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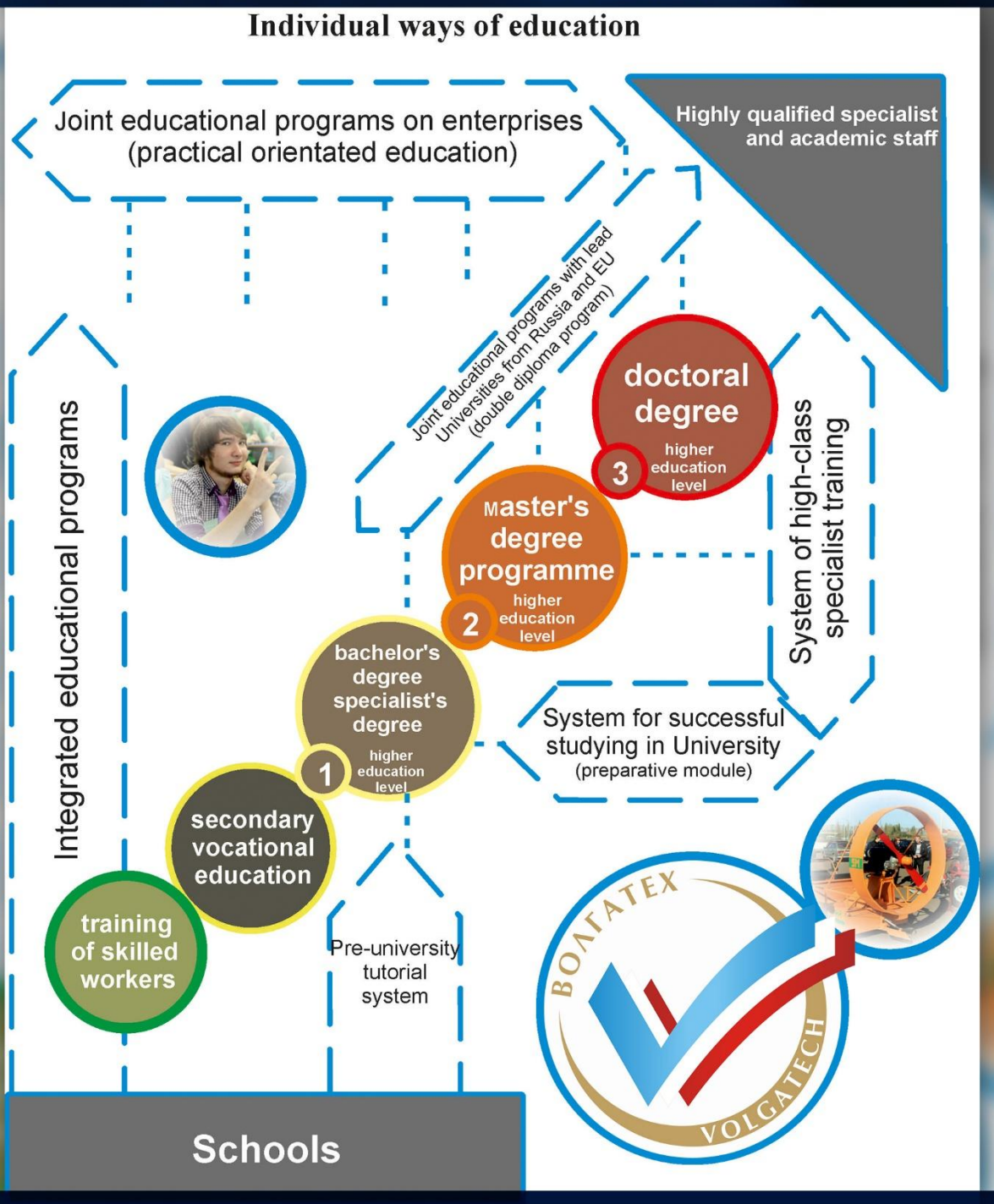

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SHOT BIOGRAPHY OF GUEST EDITOR OF YURIY S. ANDRIANOV

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UDK: 004.421:004.921 COBISS.SR-ID 222174220 **Review Article**

ANALYSIS OF SELECTED CLUSTER OBJECT IMAGES DYNAMICALLY CHANGING SCENES IN COLOR MODELS

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Summary: *The study analyzed the distribution of sample object / background in different colorimetric spaces. It is shown that the investigated class of images dynamically changing scenes RGB model is optimal for the separation of the object / background. Clusters of observation objects in this color space forms with slightly overlapping areas, which extend along the vector of the luminance component.*
An analysis of the statistical characteristics of the image allowed to create a mathematical model of the sampling distributions for the synthesis of the segmentation algorithm. As a result, synthesized Bayesian segmentation algorithm, where the laws are approximated by a normal distribution law. The algorithm is the optimal maximum likelihood.
Created segmentation algorithm for images of the growth plants dynamics is characterized by a given level of accuracy of decision making. Moreover, the comparative analysis of the accuracy for the segmentation on a special test set of data from known segmentation algorithms. For comparison were obtained k-means segmentation algorithm and segmentation by connected contours. These quantitative indicators confirm the advantage of the approach developed over the standard segmentation algorithms. Estimates of the computational complexity suggest that the synthesized algorithm has good computing performance for acceptable work on modern hardware and software-based.

Keywords: *color models, colorimetric system, dynamically changing images, convex hull, RGB, segmentation algorithm, image model, optimal approach, Bayesian algorithm.*

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INTRODUCTION

Problem detection and analysis of objects in a non-uniform background for today is one of the central in creating automated systems of artificial vision. However, the methods and approaches of solving tasks may vary and depend on the context of the problem being solved and a number of characteristics, such as the dimension and structure of the data, computing and time constraints.

The development of advanced vision systems and intelligent methods in the treatment of evolving in the direction of the dynamic scene analysis [1,2]. As a consequence of increased demands on the hardware and software components of these complexes, but this allows you to get a brand new tool, which has a qualitatively new indicators [3-5].

Currently methods of dynamic allocation objects have not been studied fully and currently there are no universal approaches of image processing dynamically changing scenes. Images of dynamically changing scenes can often be found in studies in various fields of scientific and technological activities. Detect changes, tracking of targets, changes in the

objects, here are some examples of problems faced by the researcher in their analysis. Consider the examples of these types of images.

Fig. 1. Images of South Butovo district of Moscow city

Figure 1 shows visual detection of changes in the construction of South Butovo district of Moscow city [6], where the first shot SPOT 5^1 made in 2011 year and the second SPOT 6^2 in 2014 year.

Fig. 2. Image automatic object tracking

Fig. 2 shows an example of dynamically changing scenes on which the object support [7]. A characteristic feature of these scenes is a complex and heterogeneous statistical background while observing an object changes shape, texture, spatial arrangement.

Fig. 3 shows an example of the stage of plant growth, which changes over time, so for this class of image area of interest is the dynamics of change in the objects of research.

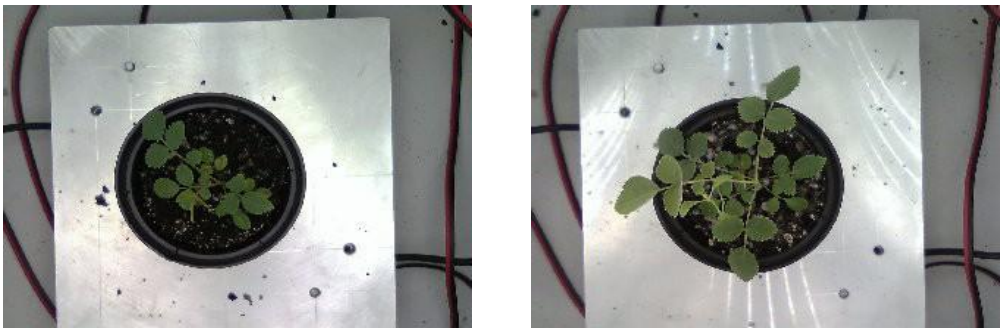

Fig. 3. Image dynamically changing scenes of time

So under the dynamically changing scenes (DCS) will understand the image of the spatial fixation position in which objects can change the position, shape, texture and other characteristics. The study aims to explore the problem, colorimetric space to determine the optimal separation models of subject and the background for the DCS.

[1] © *CNES2011, reproduced by SCANEX under license from Airbus DS*
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Modern equipment for digital imaging has the quality characteristics for registration as a color and brightness components. Color an important component of information, which can be taken into account in the analysis of dynamically changing scenes. In colorimetry, color is defined as a three-dimensional vector quantity characterizing the thermal radiation, visually indistinguishable in terms of colorimetric monitoring [8].

The decision making for majority of applications in the field of image analysis and pattern recognition depends on the choice of color space [9-11]. Under the color space we mean a geometric model of colors perceived by observing the color stimulus items. This choice also defines a set of methods and procedures for further processing the initial data.

COLORIMETRIC MODELS

Since the RGB model is currently the most common and the first, which appeared in the works of V.D. Wright [12] and G. Gilda [13] on the basis of which was created by the standard 1931 CIE color space RGB. Exploring the sample distribution of colors for the background and the object color space appropriate to use the concept of a cluster. Under the cluster of three-dimensional colorimetric space, we mean the union of the set of points which can be regarded as an independent unit, which has certain properties.

Formed samples form a cluster –H1 , that describes the flora and cluster statistically inhomogeneous background – H 2 in RGB space (fig. 4, a).

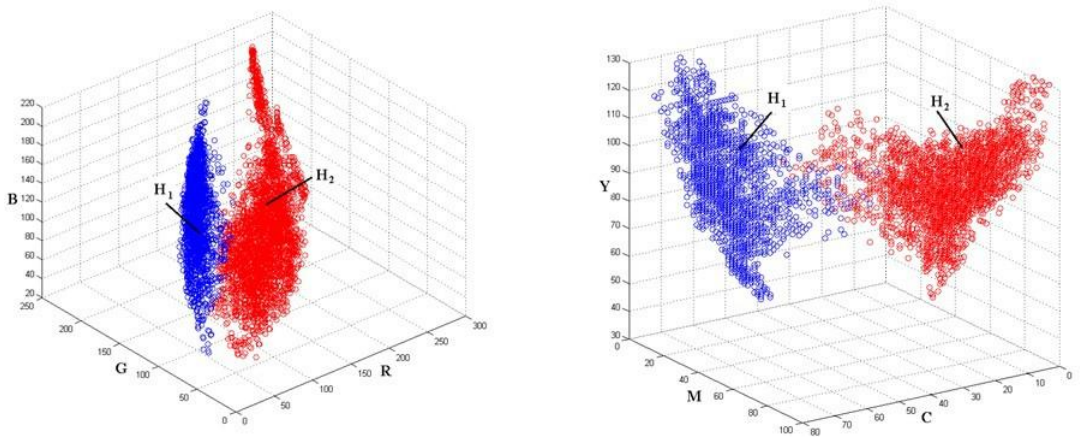
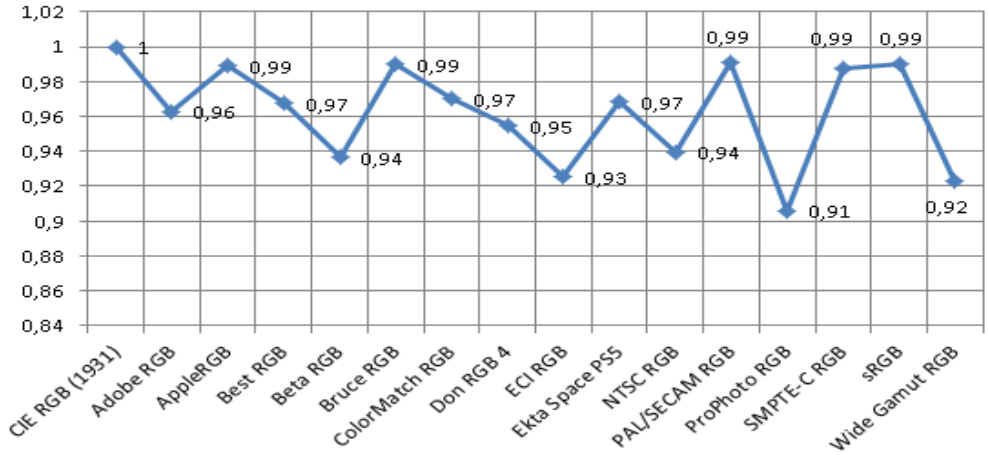


Fig.4. Cluster distribution of the background and the object in the color space:a – RGB, b – CMY

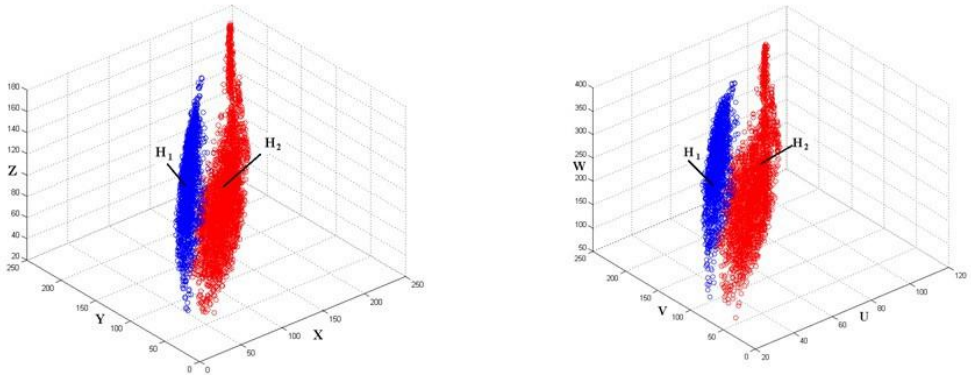
Hardware-independent standard CIE XYZ color space [14] emerged almost simultaneously with RGB, however the color of its main "emission" exists only in the color-metric equations and get them physically impossible. The coordinates of all the possible color of light emissions will be positive, which facilitates the calculations.

