three things that come to your mind

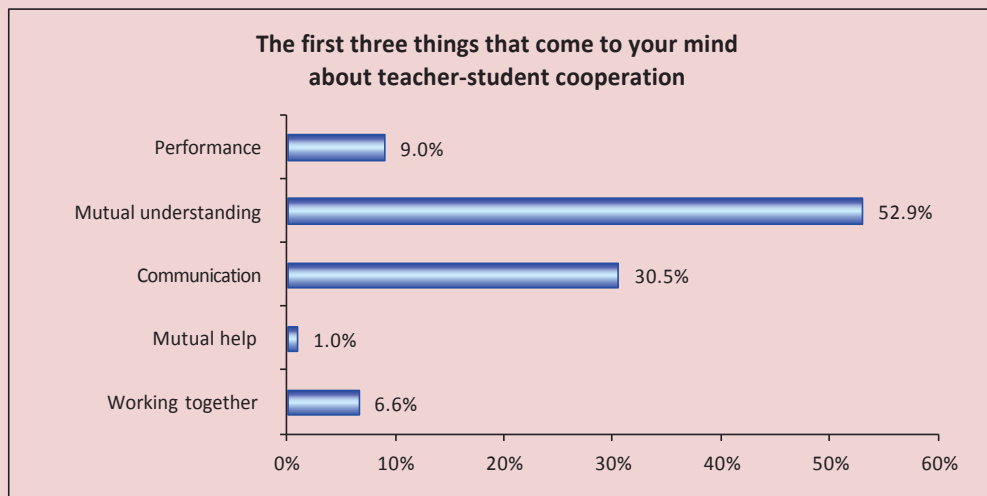
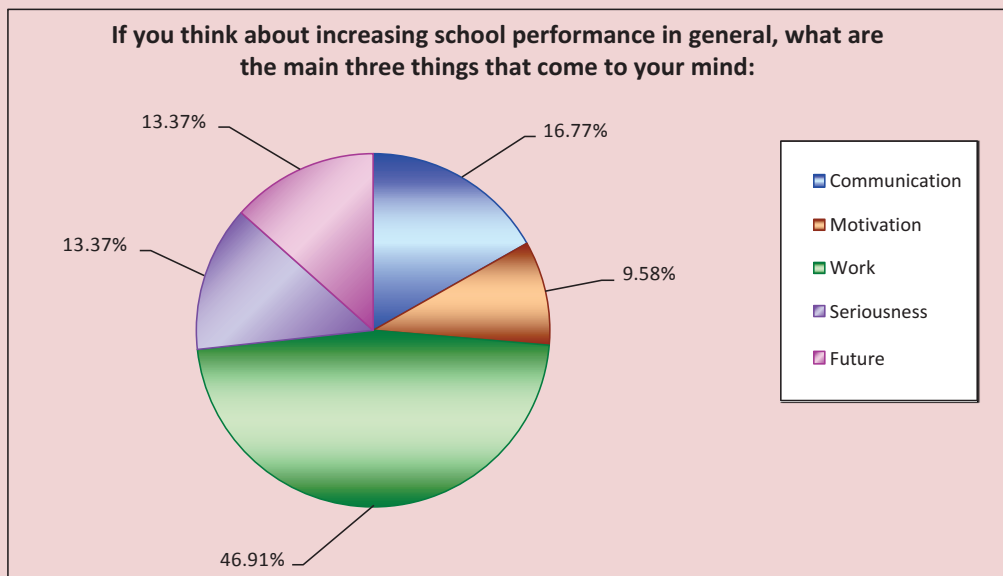


Figure 3. Notions with which the enhancement of school performance is associated



work, then, at a fairly large distance, with the communication between provider and beneficiary, and thirdly, on equal footing (13.37%) are the seriousness and the future. (Fig. 3).

The results provide information on motivation, clarity of information and the principle of reciprocity as the determinants

of co-production. Communication and mutual understanding are fundamental, reflecting the clarity of information. The principle of reciprocity outlines the double meaning of each stage of the co-production phenomenon, whether it is about involvement, time management, learning or evaluation.

5. The analysis and verification of hypotheses

We conducted an internal consistency and reliability analysis for all involved scales. After eliminating the variables with low loadings (< 0.5) on their respective factor, we let all the scales with an acceptable level of alpha Cronbach (>0.6) [11].

The operationalization of co-production by the six conceptual components mentioned (co-involvement, co-planning, co-management of time, co-learning, co-assessment and reciprocal adjustment) enables the specification of observable behaviors. The issues raised concretely in our study on samples were: “What is coproduction in education?”, “How is coproduction perceived?”, “To what extent and how does the behavior of the beneficiary of educational services change over time under the influence of the interaction with the offerer?”

A Pearson’s correlation was run to determine the relationship between the variables (Tab. 2). The first four hypothesis were found to be valid, with Sig 2 tailed level of .000, which shows that there is statistically correlation between our variables: cooperation as a prerequisite for co-production, commitment to the co-production and the belief in professional success, co-production and emotionally satisfaction, the decision to co-produce and the geographical area of origin. This means that changes in one variable are correlated with

changes in the second variable. According to the results, there is not a very strong correlation between the variables, but the fact that they influence each other to some extent, confirms the hypotheses from which we started. Thus, cooperation represents, in a percentage of almost 30%, a precursor of co-production between the offerer and the beneficiary of educational services. It is interesting that the level of co-production influences by more than 40%, the satisfaction perceived emotionally, which confirms that each co-production relationship is unique due to the subjective notes that intervene in the equation.

The last hypothesis has a great value of Sig (2 tailed) >0.05 which shows there is no evidence of correlation between the two variables and the hypothesis is not sustained.

H1: Cooperation between the provider and recipient of the educational services is a prerequisite for a good co-production of the values specific to education.

The survey results show that the beneficiaries of educational services perceive cooperation as mutual understanding, communication and performance, issue that leads in time to welfare and a better future. Among the factors which motivate the enhancement of school performances, *professional interaction with teachers improves the learning environment*, is ranked on the first place. Over 90% of the recipients consider that

Table 2 Hypothesis testing results

Hypothesis	Pearson Correlation	Sig (2 tailed)	Result
H1	.266	.000	Sustained
H2	.321	.000	Sustained
H3	.406	.000	Sustained
H4	.303	.001	Sustained
H5	.048	.280	Unsustained

in order to enhance school performances, the teacher-student cooperation is relevant. Under the conditions in which the cooperation between the providers and recipients of educational services influences the attitude toward learning to the latter and their self-esteem, it results that, working together, occurs their axiological adaptation according to the values and knowledge transmitted to them. It is the very achievement of the educational ideal, of shaping of the type of personality that society aspires to. The results of the sample research signal the conditionality of co-production existence by co-operation, thus a strong positive association between co-operation and co-production.

H2: The commitment of the beneficiary of educational services to the co-production with the provider is positively related to the belief in professional success.

Bendapudi and Leone (2003) have demonstrated that, generally, consumers participate in the co-production of value together with the manufacturer of goods and services, when they have to make a choice, partly also because they expect to achieve positive results [5]. We will analyze to what extent the beneficiaries of educational services are determined to get involved in co-production.

The large number of respondents who agree and totally agree with the fact that by co-production in education are used more efficiently the resources of both parties and thus performance increases, is an important indicator. Of the participants, 55% assimilate performance with the effectiveness of teachers, hence the importance that they give to co-involvement and co-learning of the provider and beneficiary of educational services. Also

a high percentage (50.9%) of the recipients considers that performance is reflected in the results obtained subsequently by students, respectively in the future, in college and at the work place, thus in the professional success.

Among the factors that motivate the enhancement of school performances to the recipients of educational services, the thought that they will succeed in getting a better job in the future is ranked on the first place.

The H2 Hypothesis is validated: the results of conducting the questionnaires show that the commitment of the beneficiary of educational services to the co-production with the provider is positively related to the belief in professional success.

H3: The higher the level of co-production between provider and the recipient of educational services, the greater is the satisfaction perceived emotionally.

The level of co-production means the intensity of co-production and the quality level achieved. In question Q9 on the relationship between the performance in school and that from the future workplace, the majority (62.6%) replied that the two factors influence each other in a positive direction. The thought that in the future they will have a better workplace is also an element that constantly motivates the recipients of educational services. Over 90% of the students consider that a high degree of cooperation between the teacher and student increases motivation and the student's degree of satisfaction, which means that the emotional satisfaction is also greater. Therefore, the hypothesis H3 is validated.

H4: The decision to co-produce together with the provider of educational services varies among recipients, depending on their geographical area of origin.

In order to validate the H4 hypothesis, we use the following analysis strategy. We conduct a *crosstabs* type analysis between the opinion on what co-production means in education, if this is a better way of mutual use of resources, on the one hand, and the county to which the respondents belong, on the other hand. The Chi-Square test indicates a value $p = 0.001$, which means a strong relationship between the variables. If only 19.1% of the respondents in the Caraş-Severin County totally agree that co-production means a better way of mutual use of resources, a percentage share of 80.9% agree with the statement Q1. Counties of Timiş and Ilfov are the only ones that have a percentage of respondents who disagree with the question Q1, and 1.4% of the respondents are in total disagreement. But, we notice that the answers “agreement” and “total agreement” between the counties are balanced at this level, both variants being statements, reinsurance acceptances on the question.

Question Q5 – *Students’ performance is influenced by the optimal communication between them and teachers* – indicates a large difference between the counties of Caraş-Severin and Suceava. If 55.3% of the respondents in Caraş-Severin consider that students’ performance is influenced to a great extent by the optimal communication between them and teachers, only 26% of the respondents in Suceava County agree to this. It is also noted that in Suceava County, a fairly high percentage, namely of 22% of respondents believe that students’ performance is only slightly influenced by the optimal communication between them and teachers.