For vector XYZ conversion matrix, there are several systems from RGB [15,16]. The choice of the transformation matrix depends on the use of primary colors and the selected standard light source, that is, the percentage composition of the primary colors needed to produce white. Transformation was carried out by the criterion of the most distinctive features of the basic standard CIE XYZ 1931. This condition is in good agreement with the model *Wide Gamut RGB* chart (Fig. 5) shows that the correlation coefficient - 0.92, and the maximum coverage on the chromaticity diagram [17].



5. Chart correlation matrix transformation in XYZ with CIE XYZ 1931

Fig. 6 and show clusters studied in the space XYZ model *Wide Gamut RGB*. The results of the construction of the same cluster models *ProPhoto RGB* and *ECI RGB* vary between 5%.



Hardware-dependent standard CMY formed on the principles of subtractive synthesis and is designed to display the information. [18] Highlighted computational simplicity and yield the projections in clusters, without additional calculations to the appropriate plane (Figure 4b).

Standard equal-contrast colorimetric system UVW, characterized in that all areas on the chromaticity diagram by any pair of colors at the same distance corresponding to the same color contrast [19]. The result of the construction of the color clusters is shown in Fig. 6.b. Space HSV [20] (hue (color), saturation, value) was created as a natural and closer to human color perception. There are also a number of unique options: HSI, HSB HSL [21,22]. This group color space has some unique performance [23], in which the tone is invariant under certain types of lighting, shading and shadows, as well as segmentation performance using only one dimension, resulting in fewer segments than using the basic colors.

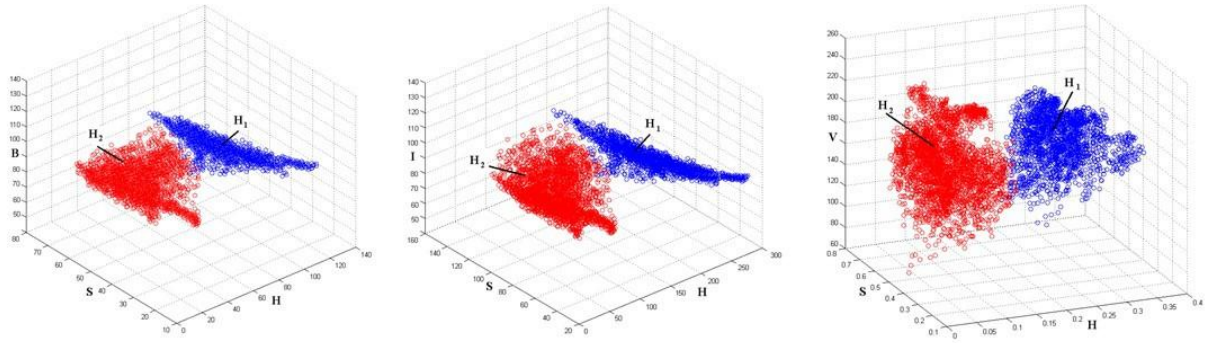


Fig.7. Cluster distribution of the background and the object in the color space: a – HSB, b – HSI, c – HSV

Fig. 7 shows the clusters in the space of hue, saturation and value. Presentation of clusters in these models has some unique distinguishing features.

The next class of device-independent and equally-contrasting spaces is Lab, Luv and LHC [24-26]. So *ab* components are non-linear transformation (X, Y) CIE, and *uv* associated with (X, Y) - linear transformation. For the LHC cylindrical coordinates of this space correspond both empirical Munsell, and are consistent with the physiological model of color vision. In the calculations was taken the point of equal energy for Lab and Luv (0,9642, 0,8249, 1), which is the standard for the D65 light source.

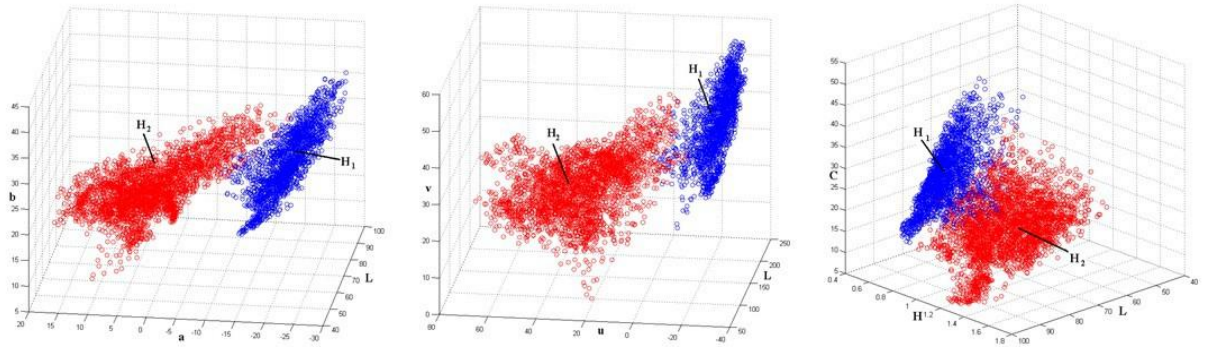
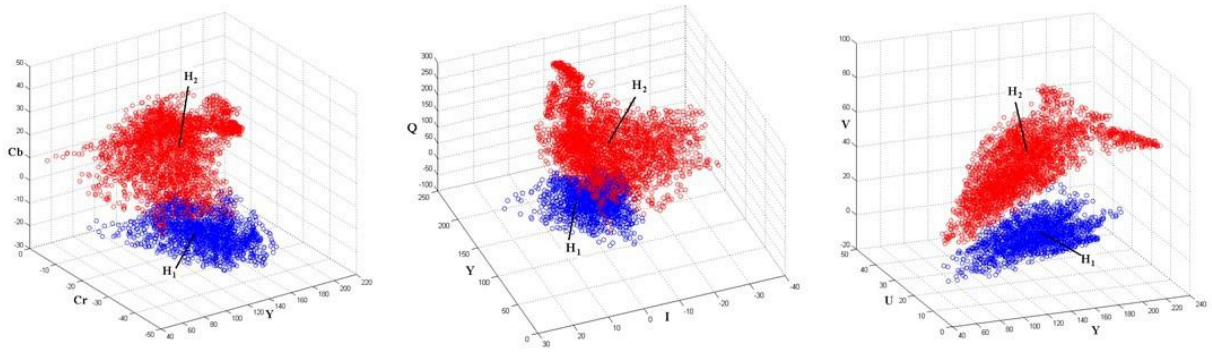


Fig.8. Cluster distribution of the background and the object in the color space: a – Lab, b – Luv, c – LHC

Fig. 8 shows the clusters in the space of lightness and two chrominance components. Clusters slightly overlap, but to construct an algorithm separation hyperplane in the space will be challenging.

Color space class - Y ** are perceptual, device-dependent came from TV [26-27], which has the luminance component and two color difference components. So it was tested model: YUV, YIQ and YCrYcb. Fig. 9 shows the clusters that intersect in a narrow spatial domain. This construct an algorithm of separation into two independent cluster is a complex algorithmic problems.



a *b* *c*

Fig.9. Cluster distribution of the background and the object in the color space: а – YCrCb, б – YIQ,в – YUV

If we construct minimum convex hull for individual clusters using an algorithm QuickHull [28], then we can get a model of selective distribution in the colorimetric space.

Table

RGB	CMY	HSB	HSI	HSV	Lab	LHC	Luv	YCrCb	YIQ	YUV	XYZ	UVW
0,044	0	0,019	0,017	0,043	0,003	0,007	0,033	0,007	0,011	0,011	0,017	0,026

Taking the space of a single volume, and calculate the volume of the model, we introduce the specific volume ratio of clusters background / object. The table shows the calculation results of this ratio.

CONCLUSION

Comparative analysis examined the colorimetric space allows to make the conclusion.The RGB color space is best for color segmentation algorithm synthesized as representations of objects and background form a weakly overlapping clusters. Spatial clusters of the most symmetrical and elongated along the brightness of the vector. Thus, the brightness of the segmentation a little informative. These properties of the space should theoretically provide the most accurate image segmentation and evaluation of the relative area of cover plants. Visual characteristics are confirmed, as an objective indicator of specific volume ratio, which is the maximum value for RGB space.

Known algorithms for object recognition by a point described [29-33], but their computational complexity does not allow to be used for this class of images. In this present study determines the optimal color space for the subsequent synthesis of the segmentation algorithm DCS. Work is carried within the grant of the President of the Russian Federation for the state support of young scientists MK-7290.2015.9.

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UDK: 005.591.6(470) 332.15(470) COBISS.SR-ID 222176012 **Review Article**

INTERACTION BETWEEN FORMAL AND INFORMAL INSTITUTIONS IN THE CONTEXT OF INNOVATIVE ACTIVITY OF GEOGRAPHICALLY LOCALIZED FORMATIONS

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Faculty of Management and Law, Volga State University of Technology

Summary: *The change of the direction of the development of the Russian economy requires the transformation of methods for regulation of innovative activity of economic agents. The polarization of the national economic space determines the significance of the improvement of regional instruments to support innovative activity of entities. The aim of this work is to study the effect of the interaction between formal and informal institutions of the local market on the development of innovative relations, to study measures to support innovative activities in geographically localized formations of the Russian economy. The article highlights the main tools to stimulate innovative activity of economic agents at the local level in the economically and technologically developed countries. A comparative analysis of the structure of the sources of financing innovative activity of individual countries such as the US, Germany, France, China is presented. It is concluded that the largest amount of investment in research and development in these countries is given by the business sector. The role of informal institutions, their influence on the development of innovative activities in geographically localized formations is shown. The concept "regional economic culture" is regarded as a set of informal behaviors of individuals, aimed at the creation, implementation and preferential use of innovation and product innovation in their activity as a key factor in the competitiveness of the economic entity and geographically localized formation. The issue of congruence of formal and informal institutions that support innovation in the regions of the Volga Federal District is discussed. The models of interaction between formal and informal institutions in the context of innovative activity of the regions of the Volga Federal District are presented. The conclusion about the necessity of active creation of regional economic culture based on the promotion of innovative ideas and the creation of the demand for innovation is made. After conducting the SWOT-analysis of innovative development of the Republic of Mari El, the following ways of increasing innovative activity in the region were proposed: direct funding of R &D, innovative companies and projects, cooperation between manufacturing and research organizations; preferential purchase of innovative goods and services within the public procurement; development of information and methodical support of innovative activity in the region.*

Keywords: *innovation-supporting institutions, interaction between formal and informal institutions, informal institutions, regional economic culture*

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INTRODUCTION

The rapid deterioration of the macro-economic and geopolitical conditions, a high level of turbulence observed on the world energy markets, determine the acute need to strengthen the innovative activity of all entities of the national economy. Implementation of innovative vector imposes newrequirements for the content, forms and methods for regulation of innovative relations at the level of geographically localized formations. The question of effectiveness of interaction between formal and informal regional development institutions arises, as there are closely located areas with similar conditions, but they have totally different results. Theory and practice of recent decades clearly show that the main factors determining the success of economic development of countries are the processes of interconnected dynamics of institutional, cultural and geo-spatial parameters of the national markets. Without understanding the role of informal institutions of the market, successful modernization of the Russian economy is not possible. Radical reforms, including innovative activity of economic agents are always fundamental changes in the life of the people connected with their values, beliefs and prevailing stereotypes of behavior. In this regard, the study of the interaction between formal and informal institutions in the context of innovative activity of territorially localized entities is a relevant direction of scientific research.

THE STUDY OF INTERNATIONAL EXPERIENCE IN SUPPORING INNOVATIVE ACTIVITY IN THE GEOGEAPHICALLY LOCALIZED FORMATIONS.

Traditionally, researchers pay great attention to formal institutions and innovation funding provided by the state. However, the results of the analysis indicate that the share of research and development funding provided by the state is much smaller than research and development funding provided by the business sector in the most developed economies in the world (Table 1).

Table 1. The structure of domestic expenditure on research and development by sources of funding *

Country	Value, %			
	State funding	Business sector funding	Other national sources	Foreign sources
Belarus	45.5	45.8	-	8.7
Belgium	23.4	60.2	3.5	13.0
Great Britain	28.9	45.6	5.7	19.7
Germany	29.8	65.6	0.3	4.2
Italy	41.9	45.1	3.9	9.1
Canada	34.5	48.4	11.3	5.8
China	21.6	74.0	-	1.0
The Netherlands	35.5	49.9	3.6	10.9
Poland	51.3	32.3	3.0	13.3
Russia	67.8	27.2	1.0	4.0
Singapore	38.5	53.4	2.2	5.9
The USA	30.8	59.1	6.3	3.8
Turkey	28.2	46.8	24.4	0.6
Finland	26.7	63.1	1.4	8.8
France	35.4	55.0	1.9	7.7
Sweden	27.7	57.3	3.9	11.1
Japan	16.8	76.1	6.6	0.4

* based on [9]

Table 1 shows that in more developed countries such as Germany, Belgium, China, Japan the share of state funding in the structure of domestic expenditure on research and development does not exceed 30%. The largest amount of investment in research and development in these countries accounts for the business sector. Without underestimating the significance of the state funding of innovative activities of economic agents, it should be noted that systematic approach to the formation of development institutions of the Russian economy is very important.