With regard to the relationship between increasing school performance and student-teacher cooperation, the answers are mostly

affirmative; one interesting thing to note is that in Caraş-Severin County the percentage of affirmative answers is 100%. All students consider that in order to increase school performances, the cooperation teacher-student is relevant.

A difference between the counties is observed when asking for the first three things that suggest the teacher-student cooperation:

- Timis County: mutual understanding, communication, working together;
- Caraş-Severin County: communication, mutual understanding, working together;
- Ilfov County: mutual understanding, communication, performance;
- Suceava County: performance, mutual understanding, working together.

The data analyzed show that the area in which the beneficiaries of educational services originate counts for the decision to be involved in co-production. In this case there is the influence of the cultural factor specific to each area, as a way of selecting the values, attitudes and skills that the members of a society share.

H5: The decision to co-produce together with the provider of educational services varies among recipients, depending on gender.

If, according to gender, individuals are more prone to be involved in co-production or not, it is interesting to be established. By comparing the percentage of boys and girls who believe that by co-production is achieved a better mutual use of resources, by the teacher and student, in order to increase performance, we notice that the ratio is, approximately, equal: total agreement – 31.4% boys and 29% girls; agreement – 63.3% boys and 67.6% girls.

With regard to the first thing that it is suggested to them by the idea of teacher-student cooperation, most of the respondents

of both genres indicate mutual understanding, followed by communication. A difference is observed at the third thing suggested by cooperation, male students choosing “working together”, and the girls “performance”.

By analyzing the questions Q2, Q5, Q8, Q22 we have noticed that there is no significant connection between the decision taken by the recipient to co-produce with the educational service provider and gender. The Hypothesis H5 is invalidated.

6. Strengths and limits of the research

A strong point is that the data used come from 11 high schools in various developing regions of the country, providing information based on which can be drafted improved plans to ease the involvement of teachers and students in co-production.

In the research undertaken, the main problem that I have encountered was the reluctance of some school organizations to grant me permission to conduct the questionnaire. Personal movement in certain towns was necessary, noting that people are more open to cooperation when dealing directly with a person.

Another limitation of this study lies in the fact that the sample used consists of students from the 12th grade, thus lowering the degree of generalizing the results for the general population of beneficiaries of educational services. However, this is also a strong point, because the students in the last year of pre-university education are in the best position to provide complete answers to the questions in the questionnaire.

The answers of the interviewed persons have a few limits determined by the influence of certain factors: themes approached by the questionnaire, novelty of certain notions, the

time of the survey. In most cases, the time allotted to complete the questionnaire was one hour for about 25 people, which included the explanation of unknown or ambiguous terms.

An important limitation is given by the fact that the number of respondents was about 25 people at the time of completing the survey questionnaire, and could influence each other in respect of the answers.

We mention that an important aspect was also the omission of using the term “co-production” in the questionnaire (is used only in question Q1) because in the current language is less frequently used and therefore we intended to avoid creating confusion among the respondents; its meaning took shape over time from the way the other questions were formulated.

7. Conclusions and future paper works

The main contribution of this paper is the conceptualization of co-production between the provider and the beneficiary of educational services through the elements indicated (*co-involvement, co-planning, co-management of time, co-learning, co-evaluation and mutual adjustment*), that sets the direction towards an approach to address in stages the training and educational process. Co-production in the education sector is not a one-dimensional concept, our results showing that it consists of the six items listed since the very beginning, as a theoretical basis for this research. By proposing this strategy of staging the phenomenon, it is supported the idea of its complexity, but also of the uniqueness due to the adaptation to individual contexts. According to Vargo and Lusch [20], the consumer is always co-producer. According to our results, co-production is slightly nuanced as compared to the statement quoted, in the meaning that

students (consumers of educational services) *participate in co-production if a few conditions are met*. Namely, the recipients of educational services actually participate in the co-production with the provider to the extent to which the working environment is positive, the teacher-student communication is present at a significant level and they have the certainty of the correlation with a satisfactory professional future; it also shows the importance of the social and cultural environment to which the receivers of educational services belong to.

Although the empirical research has shown various results as regards co-production between the provider and the beneficiary of educational services, it is interesting to note a few ideas arising from the data analysis: we emphasize in particular the conclusion that performance is related, firstly, with the effectiveness of teachers. Educational management should take account of this aspect, when proposing its indicative axiological foundations.

Secondly, the results of the study provide information regarding motivation, the clarity of the information and the principle of reciprocity as determining factors of co-production. A powerful motivation with regard to obtaining, in the future, a valuable place of employment, shows among the beneficiaries of educational services, an important association with co-production. Communication and mutual understanding are fundamental, and reflect in the clarity of

the information. The principle of reciprocity outlines the double meaning of each phase of the co-production phenomenon, whether it is about involvement, management of time, learning or evaluation.

Important implications can therefore have the development at the recipients of educational services, over the years of study, of the conviction that the effort made during the school years will be reflected, by default, in obtaining knowledge, skills and useful abilities for their professional development.

Also, many forms of communication from the teaching and learning activity can be improved, in such a way that the providers of educational services to better meet the needs of their recipients. Teachers are a source of information, expertise and orientation of learning (and of professional guidance in general), and must also be prepared to respond to the requests of recipients.

Last but not least, by increasing, at the recipients of educational services, of the motivation to co-produce, the teaching-learning-evaluation experience becomes a fair activity. By being perceived in this way by the recipients brings a plus of motivation and emotional commitment toward the organization (in this case, a learning institution). Coproduction in educational services could be one of the ways through which the European Union objective regarding the school dropout under 10% until 2020 can be reached.

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Trends and Promising Models Forming Industrial Clusters in the Russian Federation*



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Abstract. The purpose for the research is to develop and substantiate the models forming regional industrial clusters amid modern Russian economy. The article presents performance indicators of economic space clustering in Russian regions, identifies the main stages and prospects for generating of the “fourth wave” of clustering. The study formulates the quantitative approach to identifying regional industrial clusters and their further parameterization in the framework of a comprehensive multi-level clustering model of economic space of the region. In contrast to similar studies, the research focuses on trends in the formation of innovative multi-cluster units which integrate cluster initiatives for the development of high-tech industrial production. The scientific novelty is presented by the model of inter-sector interaction between current regional industrial clusters, as well as the author’s model of perspective development of cluster initiatives amid innovation-driven economy. The article presents results of analyzing the correlation between sectoral specialization of regional economic systems and processes of cluster formation in Russia based on the calculation of localization index of aggregate economic activities and industrial production sectors. The example of clusters such as microelectronics, instrumentation engineering and information technology focuses on the organizational aspects of the formation of regional industrial clusters. Based on the values of the Herfindahl-Hirschman index and concentration ratios, the authors developed scientifically new models of organizational development for clusters such as microelectronics, instrumentation engineering and information technology. The contribution to the Russian cluster

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theory lies in highlighting major trends and patterns of clustering of Russian regions, which revealed that successful cluster initiatives combine a developed innovation-driven core, a substantial industrial framework and a significant number of participants representing small and medium forms of innovation-driven entrepreneurship. There is a promising conclusion for further research about possible synthesis of organizational forms of economic development of clusters and territorial industrial complexes with the aim of realizing the potential of regions with developed territorial industrial complexes and large industrial enterprises. Analysis of industrial and organizational aspects of cluster development in Russian regions has helped conclude that cluster support under government programs remains relevant. The research data will be useful for improving the existing regional socio-economic development strategies and sectoral programs of production clustering.

Key words: industrial clusters, innovation-driven multi-clusters, clustering models, industrial aspects, production localization.

Introduction. In modern Russian conditions the formation and development of regional industrial clusters remains the main area of raising the competitiveness of the national economy. The issues of practical implementation of the cluster concept of regional development are made relevant due to the need for accelerated implementation of the policy of import substitution and expansion of high-tech product output. The best solution to these issues is possible relying on existing clusters and individual large enterprises outside the clusters. A key feature the author's model of innovative multi-cluster is the possibility of synthesis of organizational forms of economic development of regional industrial clusters and territorial-industrial complexes with the aim of minimizing negative impacts and weaknesses of the implementation of the traditional cluster concept.

Research methodology. Economic science has developed a number of conceptual approaches to the implementation of the regional cluster policy. Yet the development of a comprehensive approach for quantitative modeling of key aspects of cluster development remains relevant. Problems of territorial

industrial clusters in the EU countries are monitored by the European Cluster Observatory. In the USA, the main scientific school on issues of cluster policy is represented by Institute for Strategy and Competitiveness at Harvard business school. The scientific schools whose approaches were used in analysis of issues of the clustering processes regulation and innovative development of economic systems in Russian regions include the Russian Cluster Observatory at National Research University Higher School of Economics, M.V. Lomonosov Moscow State University, Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences. Alternative methodological approaches [1, 2, 5, 6, 10, 12, 16] mainly focus on constructing organizational cluster schemes and abstract graphical modeling, or refer to some quantitative aspects of the clusters. These approaches include the basic organizational cluster model by Ö. Sölvell [20], the cluster model by E. Feser based on balance of supply and demand [17], the institutional cluster model by Ch. Ketels and G. Linqvist [18]. Russian economic literature practically does not consider

Table 1. Areas of integration of innovative and industrial clusters into multi-cluster formations amid innovation economy*

Innovation clusters developing breakthrough technology of the following technological order	Clusters of innovation technology and means of production initiating multiplier effects	Clusters of high-tech products mass-producing innovation technology
Clusters of new composite and polymer materials	Clusters of additive technology and digital simulation facilities	Clusters of heavy and medium mechanical engineering
Clusters of sensoric and mechabiotronics	Clusters of robotic technology	Clusters of precision engineering
Clusters of quantum communication and cryptography	Clusters of new communication technology	Clusters of personal security systems
Clusters of new and portable energy sources	Clusters of distributed power generation technology	Clusters of power-efficient light engineering
Clusters of genomics and synthetic biology	Clusters of biopharmaceutics and biomedicine technology	Clusters of personalized medicine
Clusters of nuclear physics research	Clusters of radiation technology	Clusters of nuclear mechanical engineering
Clusters of nanotechnology	Radioelectronic clusters	Clusters of microelectronics and tool engineering
Clusters of photonics	Clusters of laser and fiber optics technology	Clusters of industrial and medical equipment
Clusters neurotechnology	Clusters of virtual and alternate reality technology	Clusters of artificial components of conscious and psyche
Clusters of artificial intelligence and Big Data Clusters artificial intelligence and Big Data	Clusters of block chain systems	Clusters of IT, decentralized financial systems
	Clusters of unmanned sea transport, driverless motor vehicles	Clusters of aerospace technology, shipbuilding clusters, automobile clusters
Innovative environmental clusters	Clusters of environment protection and recovery	Wood industry clusters and clusters of mineral resource management
	Agrotechnological clusters	Clusters of personal food production and delivery
	Clusters of intelligent systems of water supply and disposal	Clusters of drinking water production and treatment

* Compiled from: Areas of implementation of National technology Initiatives (NTI). Available at: <http://asi.ru/nti/>

modern trends of cluster formation with mixed sectoral specialization and territorial clusters associations [7, 8, 15, 19].

The reviewed model of clustering of the economic space of Russian regions is based on the dialectical law of the negation of the negation: the policy of cluster development replaces the previous cluster concept [2] but in practice it uses the established industrial and infrastructure base. This negation of the negation contributes to institutional synthesis which is one of the conceptual foundations of models of formation and development of regional industrial clusters, developing based

on cluster conglomeration. In the framework of the author's concept of development of an integrated model of clustering of the regional economy, industrial clusters are considered as a fundamental segment of innovative multi-clusters whose development is considered as one of the areas of differentiation of development priorities of mixed economic systems in Russian regions. Innovative and industrial formed during the implementation of state programs can be considered as part of the author's model of gradual integration of three cluster levels presented in *Table 1* into the multi-cluster.

Research methodology. The research includes analysis of cluster initiatives implemented in the framework of the following state programs:

- support for clusters included in “List of pilot development programs for innovative territorial clusters” (Ministry of Economic Development of the Russian Federation);
- support for clusters included in the “List of industrial clusters” (Ministry of Industry and Trade of the Russian Federation);
- support for clusters from the Center for Cluster Development in the framework of the Program of Ministry of Economic Development to support small and medium enterprises (Ministry of Economic Development of the Russian Federation).

We also analyzed innovation and industrial clusters included in the register of the Russian Cluster Observatory, National Research University Higher School of Economics [14]. The Index of Production Localization (I_L) is taken as a criterion for specialization of the regional economic system in certain types of economic activities. Given the fact that, in contrast to regional production complexes, clusters are characterized by production localization and its institutional de-concentration, we justify the use of Herfindahl–Hirschman Index (HHI) traditionally used to assess the degree of production monopolization within a particular industry [4, 9]. Special attention in identifying objective prerequisites for the formation of regional industrial clusters is given to economic activity concentration ratio (CR) which is calculated as the sum of market shares of three (for a number of industries – four) major economic agents of the territory.

It should be noted that the use of values of the above indicators is not a sustainable and only approach to managerial decision-making about supporting cluster initiatives at the regional level. The author’s methodology complements the existing approaches to assessing the effectiveness of cluster development; its application requires detailed analysis of characteristics of the socio-economic development of a specific territory. The advantage of using these indicators is the ability to generate a complex of cluster development patterns to select the best strategy for economic clustering for each specific area, as well as differentiate clusters from regional production complexes and quasi-clusters.

Based on data from the Federal State Statistics Service of the Russian Federation for 2014, we calculated the values of localization index by Russian constituent entities. Analysis of the relations between sectoral specialization of regional economic systems and processes of innovation and industrial cluster formation in Russia was carried out for consolidated types of economic activity and industrial production [11, 13]. The choice of consolidated economic activities and industrial production for analyzing the relations between sectoral specialization of regional economic systems and the processes of innovation multi-cluster formation stems from the following reasons. The main reason for this choice is the economic essence of innovation multi-clusters representing economic systems integrating production in related types of economic activity. Moreover, modern Russian conditions are characterized by clusters integrating traditionally unrelated economic activities. The choice of 2014 as the period for calculating the

values of production localization index based on official statistics is based on the following considerations. In 2014–2015, here was the highest number of cluster initiatives for the whole implementation period of the state policy of cluster development in Russia. As of 2014, we can also talk about the beginning of full implementation of projects of the “third wave”

of formation of pilot innovation clusters as relatively new forms of economic development.

Research results. Analysis of successful initiatives in formation of clusters in Russian regions has showed trends in the development of multi-cluster formations in modern Russian conditions. *Figure 1* presents a model of inter-sectoral interaction of operating regional

Table 2. Dynamics of cluster formation in Russia*

Years	Number of established clusters, units	Number of participant organizations in 2016 (units) in clusters created in the relevant period	Number of employees in 2016 (people) in clusters created in the relevant period
1999–2007	1	66	20,838
2008	1	11	2,532
2009	4	125	35,130
2010	7	178	68,955
2011	4	48	33,175
2012	19	970	558,553
2013	11	295	129,407
2014	27	656	231,661
2015	23	599	161,488
2016	4	71	25,925
Total	101	3,019	1,267,664

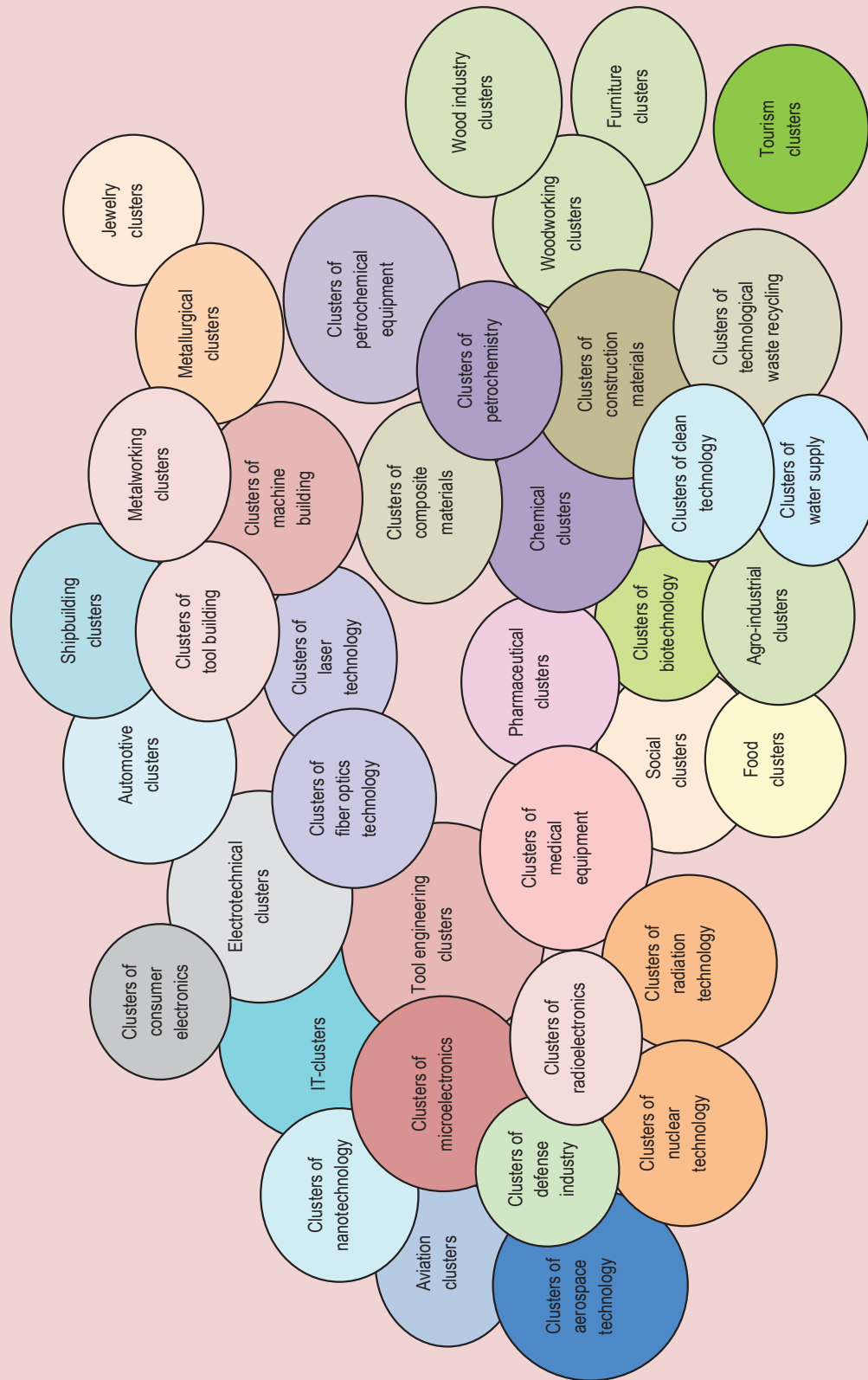
* Compiled from: List of clusters of the Russian Cluster Observatory at National Research University Higher School of Economics. Available at: <http://clusters.monocore.ru/list>

Table 3. Dynamics of the number of Russian regions successfully implementing cluster initiatives*

Years	Number of regions implementing cluster initiatives		
	Total in the given period (units)	Including those implementing for the first time (units)	Total number of regions implementing cluster initiatives since 1999 (units)
1999–2007	1	1	1
2008	1	1	2
2009	4	2	4
2010	5	3	7
2011	4	2	9
2012	16	15	26
2013	10	6	32
2014	17	8	40
2015	16	7	47
2016	4	0	47