Undoubtedly, the significant role in the economic development of the country belongs to the federal institutions, and the polarization of the national economic space, different natural and socio-cultural conditions require differentiation of tools used in territorially localized entities that defines the importance of the formation and improvement of regional development institutions. In order to explore the possibilities of improving the local institutional environment, we have analyzed measures to support innovative activities implemented at the regional level in the leading economically and technologically developed countries. The study allowed us to define the following basic technologies and measures to support innovative activity at the regional level: the direct financing of innovative companies and projects in the form of grants and loans; the creation of specialized funds that combine public and private funds to support innovative research and development; tax incentives, including tax breaks and tax credits; support of innovative products through their prior acquisition within government procurement; creation of scientific and technological parks, business incubators, special economic zones; implementation of various forms of support for scientific staff and experts; the creation of special structures to provide advice, information and technical support to innovators and entrepreneurs; the creation of information resources and agencies which accumulate and spread information in science, technology and innovation area to coordinate the activity of economic agents in the field.

INFORMAL INTITUTIONS AND THEIR ROLE IN THE DEVELOPMENT OF INNOVATIVE ACTIVITY

The rate of changes of informal institutions, which "lags behind" the rate of changes of formal institutions is among many other reasons hampering innovative development of regions.

Dynamics of formal institutions of innovative development in the Russian Federation has significantly increased in recent years.

Strategic documents that have caused fundamental change in the architecture of formal market institutions and development institutions have been adopted: Federal Law "Amendments to the Federal Law "Science and Scientific and Technical Policy of the government", Federal Law No 132 "Amendments to the 95th clause of the first part and to the second part of the Tax Code of the Russian Federation regarding formation of favorable tax conditions for innovative activity", Decree of the President No 878 of June 18, 2012 "The Presidential Council of the Russian Federation concerning economic modernization and innovative development of Russia" and others.

Hereby, these documents set the “tough” rate of changes of formal institutions of innovative development of territorially localized entities. This rate is controlled and maintained by the federal government. However informal institutions do not always fit into the “federal-formal” dynamics.

Legal and administrative methods are ineffective for informal restrictions. It is impossible to set changes in the informal institutions (economic mentality, social capital) in accordance with the laws and regulations, starting from a particular date.

You cannot become an entrepreneur-innovator formally, without internal self-determination, a willingness to take responsibility for the result and risks. These qualities cannot be formed immediately by registering the person as a private entrepreneur.

Economic interests of certain subjects, leading to conflict with the formal institutions of the economy are at the heart of each of informal institutions. We are close to the position of scientists who emphasize the direct interconnection between institutions and economic interests.

In particular Volchik V.V. notices that the institutions are created in accordance with interest groups and exist, while they are quite effective in coordination of the activities of their constituent individuals [1]. The characterization of economic behavior, particularly behavior «homo-post-soveticus» is used in the research of informal institutions [1].

Informal institutions are typed form of informal practices, perceived by the majority of economic agents of the market, any such typing is an institution. So the informal institutions is a way of realization of economic interests, which is achieved due to special information models that are not official, institutionalized and freely modeled according to the economic interest of the subject.

From our point of view, the main informal institutions that promote innovative activity of economic agents are the trust institutions, institutions of entrepreneurial thinking (the customs and traditions of business turnover), the institutes of partnership and co-operation [8].

The importance of the trust institute due to the fact that the contractual relations between economic agents in the market are based on impersonal trust. The complex of informal behavior models, conducting to the confidence of economic agents that the actions of contractors do not have negative consequences is considered as the trust institution.

Needs of economic agents in the mutual support and cooperation are at the heart of the institute of partnership and cooperation. It can lead to the diffusion of innovation. Institute of entrepreneurial thinking is understood as a complex of informal behavior models aimed at the implementation of innovations, which are determined by the presence of knowledge, skills and motivation to innovative activity, the ability to follow the customs and traditions of business turnover and norms of business ethics.

Informal institutions include institutionalization and cultivation of innovative thinking among entrepreneurs and population, the development of regional culture of economic agents' behavior.

From our point of view, namely informal institutions and socio-cultural factors have a significant impact on the increase of innovative activity and the formation of economic agents' interest in the creation of innovative products.

The importance of informal institutions in the development of innovative activity is recognized by many authors. A. A. Auzan emphasizes that the process of long-term modernization is socio-cultural, not techno-economic. Modernization should be based on socio-cultural specificity, a characteristic element of which in Russia he calls creativity, natural talent. Th. Schumpeter believed that the main driving force of economic development of society is innovation in the state economy, and also new combinations of changes in the development of production and market. O. S. Sukharev noted that these combinations do not occur by themselves, but are the result of the transforming activity of businessmen. The ability to increase, change knowledge, to modify the experience is based on a particular psychological model that can be described as "innovative" psychology. The main components of this psychology, in his opinion, are: 1) the agents' knowledge and skills of combining factors of production, organization, management, or their ideas for implementation in business with the potential points of application; 2) well-developed institutional infrastructure that encourages "innovative" psychology, that is, providing opportunities for the emergence, perception and replication of new combinations; 3) the psychological need to take the risk of introducing a new combination, the need to create such combinations. Joint implementation of these components forms a special model

of the behavior of economic agents, allowing you to apply new knowledge, produce, perceive and replicate new combinations.

Regional economic culture, from the authors' point of view, is a set of informal patterns of behaviour of individuals, aimed at creating, implementing and predominant use of innovation and product innovation in their activity as a key factor in the competitiveness of the business entity and geographically localized formations. The opportunity of realization of these normative patterns of behaviour is determined by individual's knowledge, skills and inner motivation to innovative activity.

The formation of regional economic culture involves such practical steps as promoting the ideas of innovative development in the business community; stimulation (with administrative and economic methods) of implementation and acquisition of innovative technologies and products; expanding the practice of forming and maintaining business reputation among economic agents; expanding the practice of advice and information support by creating or activating the activity of regional centers of advice, information and legal support, information resources in the sphere of science and innovation development.

THE DEVELOPMENT OF TOOLS TO SUPPORT INNOVATIVE ACTIVITY IN THE MARY EL REPUBLIC.

The development of the innovative sphere is one of the priorities of the government economic policy in the Mari El Republic. The guidelines and directions of development of the republican innovative system are fixed in "Strategies for long-term socio-economic development of the Mari El Republic" [5]. However, the Mari El Republic has not yet demonstrated effective interaction between formal and informal institutions of support of innovative activity.

As initial models of institutional interaction the authors consider the options of interaction between formal and informal institutions, which are selected according to the criteria of the speed and the direction of changes of institutions [9].

Projecting the model of the interaction between formal and informal market institutions on the practice of innovative development of the Russian regions, we see that the effectiveness of institutional interaction in the regions of the Volga Federal District is fundamentally different. The interaction between formal and informal institutions is a mechanism that selects the institutions of development, which are adequate to regional economic space and time. The local model of institutional interaction can be recognized effective, if it allows to implement successfully the vector of the region's innovative development, provide higher levels of socio-economic development (Table2).

Table 2. Models of institutional cooperation in the context of innovative activity of regions of the Volga Federal District

Characteristics of institutional interaction	Models of interaction between formal andinformal institutions		
	Highly effective	The average level ofefficiency	Ineffective
The effectiveness of institutional cooperation	High	Medium	Low
The rate of change in formal and informal institutions	Similar	Different	Significantly different
The distribution of subjects by groups of innovative activity in 2013 *	Tatarstan, Nizhny Novgorod, Region, Samara Region, Bashkortostan, Penza Region, Saratov Region	Perm Region,Ulyanovsk region,Chuvashia, Udmurtia, Mordovia	Orenburg Region Kirov Region the Mari El Republic
The estimation of innovative activity of regions	High	Medium	Moderate and low

The interaction between formal and informal institutions in the regions, the leaders of the Volga Federal District of innovation activity (Tatarstan, the Nizhny Novgorod Region, the Samara Region, Bashkortostan, the Penza Region, the Saratov Region), should be recognized as effective. Unfortunately, only the Mari El Republic in the Volga Federal District demonstrates low innovative activity.

In order to study the problems of formation of the institutional environment of innovative activity of the Mari El Republic, we consider it necessary to present the results of the SWOT analysis of innovative development of the Republic (Table 3). The table shows opportunities, threats, strengths and weaknesses of the region from the point of view of prospects of economic development.

According to the results of SWOT analysis, the main sectors of the economy, which form the gross regional product of the Republic of Mari-El, are industry, agriculture, commerce, transport, communication and building. The leading positions in the industry of the Republic of Mari El belong to such types of economic activity as food production, petroleum product, electricity, gas and water, electrical equipment, electronic equipment and optical ones. Priorities of agriculture are meat production, milk production and poultry industry. The implementation of the import substitution strategy in the context of increasing integration of Russia with the countries of EurAsEC, BRIC's, public investment in several sectors of infrastructure gives reason to state that the main strategic priorities of socio-economic development of the Republic of Mari El in the coming years will become projects on the production of high-tech industrial products, agricultural products, construction materials and petroleum products.

Table 3.Results of SWOT-analysis of an innovative development in the Republic of Mari El

Opportunities:	Threats:
1. Realization of the national strategy of import substitution 2. Increased international economic integration with the European Union, BRIC's, and the Asia Pacific region 3. The increase of public investment in the defense industry and the innovation sphere	1. Growth of the exchange rate and the inflation rate 2. GNP decrease and the expense of the national budget in Russia 3. Geopolitical unrest and deterioration of relations with Western countries 4. Exhaustion of the potential of the raw materials export model of economic
Strengths:	Weak points
1. Developed industrial complex (including defense industry) 2. Infrastructure of higher professional education, research, intellectual and stuff potential of the Republic 3. The presence of forest infrastructure, the agricultural industry, provided by environmentally friendly raw materials and labor resources 4. Large number of the deposits of solid non-metallic minerals; building materials, glass sand, gypsum and etc. 5. Favorable geographical position of the Republic, the availability of transit pipeline network and transport network and river aterways 6. Recreational resources (ethnographic, ecological and rural tourism)	1. Significant social differentiation in the region, low standard of quality of life 2. The outflow of qualified personnel, high level of migration of the economically active population 3. The lack of hydrocarbon industry 4. The low level of trust in the state and state's industries. This reduces the motivation to innovate and increase labor productivity 5. Insufficient level of the development of the regional innovative system, coordination of science, education and business.

The diversified economy contributes to successful development of high-tech production. Thus, the cities of Yoshkar-Ola and Volzhsk may become a scientific base for the region innovation development. The town of Kozmodemyansk is preferable for development of innovative manufacturing of electronic and optical equipment. Mari Chodra National Park, the historical and cultural complexes in Yoshkar-Ola, Kozmodemyansk and Yurino can be considered as the most prospective for development of the tourist and recreation activities. The SWOT analysis results show that the innovation development of the economy of the Mari El Republic can rely on the large internal resources, such as a high level of universities' scientific activity, intellectual potential and human resources. A multi-branch industrial complex of the republic equipped with high technology creates demand for innovations. On the other hand, a decreasing confidence level among citizens and in the business sphere, an underdeveloped cooperation and interaction between subjects of the innovation activity stipulate high institutional risks that in turn determines a low innovation activity in the republic.

From our perspective, the top-priority steps on the course of development of the innovation sector of the economy in the Republic of Mari El are:

1. direct financing of R&D, the innovative enterprises and projects, cooperation between manufacturing and research organizations;
2. prior acquisition of innovative goods and services within the public procurement (acquisition of brand-new goods and services or goods and services, manufactured with the use of advanced technologies);
3. development of the information and methodic support of the innovation activity in the republic (forming special structures and information resources providing an informational and consultation maintenance of the innovation work, the popularization of values in the field of the innovation development of economy);
4. creation of the professional links and communities, a platform for a dialogue between business entities, research organizations and individual innovators for improving the professional skills and the informational support of the innovation activities;
5. forming a regional economic culture, oriented on the promoting ideas of the innovation development of the economy, the notions of creation, purchase and utilization in manufacturing and in everyday life primarily of the innovative products and technologies.

CONCLUSION

In summary, it should be noted that the list of the proposed measures can be extended. The changes of the internal and external factors of the innovation development of the region as a territorially bound formation, require a constant perfection of the instruments of the innovation activity. It is supposed that proposed actions will allow the republic to raise innovation activity.

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UDK: 514.763 COBISS.SR-ID 222177292 **Review Article**

EVALUATION OF AN INDIVIDUAL'S DISTANCE PERCEPTION ACCURACY

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Summary: *To evaluate an individual's distance perception accuracy, a video camera and a light emitter controlled by the computer are mounted over the horizontal surface at a given height. A light emitter produces a light spot on the horizontal surface.*
The person under test is at the assigned distance from the boundary of the light spot. Within specified time programme-based and incalculably for the testee the direction and speed of the light spot are changed. Estimating the movement of the light spot, the testee changes his/her position to keep staying at a given distance from the light spot boundary. The movements of the light spot and those of a testee are being recorded by the video camera. The video image is transmitted to the computer, which, at regular intervals, calculates the distance from the light spot to the testee and the arithmetic mean value of the calculated distances from the moment when the direction or the speed of the light spot changed. The testee's accuracy of perception and evaluation is evaluated by the distance arithmetic mean value.

Keywords**:** *distance, perception, evaluation, accuracy*

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INTRODUCTION

Distance perception and evaluation can be done both with one eye vision (monocular vision) and with both eyes (binocular vision). In the latter case, the distance is estimated in a much more accurate way.