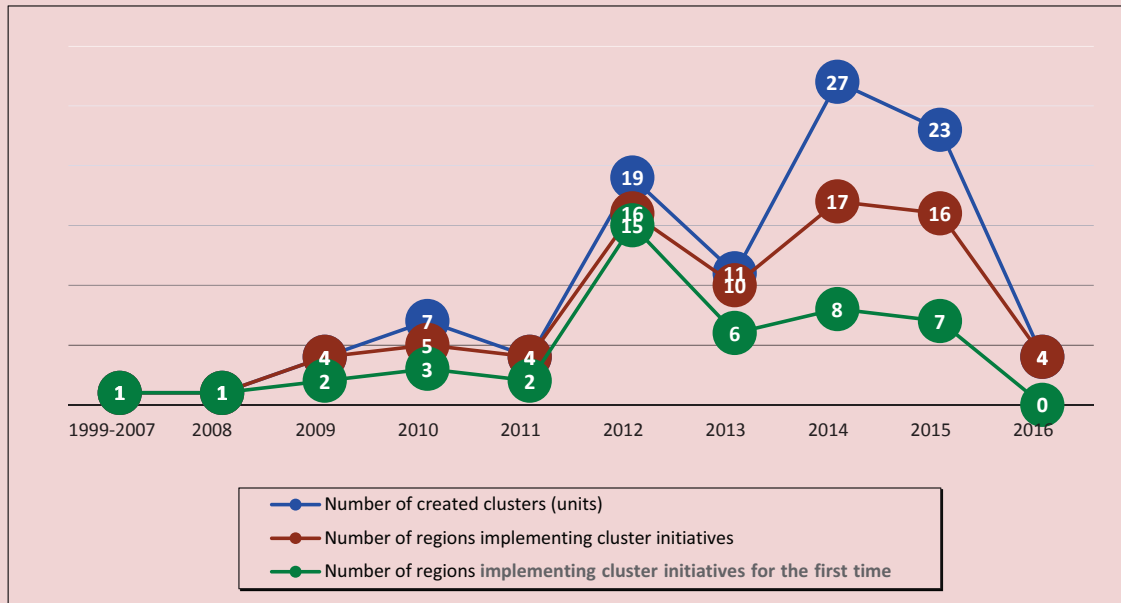
* Compiled from: List of clusters of the Russian Cluster Observatory at National Research University Higher School of Economics. Available at: <http://clusters.monocore.ru/list>

Figure 1 . Model of inter-sectoral interaction of regional industrial clusters



Source: compiled by the author.

Figure 2. Waves of clustering of economy of Russian regions



Source: compiled by the author based on data of Table 2, Table 3.

industrial clusters. Clusters integrating production in related economic activities became widespread; we also identified clusters integrating traditionally unrelated economic activities (Innovation cluster for Information and biopharmaceutical technology in the Novosibirsk Oblast, Innovative territorial cluster “Pharmaceuticals, medical equipment and information technology in the Tomsk Oblast”, Territorial Innovation cluster of aircraft and shipbuilding in Khabarovsk Krai, etc.) [14].

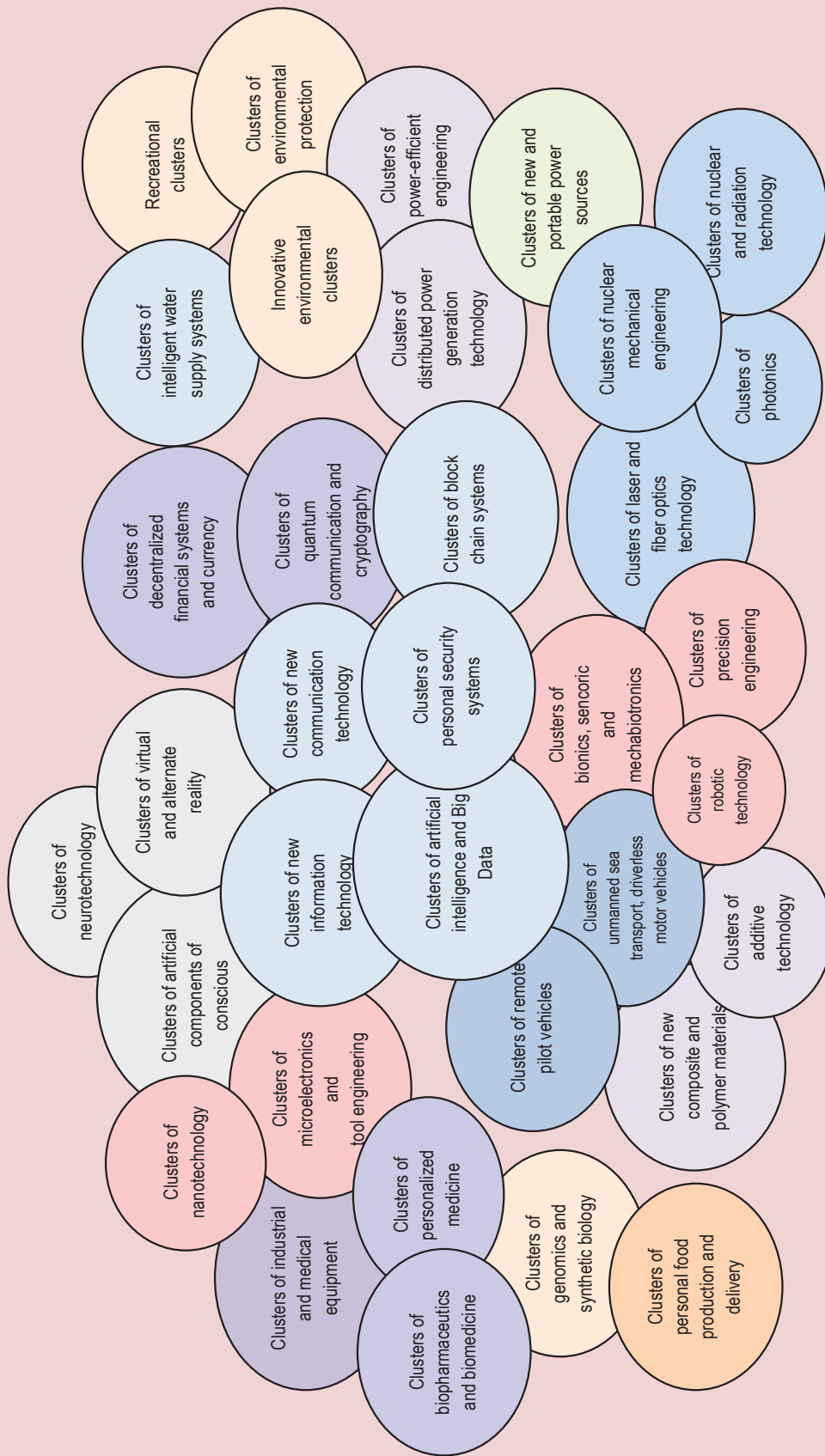
This combination of industries within cluster projects demonstrates the willingness of executive authorities in Russian constituent entities to strengthen potential clusters through multiplier and synergy effects. Dynamics of cluster formation in Russian regions are presented in *Table 2*. *Table 3* demonstrates dynamics of the number of Russian regions effectively implementing cluster initiatives.

Accordingly, there are three “clustering waves” of the economic space of Russian regions: the first is the period from 2009 to 2011, the second – 2011–2013, and the third – 2013–2016. The waves of clustering are presented in *Figure 2* as an overlay of data from tables 2 and 3.

When analyzing the dynamics of the number of Russian regions effectively implementing cluster initiatives the following criteria were used:

- compliance with the requirements established by the government of the Russian Federation No. 779 “On industrial clusters and specialized associations of industrial clusters”, dated 31.07.2015 (the number and composition of cluster participants, industrial output used by other cluster participants; technological and educational infrastructure; labor productivity and the number of highly productive workplaces);

Figure 3. Model of long-term development of cluster initiatives in the framework of innovation economy



Source: developed by the author.

– the procedure for competitive selection of tools of the cluster policy at the level of Russia’s constituent entities in the development of strategies and programs for regional development hinders the optimal use of the potential of innovation infrastructure facilities. Addressing the issues of economic development and modernization of old industrial economic systems in Russian regions makes relevant the objective of practical implementation of the model of prospective development of cluster initiatives presented in *Figure 3* in the framework of the innovation economy.

– assessment of the level of cluster development provided by the Russian Cluster Observatory [14].

Accordingly, the key objective of the research is the development and parameterization of the organizational model of cluster development able to become a factor in the “fourth clustering wave” generation in Russian regions. However, lack of implementation

of tools of the cluster policy at the level of Russia’s constituent entities in the development of strategies and programs for regional development hinders the optimal use of the potential of innovation infrastructure facilities. Addressing the issues of economic development and modernization of old industrial economic systems in Russian regions makes relevant the objective of practical implementation of the model of prospective development of cluster initiatives presented in *Figure 3* in the framework of the innovation economy.

Table 4. Organizational aspects of cluster formation in microelectronics, tool engineering and information technology (2016)*

Cluster	RF constituent entity	HHI	CR ₃	CR ₄
Cluster of radioelectronics in the Voronezh Oblast	Voronezh Oblast	1721	0.61	0.69
Cluster “Voronezh electrical engineering”		1828	0.63	0.75
IT cluster	Perm Krai	2094	0.73	0.82
Innovative territorial cluster of fiber optics technology “Photonics”		1384	0.54	0.70
Zarechenskii cluster of technology integration (CTI)	Penza Oblast	2981	0.78	0.89
Penza tool engineering cluster “Security”		1709	0.63	0.73
Innovation technology cluster “Southern constellation”	Rostov Oblast	2603	0.84	0.90
Innovative territorial cluster of civil marine engineering “Marine systems”		3302	0.89	0.93
The cluster of information and communication technology (ICT cluster) in the Rostov Oblast		1734	0.61	0.77
Innovation territorial cluster “Zelenograd»	Moscow	1064	0.53	0.60
The cluster of high-tech components and systems in the Omsk Oblast	Omsk Oblast	1452	0.58	0.68
Scientific and industrial cluster of tool engineering and electronics on the Oryol Oblast	Oryol Oblast	1666	0.61	0.74
Development of IT, electronics, tool engineering, communications and infotelecommunications	Saint Petersburg	283	0.21	0.25
Power-efficient light engineering and intelligent light control systems	Republic of Mordovia	1637	0.64	0.74
Innovation cluster of information and biopharmaceutical technology in the Novosibirsk Oblast	Novosibirsk Oblast	1034	0.47	0.54
The IT cluster in the Vologda Oblast	Vologda Oblast	1636	0.62	0.70
The IT cluster in the Novgorod Oblast	Novgorod Oblast	6497	0.87	0.88
The IT cluster in the Republic of Tatarstan	Republic of Tatarstan	4103	0.74	0.76

* Compiled from: List of clusters of the Russian Cluster Observatory at National Research University Higher School of Economics. Available at: <http://clusters.monocore.ru/list>

The author identifies two innovative multi-clusters integrating adjacent clusters of microelectronics, tool engineering and information and communication technology within the borders of the region: the Innovative multi-cluster of the Penza Oblast, the Innovative multi-cluster of the Rostov Oblast. It is also necessary to highlight the Innovative cluster of information and biopharmaceutical technology of the Novosibirsk Oblast which is a multi-cluster formation of an inter-sectoral type. The Moscow and Leningrad oblasts are characterized by the formation of multi-cluster formations on a cross-sectoral and territorial basis, which unites high-tech industries established in the framework of regional production complexes and technology cities.

Trends and promising models of formation of regional industrial clusters in Russia are reviewed on the example of the economic systems of regions which formed clusters specializing in information technology, microelectronics, tool engineering, optics and photonics. *Table 4* presents the characteristics of these clusters.

We selected areas of region's economic specialization which, from the point of view of the proposed concept of innovative multi-cluster development, should influence the processes of formation and development of clusters of microelectronics, engineering and IT from the list of integrated economic activities and branches of industry; the values of production localization index are presented in *Table 5*.

Table 5. Values of production localization index of consolidated types of economic activities and industries in Russia's constituent entities with created clusters of microelectronics, tool engineering and information technology (2014)*

Russia's constituent entity	Agriculture, hunting and forest management	Manufacturing	Food production	Wood processing	Manufacture of machinery, transport vehicles and equipment	Manufacture of electrical, electronic and optical equipment
Penza Oblast	2.43	1.21	2.37	1.31	0.93	2.47
Novosibirsk Oblast	1.24	0.74	1.95	0.92	1.1	2.02
Rostov Oblast	2.5	1.01	1.49	0.15	1.52	0.68
Moscow	0.45	1.16	1.67	1.46	1.1	1.11
Saint Petersburg	1.33	1.39	1.69	2	1.77	1.72
Omsk Oblast	1.98	2.09	0.64	0.15	0.15	0.54
Voronezh Oblast	3.17	0.78	2.47	0.15	0.95	2.3
Perm Krai	0.62	1.74	0.33	1.08	0.78	0.91
Vologda Oblast	0.95	1.9	0.51	4.08	0.34	0.07
Novgorod Oblast	1.55	1.94	1.52	6.77	0.52	0.75
Republic of Tatarstan	1.21	1.04	0.65	0.38	1.54	0.7
Oryol Oblast	3.31	1.05	2.47	0.23	1.19	1.67
Republic of Mordovia	2.45	1.29	2.52	1.15	0.61	3.09

* Compiled from: Calculation of production localization indices based on data from the Federal State Statistics Service of the Russian Federation. Available at: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1139918730234

Low values of index of localization of production of electrical, electronic and optical equipment for the regions under review is attributed to the following factors:

- focus of IT clusters in the Novgorod and Vologda oblasts on innovation-technological support of processes of forming timber industry clusters);
- focus of the cluster of high-tech components and systems in the Omsk Oblast on manufacturing in general;
- focus of the IT cluster in the Republic of Tatarstan on high-tech production in general, in particular: manufacture of machinery, transport vehicles and equipment, petrochemical production, etc.

The analysis of the relations between sectoral specialization of regional economic systems and processes of cluster formation in microelectronics, tool engineering and IT in Russia has helped propose a model of cluster development in the industry. Accordingly, the organizational aspect of the economic clustering model in Russian regions based on forming the clusters of microelectronics, tool engineering and IT is presented in *Table 6*.

The obtained parameters of the clustering model are based on the following data. According to the Russian Cluster Observatory, among the clusters under review, the Innovative cluster of information and biopharmaceutical technology in the Novosibirsk Oblast (60 organizations, 12,869 employees) and the cluster “Development of IT, electronics, tool engineering, communications and infotelecommunications in Saint Petersburg” are at a high level of information development (66 organizations, 20,838 employees). The Innovation territorial cluster of fiber optical technology “Photonics” (34 organizations, 15,762 employees), Innovation territorial cluster “Zelenograd” (48 organizations, 7,772 employees), the IT cluster in the Vologda Oblast (31 organizations, 6,182 employees), and the cluster “power-efficient light engineering and intelligent light control system” (24 organizations, 9,866 employees) are at the mid level of organizational development. Accordingly, HHI and concentration ratio values for these clusters are presented in Table 4. Other reviewed clusters are at the initial level of organizational development.

Table 6. Organizational aspect of economic clustering in Russian regions based on forming clusters of microelectronics, tool engineering and IT*

Economic clustering model parameters	Level of cluster organizational development		
	Low	Medium	High
1. Number of participant organizations (units)	10 < ... < 25	25 < ... < 50	> 50
2. Number of employees (people)	> 500	> 5,000	> 10,000
3. Herfindahl-Hirschman index (HHI)	> 1,800	< 1,800	< 1,000
4. Economic activity concentration ratio CR_3	< 0.90	< 0.60	< 0.50
5. Economic activity concentration ratio CR_4	< 0.95	< 0.75	< 0.60
* Calculated from data from Table 4.			

Table 7. Model of organizational development of clusters of microelectronics, tool engineering and IT*

Number of participant organizations in the cluster, units	Herfindahl-Hirschman index (HHI) and economic activity concentration ratio (CR ₃ , CR ₄) values		
	HH > 1,800, CR ₃ < 0.90, CR ₄ < 0.95	HHI < 1,800, CR ₃ < 0.60, CR ₄ < 0.75	HHI < 1,000, CR ₃ < 0.50, CR ₄ < 0.60
10–25	The cluster formed based on the typical software complex. Priority: development of small and medium innovative entrepreneurship.	The cluster with a distinct core. Priority: development of small and medium innovative entrepreneurship.	The cluster with a developed competitive environment. Priority: development of the innovative infrastructure.
25–50	The cluster formed based on TLC. Priority: formation of growth points of industrial production.	The cluster with a distinct core. Priority: development of the innovative infrastructure.	The cluster with a developed competitive environment. Priority: development of the innovative infrastructure.
>50	The cluster formed based on the typical software complex. Priority: formation of growth points of industrial production.	The cluster with a distinct core. Priority: development of the innovative cluster core.	The cluster with a developed competitive environment. The development of the institutional environment of the cluster.
* Compiled from data from Table 6.			

Table 8. Sectoral aspect of the economic clustering model in Russian regions based on formation of clusters of microelectronics, tool engineering and IT*

Type of economic activity	Values of industrial production localization index in the framework of types of economic activity		
	Minimum	Threshold	Recommended
1. Manufacture of electrical, electronic and optical equipment	0.05	0.5	>1.5
2. Manufacturing in general	0.7	1	>1.5
3. Manufacture of machinery, transport vehicles and equipment	0.1	0.5	>1
4. Agriculture, hunting and forest management, food production	0.25	1	>1.8
5. Manufacture of wood and wood products	0.1	1	>2
* Calculated by the author based on data from Table 5.			

Systematization of the findings is presented in the form of models of organizational development of clusters of microelectronics, tool engineering and IT in *Table 7*. The models of organizational development of clusters of microelectronics, tool engineering and IT are based on the need to combine the “core” cluster of large enterprises and the institutional development environment of small and medium enterprises, which is evaluated based on parameters presented in *Table 6*.

The sectoral aspects of the economic clustering model in Russian regions for clusters of microelectronics, tool engineering and IT are presented in *Table 8*. The minimum values of the localization index are calculated based on lowest values of the localization index presented in *Table 5*. The lower boundary of the group of “medium” regions with index values below average is used as threshold values of the localization index. The recommended value is calculated as the lower boundary of the group

of regions with localization index values above average for this type of economic activity.

Accordingly, for the reviewed clusters of microelectronics, tool engineering and IT the value of index of localization of production of electric, electronic and optical equipment, and manufacturing in general are a key criterion for determining the potential of the region's economic system for forming multi-cluster formations.

The values of industrial production localization index in the framework of related types of economic activity also serve as criteria for determining the type of territorial economic systems with the potential to form this type of clusters. Systematization of the findings is presented in the form of models of clustering of economic systems in Russian regions based

on formation and development of clusters of microelectronics, tool engineering and IT in *Table 9*.

Conclusion. Analysis of values of production localization indices in regions with created clusters has helped conclude that high values of production localization index is a factor in successful development of cluster initiatives. It is necessary to stress that the efficiency of the cluster policy is determined by production localization in key cluster industries in the framework of both cluster's key activity and consolidated types of activities and consolidated types of industrial production. However, as noted, the high value of localization index is not a crucial success factor in the formation of innovation clusters developing technology of the next technological order.