The ability to perceive and evaluate the distance is of great importance for vocational selection of employees of various fields. It is especially essential for physical education and sport, in the first place in the combat sport [9] and sport games [2-3].

The ability to perceive and evaluate the distance both on the map and on the terrain is necessary for orienteering. When measuring the distance on the map they use two methods: using the ruler and the visual method. For measuring the distance on the terrain, three methods are used: visual, by on-time movement and by the number of steps. The main way to measure the distance on the terrain is considered to be counting pairs of steps. Ocular estimate method is less precise, but very fast, and often the only possible method. It is this method that is also mainly used for estimating the distance on the map [21].

In sport, scientific and methodological literature there is some information on the person's ocular function that is associated with accurate perception of the remoteness of objects and on the possible distortions influenced by some conditions [6].

The purpose of the work is to develop the technology of distance perception and evaluation by the person.

The technology of distance estimation and perception ability

A video camera and a light emitter controlled by the computer are mounted over the horizontal surface at a given height. Light emitter produces a light spot on the horizontal surface. The person under test is at the assigned distance from the boundary of the light spot. Within specified time programme-based and incalculably for the testee, the direction and speed of the light spot are changed. Estimating the movement of the light spot, the testee changes his/her position to keep staying at a given distance from the light spot boundary.
The movements of the light spot and those of a testee are being recorded by the video camera. The video image is transmitted to the computer, which at regular intervals calculates the distance from the spot light to the testee and the arithmetic mean value of the calculated distances from the moment when the direction or the speed of the light spot changed. The testee's accuracy of perception and estimation is evaluated by the distance arithmetic mean value [4].

DISCUSSIONS

In psychology perception is viewed as reflection of objects, phenomena and processes with their direct impact on the senses in human consciousness. In the course of perception, aligning and association of individual sensations into coherent images of things and events occurs.
Physiological basis of perception is the interaction of the individual parts of the same or different analyser systems. The most important regularities of visual perception are [14]:
- integrity is the property of perception to create complete, solid views of the object based on a comprehensive stimulus;
- objectification is the property to correlate the visual image of perception with a certain object of the external world;
- conciseness is the property to create a sensual image achieved by a human's mental activity by understanding the value of objects and phenomena;
- generality (structural properties) is a reflection of individual objects as a special manifestation of the common, representing a certain class of similar objects;
- constancy is long persistence of certain properties and qualities of visually perceived objects;
- selectivity is a preferred choice of some objects or their properties over other objects or their properties and qualities;
- apperception determined by the dependence of perception on the experience, knowledge, abilities, attitudes, interests, a certain man's relationship with reality;
- fluency is speed of adjustment of the physical image by the brain on the eye retina for correct perception of the real properties and qualities of the object being its size, shape and proportions;
- flexibility is the readiness to quickly switch from the perception of a three-dimensional space to the perception of the picture plane and back.

The process of perception is regarded as perceptual activity of the subject, which helps to generate a complete image of objects perception. For visual perception the following actions are typical [14]:
- measuring actions which estimate the value of the perceived object;
- co-measuring actions to compare the size of several perceived objects;
- building actions responsible for the construction of the perceptual image;
- control actions aimed at comparing the image arising from the characteristics of the object;
- corrective actions correcting errors in the perceptual image;
- restorative (regulatory) actions keeping the necessary level of muscle tone for the processes of perception.

Perception and distance evaluation are referred to the professionally important qualities of:
- An automobile driver who mostly visually evaluates the traffic conditions, being the most important evaluation of the distance between the vehicles, pedestrians and various objects. Visual estimation is an important quality of a driver, an element of his/her professional skills. It was found out that most of the drivers' overtaking mistakes were committed due to misestimation of the distance to an oncoming automobile and its speed [20, 22];
- a surveyor, who needs a good visual evaluation of the size of objects and the distances between them [5];
- an engineering graphics specialist. When doing graphic work drawing skills, visual estimation and spatial imagination are developed [1];
- an artwork specialist for who eye sensitivity to the slight changes in the spatial properties of objects and, above all, the spatial relationships of objects are quite necessary [19];
- a boxer who needs a high level of special abilities represented in the following forms: spatial and temporal characteristics of motion (one's own and opponent's ones), specialised perception (sense of distance, a sense of time, sense of temperature), muscle and physical perception through the direct contact with an opponent [18]. It was found out that boxers-KO artist and team players are the most accurate to view the distance intervals and, to a lesser extent, the perception of distance inherent in heavyweight boxers [23];
- for taekwondo, when closer attention is required to control the distance. It is a priority for successful counter-attacks in the tactics of martial arts [12];
- for practicing judo, which requires a wide range of technical elements with a very complex movement structure that requires good space and time orientation based on the sense of distance and the sense of time [15];
- a footballer. It is proven fact that the sense of distance that allows one, first of all, to evaluate the opponent's position and that of co-players, affects the players' effectiveness and the efficiency of group interactions in probable conditions [16-17];
- a basketball player for who the sense of distance, as well as other special qualities, are the basis to master rational technique and the ability to use it to achieve high and permanent results [7].
- for tennis, especially in doubles, where a space and time symmetry of the players on the court based on the sense of distance and the sense of time is also important [8].

The visual way to perceive and evaluate the distance is the fastest and easiest, most accessible for everyone in any conditions. However, the exact eye estimation cannot be mastered immediately; it is worked out through systematic training carried out in a variety of conditions. The accuracy of the visual method of measuring is influenced by some other factors [25]:
- the larger objects appear to be always closer than the smaller ones, located at the same distance;

- the fewer intermediate objects located between the eye and the item observed, the nearer this item appears to be;
- when viewed from the bottom upwards, the objects appear to be closer and when viewed from the top downwards they seem to be located further.

The development of orienteering athletes' visual method is performed by doing the following exercises. An athlete runs along the road, meadow or forest. In certain locations (near the landmarks) he/she stops and estimates by eye the distance to other visible landmarks. Then the distance is evaluated by the number of pairs of steps and checked by the measurement on the map [13].

The ability to estimate the distance can be measured by giving the person under test the object in the form of a black silhouette of a man against a white background (40 x 50 cm sized), placed at distances as follows: 3.5; 0.8; 1.5 and 2.6 m. By the command, the testee opens his/her eyes for one second, closes them and immediately, without a pause, tells the distance to the silhouette. While attempting to do this, the error is measured in centimeters then arithmetic mean error for each distance is calculated [10].

To test the ability to perceive vertical and horizontal lines the person under test is given a vertical-horizontal figure being a horizontal line segment to which exactly in the center another line segment is vertically adjacent. Examining the test figure is done monocularly, the time of stimulus exposition is not limited. The length of the vertical line segment by the testee's command is changed by the experimenter up to the subjective equality to its length of the horizontal section at a step change of 0.1 cm. The difference in the perception of vertical and horizontal lines is set according to the reduction of length of the vertical line with respect to the length of horizontal line, which are averaged [11].

However, these methods of investigation suggest the static position of the testee, making it difficult to use for the vocational selection for various fields including sport.

Some neurological patients sometimes suffer from the rare neuropsychological disorder known as akinetopsia when the external movement is perceived as a sequence of still shots. A rapid movement is not perceived at all. Those patients' eyes are in order, the problem is a damaged extrastriate cortex, located in the medial temporal gyrus. The reasons of this disorder may vary from brain injuries to the antidepressants side effects [24, 26]. In the early stage of the disease, the use of technology to evaluate and develop the ability to perceive and estimate the distance will help to improve the patient's orientation in space.

CONCLUSION

The analysis of the scientific and methodological literature proves the fact that there observed a lack of perception and distance evaluation ability development techniques, their insufficient variety and intensity. At the same time, achieving high results in any activity largely depends on the development of specialised skills, including the ability to perceive and evaluate the distance.

The accuracy of the specialised perceptions is the first criterion to select potential athletes, especially in martial arts and sport games that require rapid situation assessment, the exact timing, distance estimation to perform attacks and defence. An athletes' well-developed physical and mental qualities cannot make compensation for their low level directly connected with the quality of technical and tactical actions.

The proposed technology of distance perception and evaluation ability could be used for vocational selection and career guidance including sport, as well as for operational monitoring and evaluation of training load effect upon the athletes' body.

This technology is useful for coaching children to raise their interest in physical training and to develop their mental functions. Furthermore, the technology can be applied to diagnose early stages of diseases connected with distance and space visual perceptio

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UDK: 338.48-53(470.11/.26-192.2) COBISS.SR-ID 222179852 **Review Article**

TOURISM DEVELOPMENT IN CROSS-BORDER REGIONS OF NORTHWEST RUSSIA: GENERAL TRENDS AND FEATURES

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Summary: *The article considers the development of tourism and recreation activities in the cross-border regions of Northwest Russia, reveals general trends and features. Tourism is considered as the current and future direction of social and economic development of the regions, which are attractive cross-border destinations. A number of measures are suggested to stimulate the development of tourism and recreation activities in the cross-border regions of the Northwest of Russia.*

Keywords: *tourism and recreation activities, cross-border region, tourism infrastructure, tourist flow, neighboring state, Northwest Russia*

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INTRODUCTION

At the turn of XX-XXI centuries the nature of cooperation between Russia and neighboring countries changed due to the transformation of social and economic space of the state in terms of processes of globalization and integration in the world community. During this period in the Baltic Sea region it become more intense the processes on the restoration of the historical interaction between states, the construction and development of new economic dialogue and intercultural contacts, the development of cross-border cooperation, including in the sphere of tourism and recreation. The development of tourism and recreation activities is perceived and recognized as a long-term (or top-priority) direction for regional development at the level of government, business and society. The specifics of geographic location, unique tourist and recreational potential of the border regions of Northwest Russia, which reveals opportunities for developing different types of tourism, defines the comparative advantage of these areas in the development of tourist business, taking into account the best practices of foreign cross-border destinations (Fedorov et al., 2011). The paper aims to identify common trends and patterns of development of tourism and recreation activities of border regions of Northwest Russia, which is one of the most promising and prioritized direction for the development of the studied regions.

MATERIALS AND METHODS

The study used the analysis of the conceptual and terminological system, analog approach, a group of statistical techniques, including a method of regression analysis and the method of analysis of time series.

RESULTS

In this paper, the general trends and features of development of tourism and recreation activities are considered on the example of the five cross-border regions of Northwest Russia with access to the land border. Russia's longest border in Northwest is the Finnish-Russian border (1325.8 km, 10 roads and 5 railway checkpoints, borders directly with the Republic of Karelia, Murmansk and Leningrad regions). The Republic of Karelia has the longest border with the European Union (more than 700 km, Finland). Leningrad and Pskov regions border with Estonia (more than 460 km, 3 car, 2 railway and 1 pedestrian crossing points). On the border with Latvia, Lithuania and Poland 4 road and 2 railway crossing points are operated. The shortest border is the Russian-Norwegian border (219.1 km, Murmansk region) (Elektronnyi resurs, 2015).

Research of tourist business development in the border regions of the Northwest Russia shows the trend of rising tourism and recreation for the period 2011-2014. (Table 1).

Well developed tourism infrastructure that meets international standards is the basis for ensuring the provision of a wide range of competitive tourist services, attraction of tourist flows in terms of inter-regional and cross-country competition for investments, resources and tourists. (Fedorov et al., 2011). The current level of development and the effective functioning of the regional tourism infrastructure largely determine the possibility of using the tourism potential of the area without harming the environment and, ultimately, the effectiveness of the development of regional tourism business. (Abramova, 2011; Vinogradova and Soldatov, 2009; Pogorelova, 2011).

Table 1. The dynamics of individual indicators of tourism and recreation activity in the cross-border regions of Northwest Russia in 2011-2014.

№	Cross-border region	Hotels and similar accommodation facilities	Fee-based service, mln of rubles	
			Tourist services	Services of hotels and similar accommodation facilities
1	Murmansk region	increase of 6%	1,7 times increase	increase of 9%
2	Republic of Karelia	increase of 16%	1,3 times increase	1,4 times increase
3	Leningrad region	1,2 times increase	2 times increase	2,1 times increase
4	Pskov region	same	4,3 times increase	1,35 times increase
5	Kaliningrad region	1,25 times increase	2 times increase	1,22 times increase

According to the survey the level of tourism infrastructure of Northwest border regions (per 1 thousand people) is slightly above the Russian average, determining the prospects of development of tourism and recreation activities (Fig. 1). Kaliningrad region is an exception with the level of the foodservice infrastructure development below the average (8%).