Table 9. Models of clustering of economic systems in Russian regions based on formation and development of clusters of microelectronics, tool engineering and IT*

Value of localization index of adjacent types of economic activity	Level of cluster's (multi-cluster's) organizational development		
	Initial	Medium	High
Recommended	Innovation multi-cluster (cluster of high-tech products and new technology as a point of innovative growth of cluster agglomeration)	Innovation multi-cluster (innovation cluster as a center for innovation transformation of the territory's economic system)	Innovation multi-cluster (innovation cluster as a center for innovative transformation of the territory's economic system)
Threshold	Innovation multi-cluster (cluster of high-tech products and new technology as an innovative core of conglomerate of potential clusters)	Innovation multi-cluster (innovation cluster as a center of integration of the conglomerate of potential clusters)	Innovation multi-cluster (innovative cluster as a scientific and technological core of the integration centre of the conglomerate of potential clusters)
Minimum	Cluster of high-tech products and innovation technology	Innovation cluster developing breakthrough technology of the next technological order	Innovation multi-cluster (innovation cluster as a center of integration of the conglomerate of potential clusters)

* Compiled from data from Table 8.

This trend is resulting from the fact that innovation clusters form a technological core of the economic space modernization in the region as a whole.

The clusters, being mostly providers of innovation technology, new materials and means of production, shape the institutional environment for streaming successful management practices.

Therefore, an additional criterion for differentiating clusters from regional production complexes is their development in region's non-traditional economic activities, the focus on both large enterprises and small and medium forms of innovative entrepreneurship.

The feature of development of clusters of microelectronics, tool engineering and IT is an opportunity to implement cluster initiatives beyond the industrial framework of large clusters. The research highlights areas of clustering in Russian regions, whose interaction with clusters of microelectronics, tool engineering and IT has the potential to develop innovation multi-clusters to implement the multiplier effects in the framework of regional

economic systems. The identifies areas of economic systems clustering in Russian regions are: nuclear and radiation technology, medical industry, biopharmaceutical technology, aviation and aerospace industry, manufacture of machinery and equipment, new materials, car manufacturing and production of car components.

The author's approach to modeling the processes of industrial clusters formation complements the existing concepts of cluster development based on the relations between parameters of organizational cluster development and localization of related economic activities. Objective limitations of the proposed approach include a quantitative approach to identifying criteria for cluster development, which is rather formal and automatic. The debatable nature of the findings is also explained by the fact that a cluster is a relatively new form of territorial production management for the Russian economy. The obtained results serve as a framework for further study of the problems of regional industrial cluster modeling including spatial modeling based on methods of geostatistics.

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The section “Public Opinion Monitoring of the State of the Russian Society” presents the results of regular sociological polls conducted by VoIRC RAS on the territory of the Vologda Oblast. The information was published in our journal since March 2009 (Issue 1(5)) as part of the article from the editor-in-chef.

Since October 2017 onward (beginning with Issue 5(53)) “Public Opinion Monitoring” is published as an Appendix to the issue presenting reference information about major trends in social well-being of the region’s residents.

Public Opinion Monitoring of the State of the Russian Society

As in the previous issues, we publish the results of the monitoring of public opinion concerning the state of the Russian society conducted by VoIRC RAS in the Vologda Oblast¹.

The following tables show the dynamics of several parameters indicating the social feeling and socio-political sentiment of the Vologda Oblast population in October – December 2017, and also on average for the latest six polls (February – October 2017). These data are compared with the data for 2007 (the last year of Vladimir Putin’s second presidential term, when the assessment of the President’s work was the highest) and for 2011 (the last year of Dmitry Medvedev’s presidency). The yearly dynamics of the data are presented beginning from 2013.

In October – December 2017, the level of approval of the work of the President of the Russian Federation did not change significantly (68–69%). It corresponds to an average annual indicator for 2015–2016 and is slightly higher than at the beginning of 2017 (66%). The share of negative evaluations of the President’s work for the past two months is 19%.

The level of support of the work of the Chairman of the Government of the Russian Federation in the past two months slightly decreased (by 2 p.p., from 52 to 50%). It is lower than in 2014–2016 (52–58%). The proportion of negative assessments in October – December 2017 was 30–31% (it was 23–28% in 2014–2016).

¹ The polls are held six times a year in Vologda, Cherepovets, and in eight districts of the oblast (Babayevsky District, Velikoustyugsky District, Vozhegodsky District, Gryazovetsky District, Kirillovsky District, Nikolsky District, Tarnogsky District and Sheksninsky District). The method of the survey is a questionnaire poll by place of residence of respondents. The volume of a sample population is 1,500 people 18 years of age and older. The sample is purposeful and quoted. The representativeness of the sample is ensured by the observance of the proportions between the urban and rural population, the proportions between the inhabitants of settlements of various types (rural communities, small and medium-sized cities), age and sex structure of the Oblast’s adult population. Sampling error does not exceed 3%.

More information on the results of VoIRC RAS polls is available at <http://www.vscs.ac.ru/>

For reference: the nationwide level of approval of the RF President's performance remains stable. According to VTsIOM, In October and in the first half of December 2017, it was 82–83% (the share of negative assessments was 10–11%). According to Levada-Center, the level of support for the President during the same period amounted to 81–82% (the share of negative judgments was 17–18%)

The proportion of positive assessments of the work of the Chairman of the RF Government according to VTsIOM in October and until the beginning of December 2017 was 54% (the share of negative assessments was 31%); according to Levada-Center, the share of positive assessments was 44–46% (the share of negative assessments was 53–55%).

How do you assess the current performance of..? (as a percentage of the number of respondents)

Answer	2007	2011	2013	2014	2015	2016	Feb. 2017	Apr. 2017	June 2017	Aug. 2017	Oct. 2017	Dec. 2017	Average for the latest 6 surveys	Dynamics (+/-), the latest 6 surveys compared to...		
														2016	2011	2007
RF President																
I approve	75.3	58.7	55.3	64.1	69.1	67.8	65.7	63.6	67.5	69.7	68.3	68.9	67.3	-1	+9	-8
I don't approve	11.5	25.6	29.4	22.3	17.5	18.8	21.1	23.6	19.3	17.3	19.4	19.3	20.0	+1	-6	+9
Chairman of the RF Government*																
I approve	59.3	48.9	54.2	58.1	52.3	50.4	47.5	47.9	49.7	51.5	49.9	49.5	-3	-10	-	-
I don't approve	-	24.7	32.8	27.6	21.7	27.6	29.8	32.8	32.1	30.9	29.9	31.3	31.1	+4	+6	-
Governor																
I approve	55.8	45.7	44.4	40.1	39.3	37.7	38.9	36.7	40.6	42.3	40.8	39.4	39.8	+2	-6	-16
I don't approve	22.2	30.5	33.2	38.9	36.2	39.3	37.8	41.1	38.9	38.7	39.2	40.1	39.3	0	+9	+17

* Included in the survey since 2008.

There were no substantial changes in the assessment of success of the President's work on addressing the key problems of the country over the past two months:

- the share of those who think that the President successfully copes with the task of strengthening international positions of Russia is 57–58%, which is higher than the average for 2017 (56%);
- the share of those who think that the President successfully copes with the task of restoring order in the country is 52–53% (national average for 2017 is 51%);
- the share of those who believe that the President is successful in protecting democracy and strengthening citizens' freedoms is 43% (national average for 2017 is 40%);
- the share of those who believe that the President successfully copes with the task of economic recovery and promotes the increase in the welfare of citizens is 32% (national average for 2017 is 29%).

It should be noted that the President's work to address material problems of the population still finds the least support among the people; however, in the course of 2017 (from February to December), the proportion of people who assess positively the work of the President in this direction increased notably (by 6 p.p., from 26 to 32%).

In your opinion, how successful is the RF President in coping with challenging issues?*(
(as a percentage of the number of respondents)

Answer	2007	2011	2013	2014	2015	2016	Feb. 2017	Apr. 2017	June 2017	Aug. 2017	Oct. 2017	Dec. 2017	Average for the latest 6 surveys	Dynamics (+/-), the latest 6 surveys compared to...		
														2016	2011	2007
Strengthening Russia's international standing																
Successful	58.4	46.2	45.7	50.4	51.7	51.2	54.5	52.4	55.3	58.1	57.6	56.5	55.7	+5	+10	-3
Unsuccessful	24.9	33.7	36.2	32.4	31.3	29.9	26.5	27.7	25.8	26.1	26.3	28.3	26.8	-3	-7	+2
<i>Success index</i>	<i>133.5</i>	<i>112.5</i>	<i>109.5</i>	<i>118.0</i>	<i>120.4</i>	<i>121.3</i>	<i>128.0</i>	<i>124.7</i>	<i>129.5</i>	<i>132.0</i>	<i>131.3</i>	<i>128.3</i>	129.0	+8	+16	-5
Imposing order in the country																
Successful	53.2	36.6	39.4	48.0	50.2	49.2	49.5	47.3	49.9	52.0	52.7	52.0	50.6	+1	+14	-3
Unsuccessful	34.0	50.0	47.5	39.1	37.9	36.7	36.8	38.8	35.8	35.6	35.1	34.6	36.1	-1	-14	+2
<i>Success index</i>	<i>119.2</i>	<i>86.6</i>	<i>91.9</i>	<i>108.9</i>	<i>112.3</i>	<i>112.6</i>	<i>112.7</i>	<i>108.5</i>	<i>114.1</i>	<i>116.4</i>	<i>117.6</i>	<i>117.4</i>	114.5	+2	+28	-5
Protecting democracy and strengthening citizens' freedoms																
Successful	44.4	32.4	31.8	37.5	40.4	36.6	38.6	36.8	39.1	41.7	42.5	43.3	40.3	+4	+8	-4
Unsuccessful	37.0	48.3	51.0	45.4	41.5	44.3	41.3	43.5	39.7	38.8	38.3	39.3	40.2	-4	-8	+3
<i>Success index</i>	<i>107.4</i>	<i>84.1</i>	<i>80.8</i>	<i>92.1</i>	<i>99.0</i>	<i>92.3</i>	<i>97.3</i>	<i>93.3</i>	<i>99.4</i>	<i>102.9</i>	<i>104.2</i>	<i>103.9</i>	100.2	+8	+16	-7
Economic recovery and increase in citizens' welfare																
Successful	47.2	30.7	31.3	34.8	34.2	27.2	26.1	25.8	28.5	31.3	32.3	31.6	29.3	+2	-1	-18
Unsuccessful	39.1	56.1	56.8	53.4	52.3	59.4	59.1	57.3	57.2	55.9	55.3	56.3	56.9	-3	+1	+18
<i>Success index</i>	<i>108.1</i>	<i>74.6</i>	<i>74.5</i>	<i>81.4</i>	<i>81.8</i>	<i>67.8</i>	<i>67.0</i>	<i>68.5</i>	<i>71.3</i>	<i>75.4</i>	<i>77.0</i>	<i>75.3</i>	72.4	+5	-2	-36

* Ranked according to the average value of the index of success for 2016.