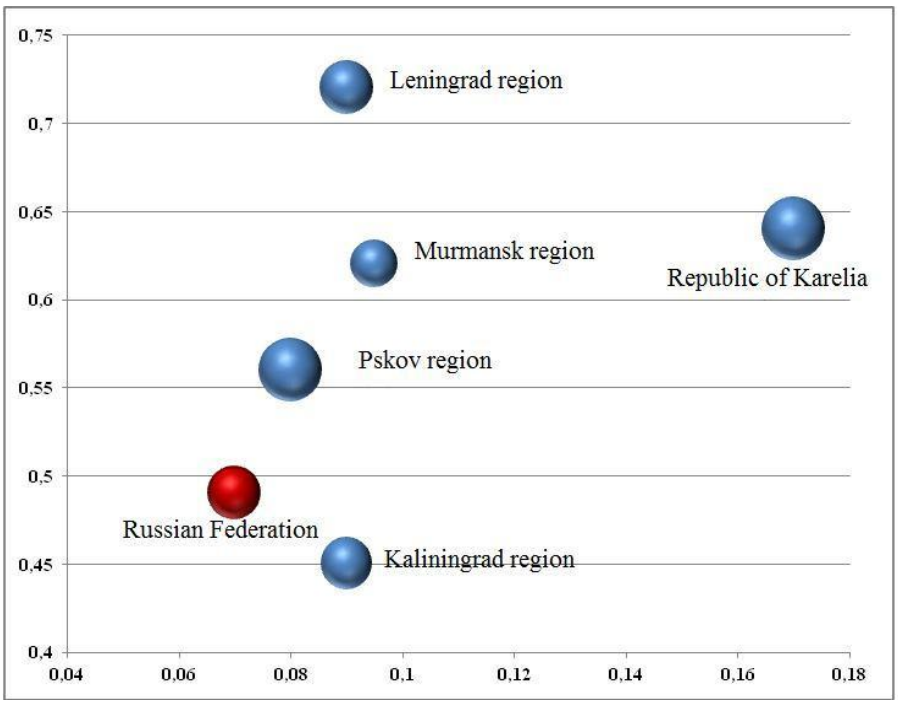

Fig. 1. Distribution of the level of tourism infrastructure of Northwest Russia border regions, 2014: X [hotels and similar accommodation facilities per 1 thousand people];

Y [restaurants, cafes, bars per 1 thousand people]; Z [size of the ball, museums the Ministry of Culture of Russia per 1 thousand people].

However, it be should indicated a certain territorial difference of regional tourism infrastructure development which is characterized by the high concentration of tourist infrastructure in the major centers with the trend of reducing the number of facilities (accommodation, foodservice, entertainment and leisure) to the periphery of the region. In many respects this may fail to correspond to the tourist and recreational potential of the territories and, consequently, to the existing capacity and orientation of tourist flows, thereby it reduces the performance indicators of the tourism business and the regional economy as a whole.

The occupancy ratio of rooms in hotels and similar accommodation facilities on the border regions of Northwest Russia is an average of 0.33 during the period 2000-2014. That is due to the distinct seasonality of regional tourism business. The main activity of the tourism enterprises of the Republic of Karelia is carried out during the summer season (May-September) with a small peak of activity during the New Year and Christmas holidays.

Considering the dynamics of tourist mobility, it should be noted that inbound tourist traffic from the territory of neighboring states is of certain importance for the development of international tourism in the border regions. And if the volume of tourist traffic from neighboring countries to the territory of Russia can be considered as insignificant in the total

flow of incoming in the country, it may be considerable for the cross-border region (which often takes a large share). Also it should be taken into account the financial costs of travelers and social and economic effect resulting from the development of this area of economic activity (due to the multiplier effect, the diversification of the regional economy).

Research of international tourism development in the border regions of the Northwest Russia in terms of tourist mobility brings its high dependence on the preferences of tourists from neighboring countries and assumes some vulnerability of the tourism economic sector on market conditions, and opening opportunities for diversification of the tourist product offer at the same time (Table. 2).

The Republic of Karelia hosts the largest share of tourists from Finland (75% of the flow in the Northwestern Federal District, 2013), Murmansk region has 56% of tourists from Norway, Kaliningrad region accepts 22% of tourists from the Baltic States, Pskov region hosts 18% guests from Poland. These figures show that cross-bordering Northwest regions have the advantage of other destinations in the reception of tourists from neighboring countries. The most dependent on the preferences of the tourists from a neighboring state are the Republic of Karelia and Leningrad region, where all inbound flow of organized tourists is formed by Finnish tourists (99% for Karelia for the period 2008-2014 and 100% for Leningrad region, 2010-2014). More than 70% of tourists in Kaliningrad are tourists from Germany (2008-2014), which is explained by the specifics of the region's development in historical retrospective.

Table 2. The combined share of border regions in the reception of tourists in the Northwestern Federal District and the Russian Federation on the whole in 2014, %

№	Neighboring country	NorthwesternFederal District	Russian Federation
1	Finland	80%	76%
2	Norway	56%	24%
3	Baltic States	25%	22%
4	Poland	20%	16%

At the same time outbound flow of Russian tourists to the neighboring states go in times beyond the flow of inbound flow of foreign tourists to Russia, which reveals Russian destinations insufficiency as compared to foreign destinations (Stepanova S.V., 2014). For example, in the Russian-Norwegian direction in 2014 outbound flow is 10 times higher than inbound one, outbound flow to Finland and the Baltic countries is higher in 7 times, to Poland - in 2.6 times. The observed steady growth of outbound flow in 2005-2014 and actively pursued foreign states policy to attract Russian tourists in the coming years are able to strengthen the tendency (for example, the experience of Poland and Finland).

Shopping tourism, which has much in common in different parts of the world, and includes visits to make purchases abroad, shall be marked as one of the areas of cross-border tourism (Timothy, 2005; Werner and Kai, 2005; Batyk and Semenova, 2013). Shopping tourism is a general trend of tourism development for the border regions of Northwest Russia: Kaliningrad region and Poland, Leningrad region and the Republic of Karelia and Finland, Murmansk region and Norway, it should be emphasized that shopping tourism is primarily outbound with respect to Russian borders. The reasons for the negative balance of streams of shopping tourists besides geographical proximity are pricing, convenience of store operations, similarity of languages (Polish and Russian to facilitate communication) or service in Russian (in the border towns in Finland, Norway), information and tourist literature and tourist sites in Russian, «tax free» system and so on. (Bar-Kołelis and Wiskulski, 2012). It is of particular

importance to stimulate the development of this direction of tourism the Agreement on the order of local border movement between Kaliningrad region in Russia and the northern provinces (voivodships) of Poland of 14.12.2011 (earlier agreement on visa-free regime, from the beginning of 90s to 2003) (Kretinin and Ostashkova, 2012; Shil'berg, 2009).

Researchers specify also "nostalgic" tourism as one of the types or stages of cross-border tourism development (Morales et al., 2013). The peculiarity of the formation and development of tourism as an area of economic activity (in contrast to the understanding of tourism as recreational activities without significant economic benefit of the Soviet period) is the development of "nostalgic" tourism in the Republic of Karelia and the Kaliningrad region. The opening of the borders, visa facilitation, the beginning of the international border crossing points operation has played a positive role in the generation of tourist flows from abroad, and provision of services to "nostalgic" tourists laid the foundation of the modern tourist business in the region (Republic of Karelia - tourists from Finland, Kaliningrad region - tourists from Germany).

CONCLUSION

Based on the general trends of development of tourism and recreation activities in the border regions of the Northwest Russia, taking into account current and future development of this area of economic activity, we can suggest a number of measures in order to facilitate the strengthening of the role of tourism in social and economic development. The spatial development of tourism, the reduction of territorial differentiation of the tourist infrastructure is possible through an integrated approach that takes into account the interests of the trinity of government, business and society partnership, formation of competitive tourist and recreational clusters (Spiriajevas, 2008; Shulepov and Tsvetkova, 2013) in the border regions. The focus of business only on shopping tourism poses risks of various changes, such as the appearance of the difficulties of crossing the state border. However, the focus on domestic demand and the needs of shopping tourists may be one of the most advantageous areas of commerce for the border region, given the impact of business activities on the social and economic development of the territory. Implementation of measures and programs aimed at the development of business and event tourism could prolong the tourist season by attracting flows in the off-season. The comparative advantage of border regions in the reception of tourists from neighboring countries, both with high exposure and vulnerability of the international tourism sector on the situation of tourism demand can be reduced on the basis of proposals of the tourist product differentiation, enhance promotion of the region on the international market of tourist services. In addition it is possible to combine the border regions of two or more neighboring countries to build and offer "multi" tours. Inter-regional cooperation between Russian regions during the formation of the tourism product to be included in the multi-day tours visiting several areas is of particular importance for the development of tourism in border regions. Thus, certain general tendencies and features of tourism and recreation activities in the border regions of Northwest Russia show the prospect of this area of economic activity development. The proposed measures will ensure the increase of entrepreneurial activity in the tourism sector, to increase the use of tourist and recreational potential of the territories, to ensure stimulating effect on the social and economic development of the regions.

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UDK: 005.96(470) COBISS.SR-ID 222180876 **Review Article**

UNIVERSITY-SUPPORTED DEVELOPMENT OF INNOVATIVE ENTREPRENEURSHIP AMONG THE YOUTH

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Summary: *This article examines the current state of development of innovative infrastructure in the Volga State University of Technology and provides an analysis of the university's role and place in the system of preparing students for the development of innovative businesses based on the commercialization of intellectual property.*

Keywords: *State, science, business, education, innovation, intellectual property, infrastructure, small innovative enterprise.*

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INTRODUCTION.

The prestige of technical higher education in Russia is undoubtedly great. Preparing specialists in scientific, technical and engineering spheres, it is rightly recognized as one of the largest and most recognized branches of the national education system.

Today, society's sustainable development is impossible without significant cooperation between education and business. The university's special task is the preparation of experts who, upon graduation, are able to quickly adapt to the reality of a given economic sector. For this purpose, it is important to pay close attention to the formation and development of innovative and entrepreneurial thinking among the youth. In this case, the university needs to modernize the learning process in order to create conditions for training professionals who are capable of creating and developing businesses. With the passing of the Federal Law 217-F3 on August 02, 2009, state educational institutions are able to generate ready-made business structures and introduce them into the market. This is a new challenge for the institutions of higher education, but its resolution will allow all students entering the university to expect, as a result of their studies, to acquire current knowledge and skills needed to create their own innovative businesses.

The project aims to create a system within the university that would allow for developing technology transfers and conducting the commercialization of research through creating innovative enterprises, while addressing important social issues in the context of the country's profound commercialization.

Developing the "idea-patent-business" thesis, we are faced with the tasks of systematic selection and analysis of competitive ideas, their legal defense, support and advancement of projects at all stages of the innovation cycle and, undoubtedly, the provision of human resources to support the commercialization process.

In all of these tasks, institutions of higher education should play a huge role through their engagement with the external environment and the development of their own infrastructure and organizational systems.

Volga State University of Technology is one of the "solid provincial institutions of higher education" in the country. It is a multi-level integrated system of continuous professional education, which includes subdivisions of different levels: primary, secondary and tertiary. This structure has provided the support for reforming the system of professional qualifications for preparing professionals in different spheres and specializations. Taking into account the labor market and the priorities of development of the economic and social environment in Mari El Republic and the Volga Federal District, this reform increased the effectiveness of professional education in the region.

In order to sustain its competitive status on a high level, the University's team is receptive to the experience of other organizations around the world and flexible in relation to new directions in scholarly research and teaching methodology. It is particularly active in developing initiatives based on current developments in information technology, including distance learning. The innovation infrastructure of the University is being developed and perfected in order to improve the quality of creating and promoting innovative projects (fig 1).

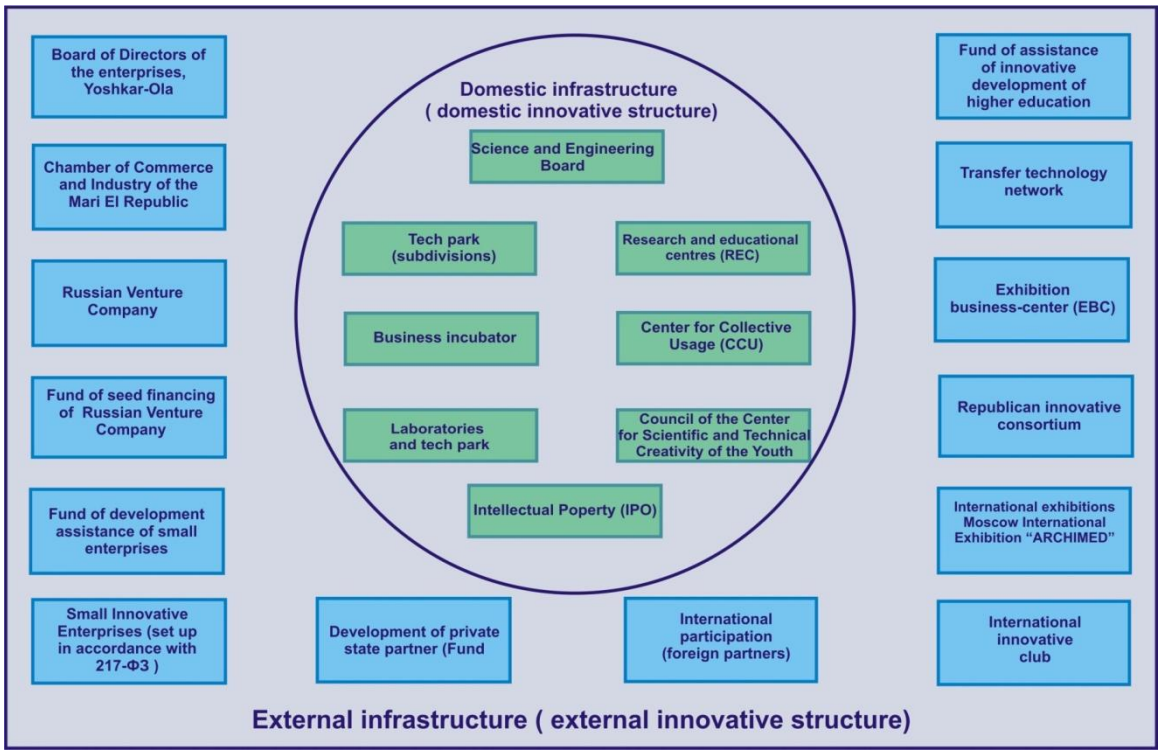

Fig.1 University's innovative infrastructure

Taking advantage of its multidisciplinarity, the University developed competitive advantages in the spheres of both research and education, as evidenced by the presence of an effective Centre for Shared Equipment, complete with unique resources; eight centres for research and education, created on the basis of recognized scientific schools, as well as current bio-, nano-, energy-saving, information and communication technologies; a well-developed system of continuous education (vocational programs, higher professional education, postgraduate, professional qualifications); important international and Russian strategic partnerships; an effective tech park; a business incubator; a student design centre; small innovative enterprises; a unique Botanical Garden Institute; a unique Educational and Experiential Forest Management Unit; effective patent production; high growth rate of the

volume of R&D; effective system of attracting young people to R&D through educational activities and the UMNIK and START programs; integration and partnership with foreign universities in preparing professionals; contemporary innovative educational technologies (state scholarships, credit point system, online exams, online competitions).

To develop a system of cooperation between the university and the business sphere (potential employers), both as part of the learning process and in collaborative research studies and projects, the University uses a cluster model (fig.2).

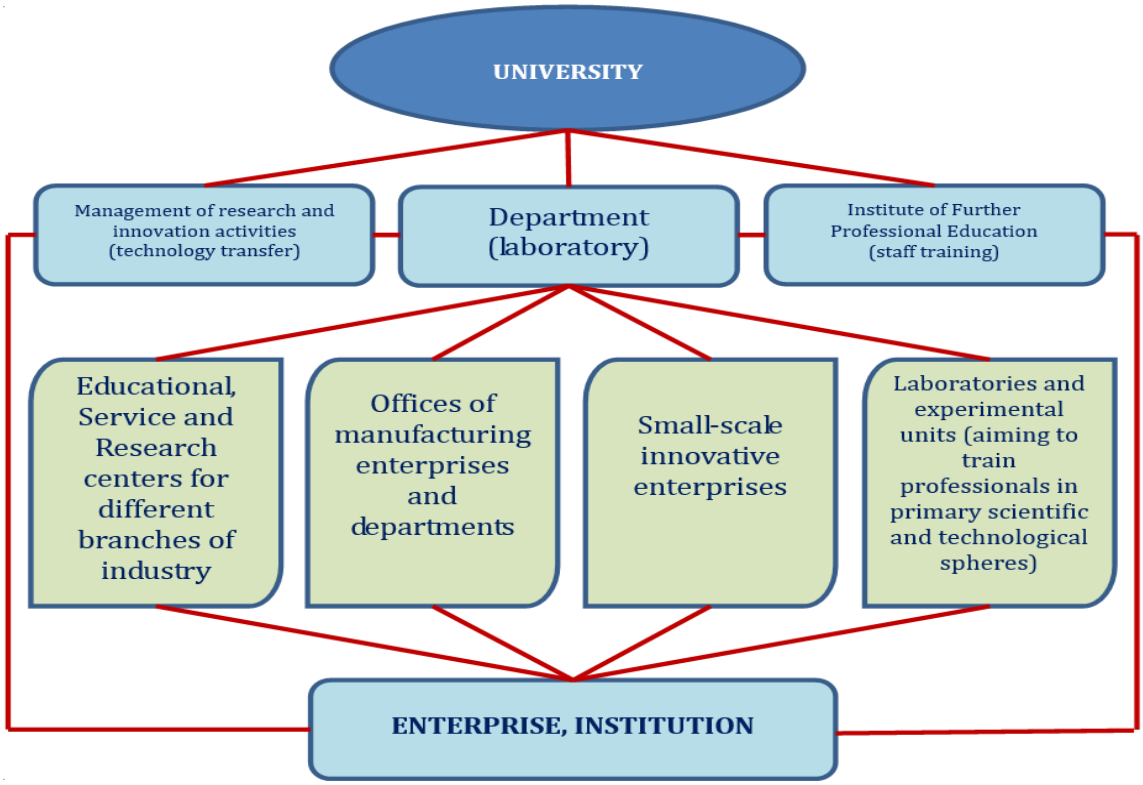

Fig. 2 Science, Innovation and Industry Cluster

The University has an integrated system for supporting the scientific creativity of students: a student grant competition and the Young Scientist grant competition for graduate students. Young scholars actively participate in competitions for presidential grants, grants from the Russian Foundation for Basic Research, grants from the Russian Foundation for Humanities and grants from international foundations (fig.3).

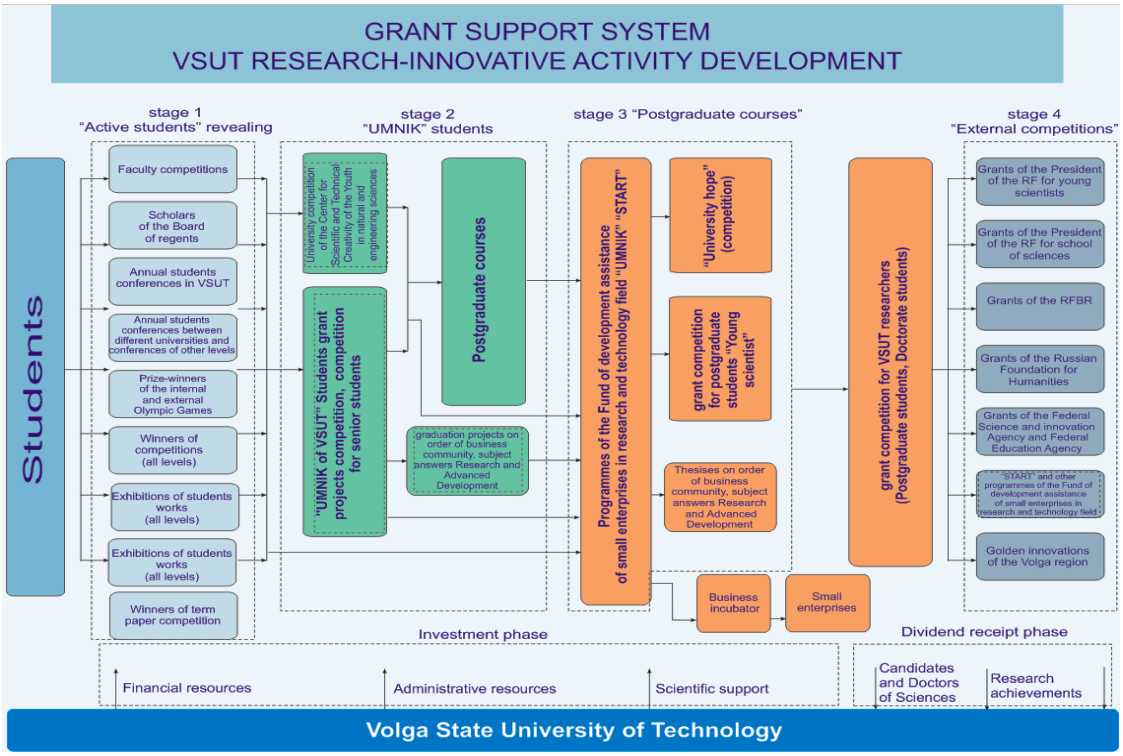

Fig.3. Grant support system for research and innovation development at VSTU

Due to this system and the measures taken, our students, graduate students and young scholars are actively integrating into the Russian academic and educational space by participating in federal programs, conferences, competitions and exhibitions in Science and Technology.

Moreover, the grant support system is a method of identifying talented youth who are capable of creating projects of innovative character. During the first stage, students are expected to produce scholarly research and construct projects, which guarantee the creation of an intellectual reserve for successful preparation for applying to graduate school and working on a Candidate's dissertation. Students are also expected to work on projects that aim for the creation of a private business. Students identified at this stage participate in conferences on the levels of the city, the region and the country. In this way, by the time a student finishes fifth year, he or she usually has two to three publications and experience presenting papers. The Board of Trustees has created twenty scholarships named after the scholar S.I.Vavilov for students who exhibit excellent results and actively participate in student research competitions. To further the development of innovation and academic work, the University developed and instituted the Student Grant Competition Provision.

To facilitate communication between students, the University annually organizes subject-specific competitions, scientific conferences and seminars, competitions of graduation projects, contests of best student academic works, exhibitions of students' creativity in Science and Technology, and meetings between students and scientists. To celebrate University Day during the Student Science Month, the University puts on a Student Conference of Science and Technology, which results in the publication of student papers in the collection of conference proceedings. Student science clubs and a student design centre are working within VSUT. Especially notable events are reflected in TV and press reports.

One of the University's strategies for encouraging young people's interest in creativity in Science and Technology has been to lend active support in the preparation of projects for participation in the UMNIK program, a youth competition in science and innovation. The

University also supports the Fund of Development Assistance for Small Enterprises in the Sphere of Science and Technology, as well as the Innovative Russia's Research and Education Specialists program. This support includes teaching engineering entrepreneurship and conducting workshops and seminars. As a result, over 1600 young people participated in VSUT's UMNIK program in recent years, with over 200 winning projects. The UMNIK-VSUT club was created by university students, graduate students, and young researchers who achieved impressive results in scholarly research and commercialization of Research and Development.

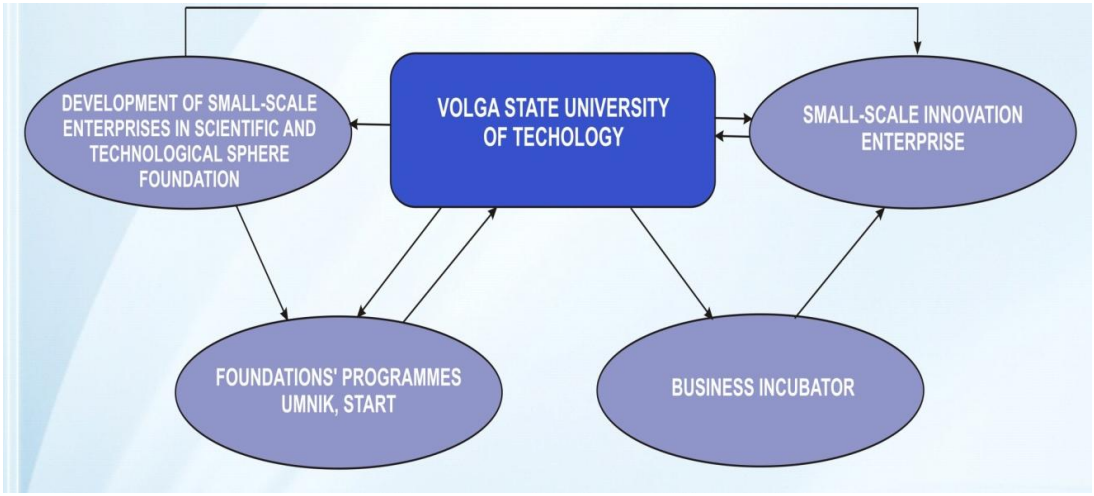

Fig. 4 The system of creation and support for small innovation-based enterprises

It is important to note that the Fund's activity and its UMNIK program facilitate the active development of the students' creativity in Science and Technology and the formation of skills in engineering entrepreneurship.

Due to the University's active cooperation with the Fund of Development Assistance for Small Enterprises in the Sphere of Science and Technology, it was possible to create a whole system of support for young people's innovative businesses (fig.4), in accordance with Federal Law 217, which allowed for the creation of 24 small innovative enterprises employing 72 people.

With the development of the model of innovative business in the university, we see a gradual emergence and formation of the system and methodology for selecting and moving projects from knowledge generation to creation of business structures (fig.5).

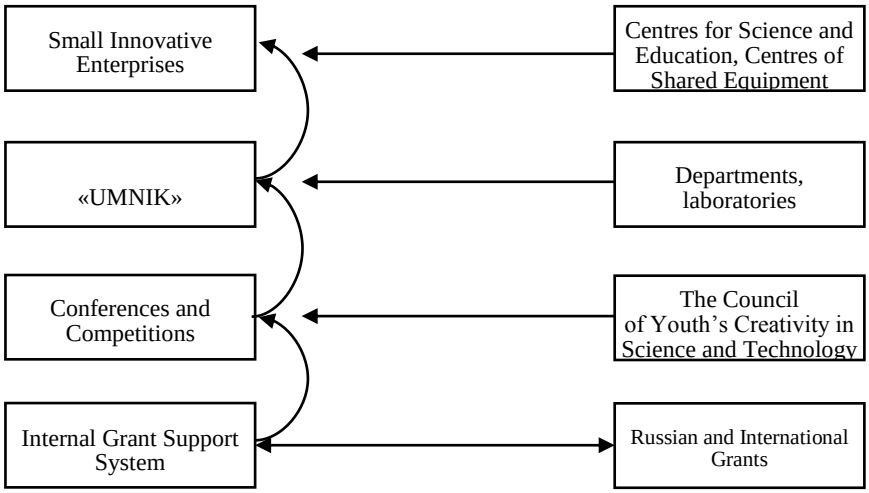

Fig.5 The model of innovative business development in the University

Today most research projects in the University are initiated by the scholars and instructors themselves. For this reason, their inventions do not always generate interest from working enterprises, even when they contain ground-breaking ideas. This is why we are striving for a significant portion of R&D projects produced by special order of industry enterprises, which is currently 30%. As a result, the University boasts a significant number of young scholars whose projects have won competitions of the Innovative Russia's Research and Education Specialists program. In the past years, VSUT has been recognized as an innovative institution of higher education at the International Salon of Invention and Innovative Technology "Archimedes" in Moscow.

It is, however, necessary to keep in mind that an invention on its own does not fully constitute a commercial product. It is more of a technical idea, which requires material resources for its realization. In this case, it is the commercial appeal of the new innovative product that is important. The uncertainty of such appeal leads many enterprises today to be reluctant about expending material resources.