Since April 2017, the structure of Russians' preferences concerning political parties shows a gradual growth of support of the United Russia Party (from April to December 2017 – by 6 p.p., from 32 to 38%). The positions of other parties did not change significantly.

Besides, from April to December 2017, there was a reduction in the proportion of people who believe that none of the major parties expresses their interests (by 6 p.p., from 35 to 29%) and the proportion of those who still finds it difficult to decide on their party and political preferences (by 3 p.p., from 11 to 8%).

Along with these generally positive trends indicating the growing interest of people in political life of the country, and the increase in the support of the ruling party, we cannot but point out that for the past two months the share of those who are not satisfied with any of the political forces represented in Parliament increased by 3 p.p. (from 26 to 29%). As we approach the presidential election scheduled for March 2018, the trend in this indicator will correlate more and more with the final number of voters who will participate in Russia's most important election.

Which party expresses your interests? (as a percentage of the number of respondents)

Party	2007	Election to the RF State Duma 2007, fact		Election to the RF State Duma 2011, fact		2013	2014	2015	2016	Election to the RF State Duma 2016, fact		Feb. 2017	Apr. 2017	June 2017	Aug. 2017	Oct. 2017	Dec. 2017	Average for the latest 6 surveys	Dynamics (+/-), the latest 6 surveys compared to...		
		2011	2011	2011	2011					2016	2016								2016	2016	2011
United Russia	30.2	60.5	31.1	33.4	29.4	32.8	38.8	35.4	38.0	33.9	31.8	33.8	35.2	35.6	37.9	34.7	-1	+4	+5		
LDPR	7.5	11.0	7.8	15.4	7.2	7.6	6.2	10.4	21.9	10.2	10.7	11.1	10.9	11.5	11.6	11.0	+1	+3	+4		
KPRF	7.0	9.3	10.3	16.8	11.3	9.7	7.1	8.3	14.2	7.2	6.2	8.5	8.0	7.3	8.1	7.6	-1	-3	+1		
Just Russia	7.8	8.8	5.6	27.2	4.6	3.5	3.6	4.2	10.8	4.3	4.8	5.1	5.8	4.5	4.3	4.8	+1	-1	-3		
Other	1.8	-	1.9	-	0.6	0.3	0.2	0.3	-	0.1	0.5	0.3	0.4	0.8	1.1	0.5	0	-1	-1		
No party	17.8	-	29.4	-	34.9	34.4	31.8	29.4	-	30.7	34.8	29.1	26.1	26.2	28.5	29.2	0	0	+11		
I'm not sure	21.2	-	13.2	-	10.2	11.7	12.2	12.0	-	13.6	11.2	12.1	13.7	14.1	8.6	12.2	0	-1	-9		

After a noticeable (3–7 p.p.) decline in the main indicators of social well-being in August – October 2017, at the end of the year there was a consistently high proportion of positive assessments of mood (71%) and the stock of patience (74–77%).

This may be due to the fact that the proportion of the Oblast residents who consider themselves to be “poor and extremely poor” declined slightly in October – December 2017 (by 2 p.p., from 49 to 47%) and reached the average level for 2017 (47%).

Nevertheless, it should be noted that the share of the “poor and extremely poor” among the inhabitants of the Oblast still exceeds the proportion of people with “average income” (47 and 43%, respectively on average for 2017). Although the consumer sentiment index, the dynamics of which demonstrates the forward-looking expectations of the population, has remained stable since August 2017 (86–87 p.), still has not reached 100 points, indicating the prevalence of negative expectations of people regarding the development of their personal well-being and economic situation in the country as a whole.

Estimation of social condition (as a percentage of the number of respondents)

Answer	2007	2011	2013	2014	2015	2016	Feb. 2017	Apr. 2017	June 2017	Aug. 2017	Oct. 2017	Dec. 2017	Average for the latest 6 surveys	Dynamics (+/-), the latest 6 surveys compared to...		
														2016	2011	2007
Mood																
Usual condition, good mood	63.6	63.1	68.6	69.4	68.7	68.0	67.2	68.6	71.0	73.8	71.0	70.5	70.4	+2	+7	+7
I feel stress, anger, fear, depression	27.8	28.9	26.2	24.9	25.9	26.2	28.5	25.5	23.2	21.2	22.8	24.0	24.2	-2	-5	-4
Stock of patience																
Everything is not so bad; it's difficult to live, but it's possible to stand it	74.1	74.8	79.3	80.8	78.4	78.0	78.2	77.3	78.7	80.5	74.4	77.1	77.7	0	+3	+4
It's impossible to bear such plight	13.6	15.3	14.2	12.6	14.5	15.6	16.1	16.4	14.8	13.5	17.5	16.2	15.8	0	0	+2
Social self-identification*																
The share of people who consider themselves to have average income	48.2	43.1	43.9	43.2	38.7	42.1	42.5	42.8	43.5	45.2	43.0	41.7	43.1	+1	0	-5
The share of people who consider themselves to be poor and extremely poor	42.4	44.3	46.9	49.1	50.7	49.0	47.2	47.3	43.2	45.8	48.8	47.1	46.6	-2	+2	+4
Consumer sentiment index																
Index value, points	105.9	89.6	90.3	87.6	77.1	77.7	82.0	80.8	84.3	86.2	86.7	87.3	84.6	+7	-5	-21
* Question: "Which category do you belong to, in your opinion?"																

In October – December 2017, the proportion of positive assessments of social mood has not changed in the majority of socio-demographic groups. The increase in the share of people whose condition is “normal, and fine” is registered among those whose self-reported income relates to 20% of the wealthiest inhabitants of the Oblast (by 4 p.p., from 82 to 86%) and among people under 30 years of age (by 3 p.p., from 79 to 82%).

At the same time for the last two months there was a significant decrease in the share of positive assessments of social sentiment among people over 55 years of age by 5 p.p., from 66 to 61%) and among those who, according to their self-reported income refer to the 20% of the poorest inhabitants of the Oblast (by 7 p.p., from 58 to 51%).

Social mood in different social groups (answer: "Good mood, normal condition",
as a percentage of the number of respondents)

Population group	2007	2011	2013	2014	2015	2016	Feb. 2017	Apr. 2017	June 2017	Aug. 2017	Oct. 2017	Dec. 2017	Average for the latest 6 surveys	Dynamics (+/-), the latest 6 surveys compared to...		
														2016	2011	2007
Sex																
Men	65.9	64.5	69.9	68.9	69.5	68.8	66.9	67.6	72.5	74.6	71.3	70.8	70.6	+2	+6	+5
Women	61.7	62.0	67.5	69.8	68.0	67.4	67.4	69.4	69.9	73.1	70.8	70.3	70.2	+3	+8	+8
Age																
Under 30	71.3	70.0	75.5	75.1	77.1	76.4	70.9	80.5	75.4	80.1	79.4	82.2	78.1	+2	+8	+7
30-55	64.8	62.5	69.2	69.5	67.2	67.4	66.7	70.1	72.0	75.9	71.4	73.1	71.5	+4	+9	+7
Over 55	54.8	58.3	62.4	65.4	65.5	64.0	65.8	60.4	67.4	67.8	66.4	61.4	64.9	+1	+7	+10
Education																
Secondary and incomplete secondary	58.4	57.4	60.6	62.5	63.6	62.1	61.4	64.9	65.8	65.2	63.3	61.2	63.6	+2	+6	+5
Secondary vocational	64.6	63.6	68.1	70.4	70.1	68.4	67.7	69.3	70.2	76.7	73.3	75.0	72.0	+4	+8	+7
Higher and incomplete higher	68.6	68.3	77.4	76.2	72.7	74.3	73.1	71.7	78.0	79.1	77.1	75.6	75.8	+1	+7	+7
Income groups																
Bottom 20%	51.6	45.3	46.2	50.8	51.8	52.5	44.6	49.1	57.1	58.1	57.9	50.7	52.9	0	+8	+1
Middle 60%	2.9	65.3	71.9	72.3	71.0	69.4	70.8	70.6	72.9	73.7	71.7	72.0	72.0	+3	+7	+9
Top 20%	74.9	75.3	83.3	84.8	82.0	80.9	86.3	79.9	81.3	86.4	82.1	86.2	83.7	+3	+8	+9
Territories																
Vologda	63.1	67.1	75.0	76.4	73.9	69.9	67.9	70.6	74.0	77.0	74.0	72.2	72.6	+3	+6	+10
Cherepovets	68.1	71.2	75.3	76.3	70.6	71.7	73.7	74.1	76.1	77.9	76.9	75.2	75.7	+4	+4	+8
Districts	61.6	57.1	61.6	61.8	64.6	64.8	63.1	64.3	66.6	69.7	66.1	66.9	66.1	+1	+9	+5
Oblast	63.6	63.1	68.6	69.4	68.7	68.0	67.2	68.6	71.1	73.8	71.1	70.5	70.4	+2	+7	+7

CONCLUSION

The results of the public opinion monitoring carried out in 2017 allow us to draw the following conclusions:

1. In society there remains a high level of support for the incumbent President. For the period from February to December 2017, the proportion of positive assessments of the work of the head of state increased by 3 p.p. (from 66 to 69%). The proportion of those who think that the President is successful in addressing key problems of the country increased by 2–6 p.p. It is important to note that in the first place the evaluation of success of the President's work on economic recovery and growth of welfare of citizens improved (by 6 p.p., from 26 to 32%).