To sum up, we can say that there is a need for a state-level system of measures to facilitate the transfer of innovative university projects, including inventions. It is necessary to create conditions under which the inventor participates only in the first stage of this process, and is supported by other professionals further on.

Another approach, which was set in motion by the Federal Law 217, is the commercialization of projects within small innovative enterprises created with the university's participation. The inventor plays a main role in this process today.

The interaction of the state, the education system, and business (fig.6) in the context of creating small innovative enterprises is yielding positive results in solving the most important social problems.

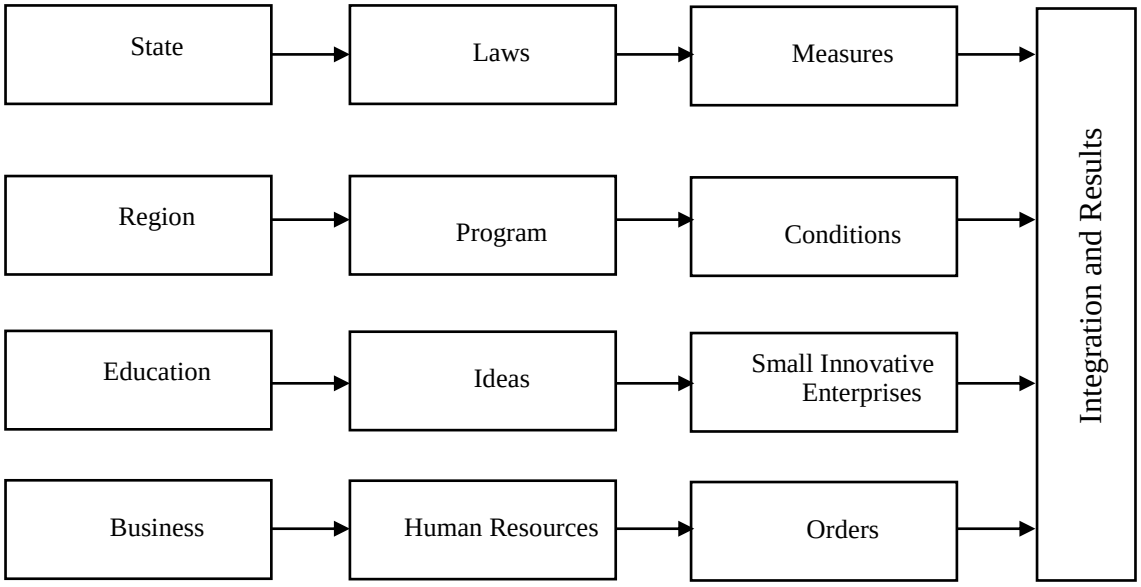

Fig. 6 The interaction of the state, the education system and business

Young people recognize that Russia is systematically moving towards a knowledge-based economy and that receiving quality education forms the basis of their future careers. VSUT is working on the creation of additional possibilities for receiving such an education through the innovation infrastructure at the university. Systematic work in this direction through the system of internal and external support of student projects is already yielding

positive results, increasing the role of university scholarship and education in the economic development of the region.

CONCLUSION:

Results presented in this paper show that with the right organization and encouragement of innovative work of young scholars in state institutions of higher education, it is possible to achieve the active involvement of young people in the development of small innovative enterprises and in the process of creating a knowledge-based economy in Russia.

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UDK: 338.242.2(470) 005.21:331.5 COBISS.SR-ID 222181388 **Review Article**

LABOR MARKET AS A FACTOR OF MARKET ECONOMY

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Summary: *The article deals with the problems of labor market formation as a factor of market economy on the basis of evolution of conceptions, patterns and scientists' interpretations. The comparative dynamics of employment and unemployment indices on the international, national and mesoeconomical levels was conducted. We revealed the problems and determined their solutions with the use of monitoring of labor market indicators and social researches.*
Keywords: *labor market, market economy, unemployment, employment, unemployed citizens, employers.*

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INTRODUCTION

"Labor market consists of all those who buy and sell labor" -
Ronald G. Ehrenberg, Robert S. Smith [11].

Labor market is the most complicated element of the market economy and an important sphere of economical, social and political life of society. It reflects the main tendencies in the employment dynamics, social division of labor, influences the unemployment rate. One can measure the labor market changes with indicators which characterize the state of its components: supply, demand and work force cost, infrastructure, market condition and labor market competition. As the methods of these measurements we have chosen the following ones: monographic (to study evolution, patterns and scientists' interpretations); economic and statistic (to monitor the labor market); expert survey method (to reveal priorities, problems and realization measures).

EVOLUTION OF CONCEPTIONS, PATTERNS AND SCIENTISTS' INTERPRETATIONS

About labor market

In economic theory one can distinguish the following conception approaches to the analysis of the labor market functioning:

Classical and neoclassical conception (A. Smith, D. Ricardo, J. Perri and others). Its essence: labor market operates on the basis of price equilibrium, salary regulates supply and demand of work force, when there is the balance on the labor market unemployment is impossible, it has only voluntary nature.

According to A. Smith market economy is able to provide the total use of work force resources: "Give me what I need, - he wrote – and you will get what you need**!"** [12].

However, we believe that this theory does not correspond to the modern reality, as under the market conditions it is impossible to talk about total employment and absence of unemployment.

Marxist conception (K. Marx, F. Engels, V. I. Lenin and others) determines labor market as the market of a special kind where the item of goods is work force that creates cost, influences the correlation between supply and demand, market price. According to K. Marx: "…capital is divided into permanent capital or the cost of production means, and changeable capital or the cost of work force, i.e. the total sum of wages" [10].

Keynesian and monetarist (J. M. Keynes, R. Gordon, M. Fridman and others) are based on the following concepts: the labor market is the phenomenon of constant and fundamental balance; the cost of work force (wages) is strictly fixed and can be hardly changed; workforce supply is regulated not with the fluctuations of market prices of labor but with the total demand or production volume [13]. J. Keynes came to the conclusion that market capitalist economy does not have automatic balance in economy and employment; for this purpose effective demant is needed [13]. The monetarist's school representatives lean on non-flexible work force cost structure, introduce the idea of "natural" unemployment level.

Institutional conception (J. Danlon, L. Ulman, J. Galbraith, T. Veblen and others) interprets economics in the field of employment in wide sense. According to authors' opinion in modern conditions under the influence of economical, social, juridical and demographic factors it is created the institutional environment which consists of formal and informal institutions [9]. Formal institutions include the institute of state, laws, employment services, social agencies and establishments. The system of informal institutions is represented by ethnical and social and psychological institutions which include traditions and customs of certain peoples' employment (fig.1).

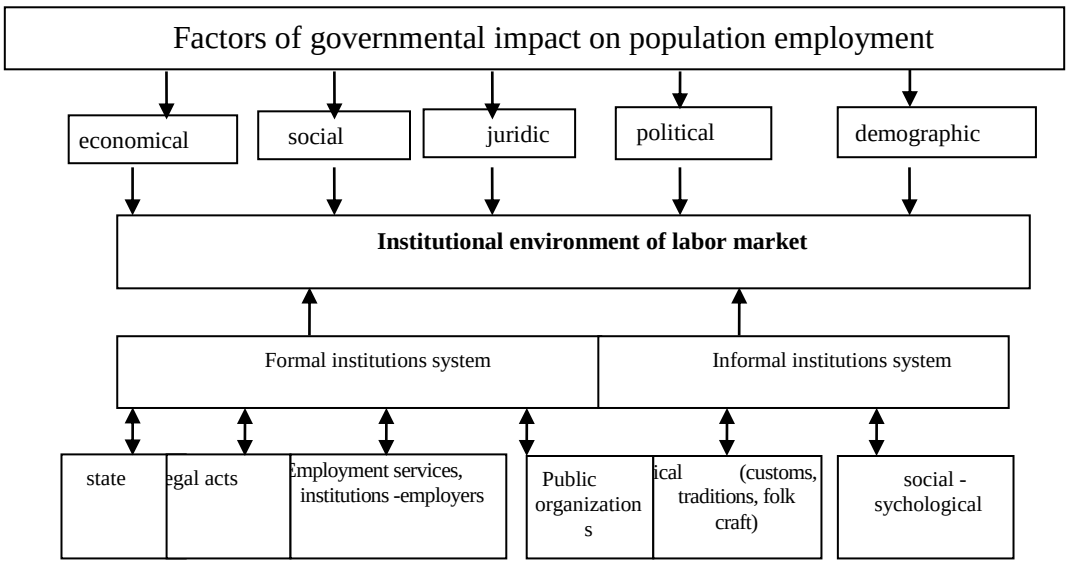

Fig. 1 Main components of labor market institutional environment

All mentioned above conceptions lay in the base of different patterns (construction schemes) of labor market. Each country forms its own labor market taking into account the peculiarities of economics. Some countries are oriented to the foreign market, others – to the

domestic labor market. One distinguishes Japanese ("lifetime hiring" principle, advanced training), American (decentralization of employment legislation, foreign market predominance преобладание) and Swedish (active government policy and unemployment prevention) patterns.

Labor market has always been the subject of scientific researches. Among economists there is no unity of this concept interpretation: some use the term "work force market", others – "manpower resources market", still others – "labor resources market". In modern economic literature one can find two definitions of labor market: in wide sense (L.I. Abalkin, A.V. Kashepov, R.I. Kapelyushnikov) and in narrow sense (L.A. Kostin, A.E. Kotlyar, A.D. Arzamastsev). In our opinion, the most suitable definition is that which is connected with the object of buy-sell-workforce. At the same time labor is the process of creation of material and nonmaterial benefits and services. That is why the concepts of "labor market" and "work force market" are not synonymous. :

work force market is the complex of relations between work force owners (independent citizens) and work force buyers (entrepreneurs);

labor market is the system of social relations reflecting the interests balance between market participants: entrepreneurs, employees and government.

A lot of legal acts of International Labor Organization are devoted to the problems of employment. The most important among them are: Convention no. 2, enlarged with Recommendation no. 1 about unemployment (1919) [1], Convention no. 122 and Recommendation no. 122 "About labor policy" (1968) [2], Convention no. 150 and Recommendation no. 158 "About labor issues regulation" (1978) [3], Convention no. 168 and Recommendation no. 176 "About employment assistance and unemployment protection" (1988) [4] and others. Many of these international labor standards were ratified in the Russian Federation and were laid in the base of The Constitution of the Russian Federation (section 37) [5], Labor code of the Russian Federation [6] и the RF Law Закона РФ "About population employment in the Russian Federation" [7].

RUSSIAN PATTERN OF LABOR MARKET

The Russian pattern is closer to the foreign labor market. It is commonly known that during a long period the subject matter of work force employment was not raised. It was considered that the principle of total employment under socialism worked automatically. Consequently, there was no need to develop unemployment issues, labor motivation, work force mobility. Under the market conditions from all the production factors a man appeared to be the most vulnerable one [15]. That is why there were introduced such notions as unemployment, employment, labor activity decrease, violation of fair forms of labor distribution. The problem of work places deficiency from the one hand, and labor redundancy from the other hand have local and structural nature as a result of insufficient working-age population mobility [17] .

The labor market formation is complicated by such market phenomena as: restructuring and diversification of economy branches lead to the reduction of ineffective work places and workers release [14]; changes of population age structure (its ageing) cause reduction of working-age population and labor resources deficiency; disintegration processes on the labor market and territorial disproportion of supply and demand cause in some regions stagnant unemployment, and in others – work force deficiency; production modernization and science-driven technologies lead to the imbalance of professional and qualification structure of work force supply and demand, disproportions on the labor and educational services market; high differentiation in the payment rate causes the outflow of highly qualified personnel and demand decrease to the professional education of blue-collar jobs; economic

sanctions have aggravated the situation on the regional labor markets; fiscal policy demands further flexibility towards employers creating work places for socially vulnerable citizens [18]. Under such conditions employment decreases (fig.2) and labor market tension increases (fig.3) in the Russian Federation, Volga Federal District and the Republic of Mary El.

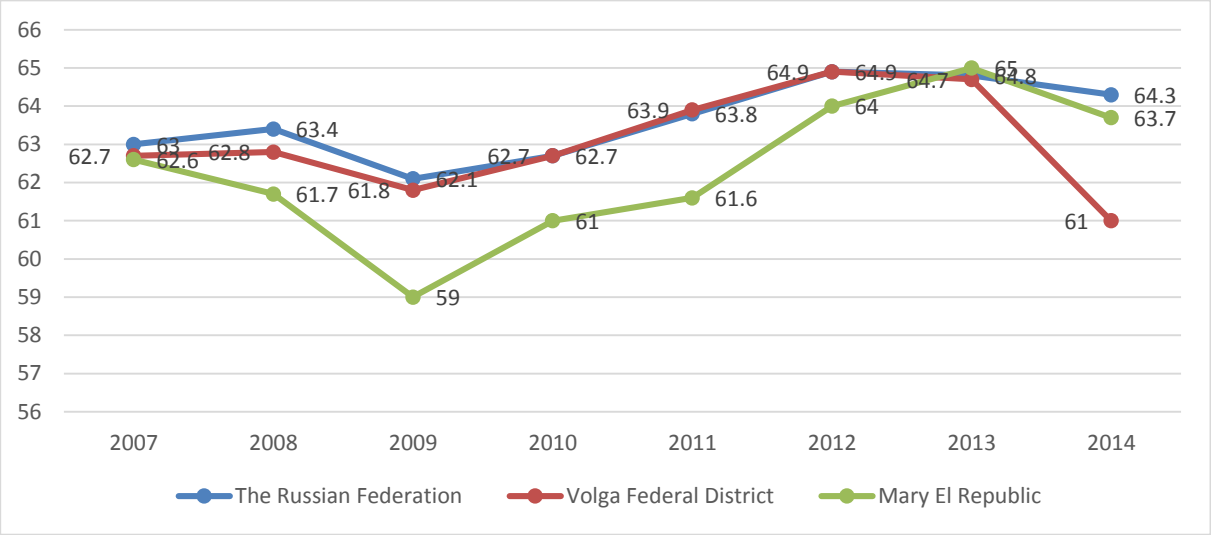

Fig. 2 Dynamics of employment level in the inter-crisis period, %

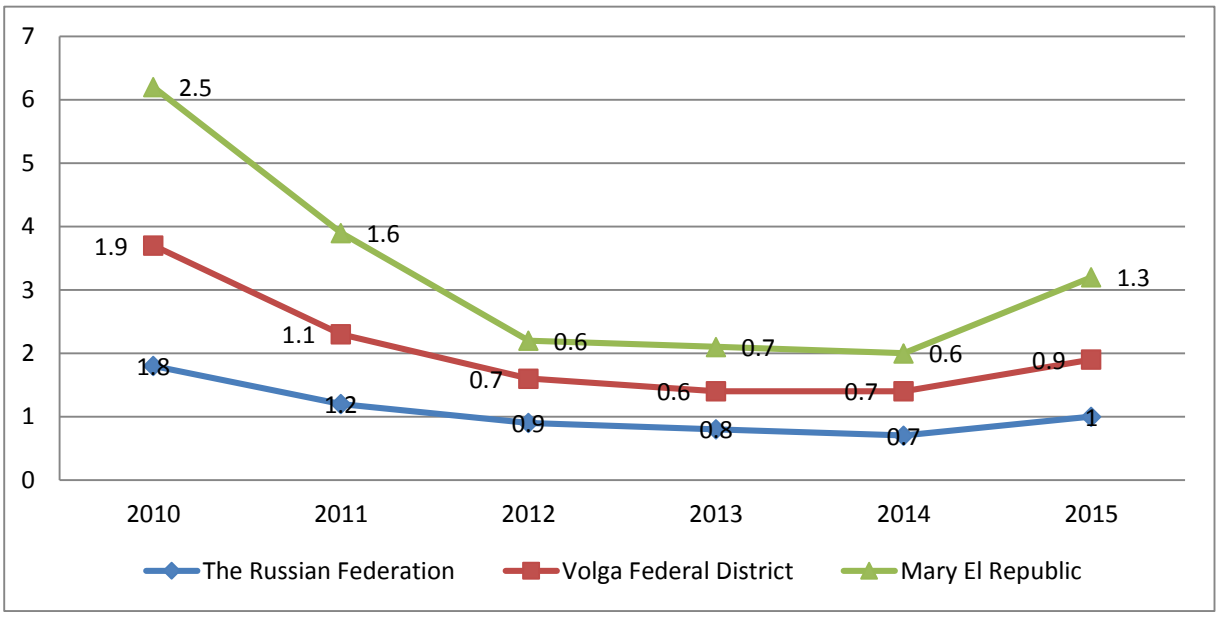

Fig.3 Comparative dynamics of the market tension coefficient in the post-crisis period, persons

The processes in the social sphere set for the science and practice a lot of difficult and absolutely new problems that are covered in the plan of high priority measures of the Russian Federation to provide stable development of economics and social stability, the main aim of this plan is "achievement of the balance and tension decrease on the labor market, assistance to the effective employment" [8]. These measures in the context of economical sanctions allowed to keep the stability of unemployment rate: in Russia it is less (5,4%) than in some countries of the Western Europe (fig.4).

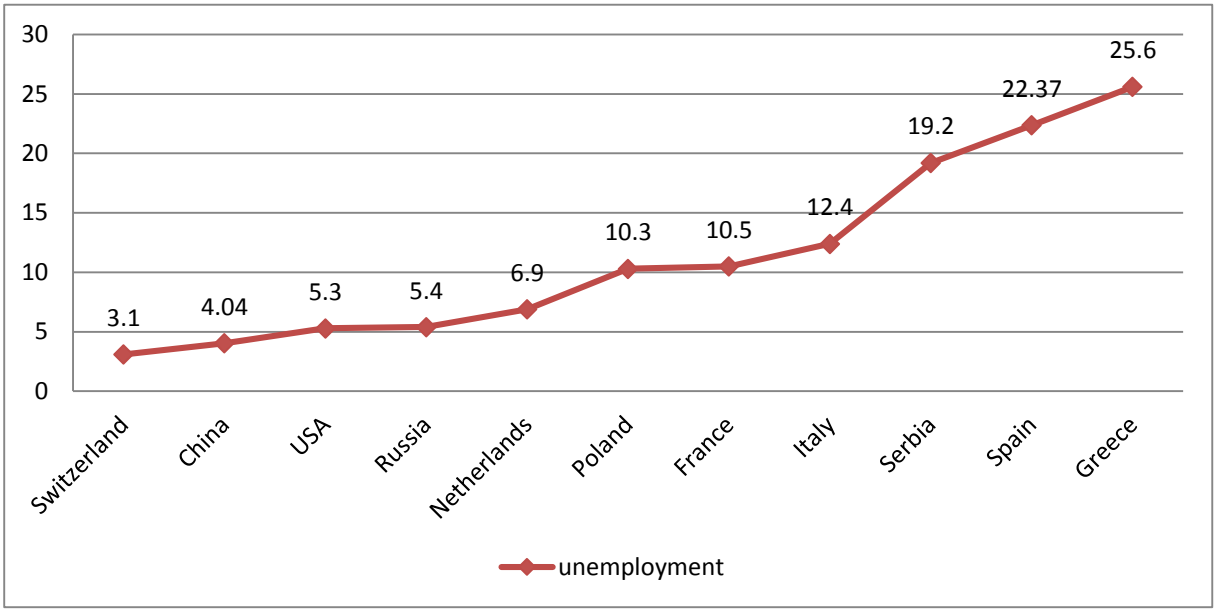

Fig.4 Indices of general worldwide unemployment level in the 1st of July, 2015

It is known that labor market is situated on the single economic area; it is affected by political, social, and demographic factors. Irregularity of economic development in regions causes macroeconomic territorial differentiation. To prove this fact the authors conducted monitoring investigations and expert survey through the example of the Republic of Mary El.

LABOR MARKET ON THE MESOECONOMICAL LEVEL

The Republic of Mary El refers to the group of industrial and agricultural regions of the Russian Federation. The leading fields of economy are agro-industrial, forest and military sectors, which were the most subjected to the reforming and modernization. During the reformation period in Russia (1990-2015) Mary El Republic was three times declared as one of the areas with tense labor market situation: in 1999, in 2004 and in 2011. The coefficient of tension which is determined as the relation of unemployment population rate to the number of vacancies reached 60 unemployment citizens on one position. The work force supply two times exceeded the demand, and the total unemployment index was 10%, that is two-three times higher than the official (registered) unemployment level.

To fix the situation on the regional labor market the government of Mary El Republic has undertaken effective measures:

has developed and been successfully implementing the complex program of creating and saving work places which allows to create annually from 3000 to 4000 new work places;

development of entrepreneurial activity and self-employment in the context of republic's special-purpose program "The development of small and medium businesses in 2012-2016". Nowadays in Mary El Republic it is registered more than 9000 small enterprises and more than 13000 individual entrepreneurs where the number of employed people is 69000 that is 34,5 % of the total amount. During the years of economic reforms more than 6000 of unemployed citizens were directed to self-employment. The amount of payment to all those

who wish their own business was increased up to 58,8 thousand rubles, and in the cattle production field up to 88,2 thousand rubles;

professional training, re-skilling and further personnel training in the context of Measures complex of education modernization in the Republic of Mary El in the period till 2020; annually in this sphere one gets almost 1,5 thousand services;

realization of republic's special-purpose program "Assistance to the citizens employment in Mary El Republic in 2010-1020", which allows annually direct citizens to the active employment forms (more than 100 thousands unemployment people), including public works (21,3 thousand people), self-employment (1434 people), and professional training (11 thousand people).

All these measures had the positive impact on the situation in the field of employment. On the figure 4 one can see that the unemployment rate in the Republic of Mary El is lower on 0,14% than the average rate in the country (1,16% against 1,3%). According to this index the Republic is on the 20th place among 85 territorial entities of Russia (fig.4).

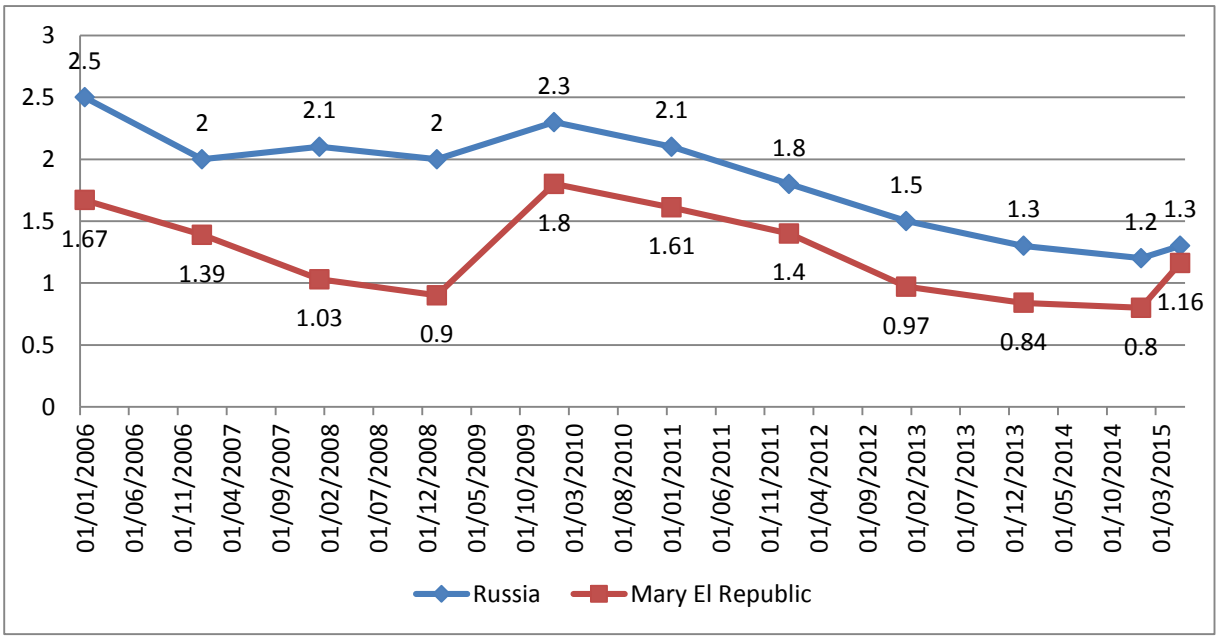

Fig.5 Comparative dynamics of the registered unemployment level in the pre-crisis and post-crisis periods (%)

At the same time under the conditions of economic sanctions the level of employment has decreased on 3,7% (fig.2), the coefficient of labor market tension has increased twice as much, c we have from 0, 6 to 1, persons on one vacancy (fig.3). These indices overpass average Russian rates now. Moreover, the demand for work force is decreasing (1,5 times less than supply), the average duration of unemployment is rising (4,2 months), the gap between total (5,2%) and registered unemployment (1,17%) is growing, i.e. in 4,4 times. These criteria are highly differentiated by the area: for example, while the rate of total unemployment in Sovetsky municipal district is 3,61%, in Yurinsky municipal district the same index is 13,65%, i.e. 3,8 times more. The main reasons for such imbalance are economic development irregularity in municipal districts and employees' release to the labor market [16]. For the Mary El Republic the high degree of labor market and education services market irregularity is very common.

To specify the reasons of the above mentioned problems the authors conducted the social survey of two categories of people: unemployment citizens and those ones who are under the

risk of dismissal. The grading of their opinions showed that the main reason of unemployment growth is the decline in manufacturing and consequently work places decrease and liquidation of enterprise in the whole (53%). In employed people's opinion the emission of working citizens to the labor market has resulted in the wages decrease (19%), and workload increase (67%).

In their opinion the leading problems of job placement are the lack of information about existing vacancies (41%), blue-collar personnel deficiency (31%), steep demands of employers to the potential employees (22%) and nonconformity of applicant's qualification to the vacancies (6%). Respondents consider that the main measures are to increase employment efficiency on the basis of production volume increase and labor productivity, creation of new work places and labor market competitiveness.

CONCLUSION

The efficiency of population employment measures on the basis of social research and monitoring on the mesoeconomical labor market showed the priority of the following directions:

economical growth by means of inflation decrease, labor efficiency rise, economic sanctions elimination and flexible fiscal policy;

balance between labor market and educational services;

development of professional education system in the sphere of blue-collar jobs;

balance between supply and demand on the basis of professional and qualifying structure of population unemployment and professional level of vacancies;

efficiency rise of active forms of population employment assistance: public works, professional education, self-employment and relocation in labor-deficient areas of those citizens first who are under the risk of dismissal;

economical stimulation of unemployment population to search the job and stimulation of employers to hire vulnerable groups of citizens;

using of non-conventional work forms for young people and educational institutions graduates. They will be revealed in the next article which will be devoted to the employment experience of bachelors and masters of Volga State University of Technology, Mary El Republic.

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