However, the lack of negative dynamics in the assessment of the work of the key state authority does not allow us to talk about people's satisfaction with the situation in the country, and can only prove the absence of any really promising options of the course of development from the point of view of the people.

Still, it is necessary to point out that:

- the success of the President's work to raise the welfare of the population is noted only by 32%, while 55–59% of respondents express the opposite point of view.
- the work of the Chairman of the Government of the Russian Federation is supported by about 50% of the Oblast residents, however, 30% (one in three people) characterize it as negative;
- the proportion of people who believe that the ruling party United Russia reflects their interests, for the period from February to December 2017, increased by 4 p.p. (from 34 to 38%). However, can we say that this level is sufficient for the political force that has been dominating the political scene of the country for more than 20 years and has a constitutional majority in the State Duma, taking into account the fact that more than 60% of the population do not consider themselves to be its supporters?

2. Throughout 2017 in the assessments of public opinion the relevance of financial issues remained high.

This is indicated not only by a substantial (30%) share of negative judgments about the work of the Prime Minister (who is responsible for the solution of these problems) and the high level (55–59%) of negative judgments about the President's work to address financial problems of the population, but also by the fact that almost half of the Oblast residents (47%) consider themselves “poor and extremely poor” and only 42% of the population belong to the category of people with “average income”. Over the past year of 2017, there were no positive changes in the dynamics of social self-identification of the population.

The consumer sentiment index, despite a 5 point increase (from 82 to 87 p.) in the period from February to December 2017, remains extremely low. In addition, the results of the latest wave of the surveys allow us to conclude that material problems have become more important to the public. This is evidenced by the fact that in October – December 2017 among the 14 socio-demographic groups the decline in the assessments of social mood (quite a significant decline by 5–7 p.p.) occurred only in socially vulnerable groups – among pensioners (from 66 to 61%) and among the people who according to their self-reported income belong to the 20% of the poorest inhabitants of the Oblast (from 58 to 51%).

3. Despite the importance of financial problems, the indicators of social well-being in 2017 remained fairly steady:

- the percentage of people describing their emotional state as positive for the period from February to December 2017 increased by 4 p.p. (from 67 to 71%); moreover, the positive changes occurred in all main socio-demographic groups, with the exception of socially vulnerable groups;
- the stock of patience remains consistently high (78% of the Oblast residents believe that “everything is not so bad; it's difficult to live, but it's possible to stand it”; and only 16% of respondents share the opposite opinion).

VTsIOM experts point out that the stable evaluation of social mood by Russians can be associated with the “absence of economic shocks in the past year... Russians have adapted to the economic situation. However, the optimism about the future is coming slowly: only one in three people expects their lives to be improved in the foreseeable future. The lack of optimism may partly explain the overestimations of current period: excess of pessimism, negative forecasts and expectations create a favorable background for comparing what we have now with what we have feared”².

We should also note that the most favorable assessments of social mood are typical of young people under the age of 30 years (70–80%) high-income groups (86%) and individuals with higher education (73–76%), that is, for those population groups who, by their socio-demographic characteristics form the basis of a “self-sufficient” part of the Russian society³ – “Russians, who take responsibility for what happens, who are guided by their own strength, who are confident in their ability to provide for themselves and their families and who do not need support from the state in this regard”⁴.

A positive emotional state in these population groups is critical, because, according to experts at the Institute of Sociology of the Russian Academy of Sciences, “Self-sufficient” Russians form a serious social base for stable and sustainable status and development in the Russian society. This is especially important in the current socio-political situation, when Russia is facing new and serious political, economic and socio-cultural challenges... In conditions when the state is forced to choose new landmarks for its development, to enter into the saving mode, which would inevitably affect the implementation of social policies, previously adopted social programs and weaken the state support of citizens, of particular importance is the fact that in society there are groups that are willing to take responsibility for their own lives without burdening the state with their dependence on it”⁵.

Perhaps the high level of optimism typical of those groups, which by their socio-demographic parameters belong to the category of “self-sufficient” Russians, can be considered a “litmus test” that allows us to summarize the main conclusion of the conducted research: the Russian society has many (primarily financial) problems, but seeks to solve them step-by-step in the framework of the current course of political and economic development of the country.

Materials were prepared by M.V. Morev, I.V. Paranicheva, T.V. Urvanova.

² Social well-being of Russians: on the threshold of a new year. *VTsIOM Press Release*, 2017, no. 3537. Available at: <https://wciom.ru/index.php?id=236&uid=116600> (Opinion of the head of VTsIOM practice of social modeling and forecasting Yu. Baskakova).

³ As the experts from the Institute of Sociology of the Russian Academy of Sciences point out, “the self-sufficient part of society is localized mainly among young and well-off Russians” (source: Russian everyday life in crisis: how do we live and feel? *Information-analytical summary on the results of a nationwide study*. Moscow, 2015. P.16).

⁴ *Ibidem*. C. 16.

⁵ Russian society in the context of new realities. *Information-analytical summary on the results of a nationwide study*. Moscow, 2014. P. 8.

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In the upper right corner, the UDC is placed, under it, after the 1.5 spacing – the LBC, then – the symbol ©, indent (spacing), and the name and initials of the author in semi-bold. After the 2-spacing indent, the title of the article is given. Central alignment is used for the title of the article given in semi-bold. The abstract and key words are given below, after the 2-spacing indent, without a paragraph indent, in italics and aligned by width. Then, after the 2-spacing indent, the text of the article is placed.

6. Abstract

The abstract contains from 250 to 300 words. The abstract states the purpose of the research, points out its undoubted scientific novelty and its differences from similar works of other scientists; contains the methods used by the author and the main results of the work performed; identifies areas of application of the results of the study; briefly formulates the prospects for further research in this area.

Examples of good abstracts for different types of articles (reviews, scientific articles, conceptual articles, application articles) are available at: <http://www.emeraldinsight.com/authors/guides/write/abstracts.htm?part=2&PHPSESSID=hdac5rtkb73ae013ofk4g8nrv1>.

7. Key words

There should be not more than eight words or word combinations. Key words should reflect the content of the manuscript to the fullest extent. The number of words within a phrase should not exceed three.

8. Tables

The caption of the table and its number (if present) are given in normal font, without highlighting. The caption runs in bold and is center aligned.

Tables are inserted; drawing tools and AutoShapes are not allowed; column and cell alignment using spaces or tabs is not allowed. MS WORD table editor is used for tables. Each piece of data of the stub and head of the table correspond to discrete cell. Only editor standard tools are applied for creating and formatting tables, no pilcrows, spaces and extra blank lines for semantic breakdown and line adjustment are allowed.

9. Figures (schemes, graphs, diagrams)

The caption and its number are placed below the figure. The word “Figure” is in normal font (without highlighting). The caption runs in bold, center alignment, single-spaced.

MS EXCEL is to be used for creating charts, MS WORD, MS VISIO – for flow charts, MS Equation for formulas.

Figures and charts, created in MS WORD are to be grouped within one single object. No scanned, exported or taken from the Internet graphic materials are allowed in the article.

Algorithm of charts insertion from MS EXCEL to MS WORD:

1) in MS EXCEL select the chart, using the mouse, right click and select “copy” from the list of options;

2) in MS WORD right-click, select “paste” from the list of options, click on “paste special”, “Microsoft Excel chart”.

The title of the figure and its number are placed below the figure. The word “Fig.” is in common type face. The caption is given in bold and is center aligned.

10. Bibliographic description of the sources under tables and figures

Write: either “Source”, or “Compiled with the use of”, or “Calculated with the use of”, etc., after that – information about the source.

11. Page footnotes

Page footnotes are executed according to GOST R 7.0.5.– 2008.

12. References

The word “References” is given after a 1.5 spacing after the body of the article in lower-case letters, semi-bold italics, center alignment. Then, the list of references is given after the 1.5 spacing.

The sources are given in alphabetical order (first – Russian-language sources, arranged alphabetically, then – foreign sources, also arranged alphabetically).

References to Russian-language sources are given in accordance with GOST 7.1 – 2003. References to English-language sources are given in accordance with the Harvard standard¹.

The list of references contains links to scientific works used by the author in the preparation of the article. It is obligatory that the author provides links to all the sources from the list of references in the body of the article.

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- 7) textbooks, etc. It is recommended to provide the corresponding page footnotes for these sources.

¹ Information about the modified Harvard standard is given in the book: Kirillova O.V. *Redaktsionnaya podgotovka nauchnykh zhurnalov po mezhdunarodnym standartam: rekomendatsii eksperta BD Scopus* [Editorial Preparation of Scientific Journals according to International Standards: Recommendations of a Scopus Expert]. Moscow, 2013. Part 1. 90 p.

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- 2) books;
- 3) monographs;
- 4) published conference proceedings;
- 5) patents.

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