METHODS FOR ASSESSING THE EFFECTIVENESS OF THE FORECASTING OF TRAINING NEEDS BY SUBJECTS OF THE RUSSIAN FEDERATION

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Abstract

This article deals with efficiency estimation methodology of regional instruments for recruitment needs forecasting available at the Russian Federation regions. The results of implemented forecasting methodologies are being approbated in a number of pilot regions of Russia. The typology of forecasting methodologies used in various regions of the Russian Federation is also presented. In order to evaluate forecasting recruitment needs both criteria and indicators were developed, on the basis of which the integral rating of the methods was calculated. Based on the results of calculations, forecasting recruitment needs rating was performed dealing with forecasting methods effectiveness used in the pilot regions of Russia.

Keywords: forecasting projects methodology, recruitment needs forecasting, forecasting efficiency.

1 INTRODUCTION

A serious challenge for Russian regions is presented with both quantitative and qualitative discrepancy between supply and demand of labor resources in a labor market. The main component of labor resources regulating in regions is the long-term forecasting of recruitment needs. Well-founded and detailed forecasts of HR demand are the basis both for determining graduates volume of vocational education necessary for the economy and justifying new areas of training for vocational and additional vocational education.

At present, different methodologies and approaches are widely used by regions of Russia to forecast the required volumes of recruitment needs. Methodologies and approaches differ among themselves by basic principles, tools, forecast details and forecasting period. In order to improve the quality of training needs of the Russian Federation regions, a comprehensive analysis and evaluation of existing approaches effectiveness is highly needed. Based on this, we developed a methodology for effectiveness assessing used in various regions.

2 METHODOLOGY

The efficiency estimation methodology of regional instruments for recruitment needs is based on a system of criteria and indicators selected on the basis of forecasting methodologies content and the width of their application. The theoretical, practical and organizational-methodical features of the forecasting methodologies are taken into account. Method for each selected quantitative evaluation indicator is determined. In order to compare methodologies among themselves and choose the best, an integral rating of forecasting methods efficiency was formed, which is calculated by the additive convolution method for all selected indicators, taking into account their weights.

Let us consider in detail the efficiency estimation methodology of regional instruments for recruitment needs available at Russian Federation regions.

2.1 Study of the practice and information analysis on the systems and methods used for forecasting requirement needs in the Russian Federation regions

The best foreign experience in forecasting recruitment needs is presented by the Bureau of Labor Statistics of the US Department of Labor [1,2], the MONASH Model of Australia [3,4], the UK MDM Model [5], the INFORGE and Ifo Models of Germany [6].

With all the diversity of forms and methods for forecasting recruitment needs, they can be structured accordingly into two alternative approaches.

The first approach is macroeconomic, which is based on the assumption that the structure of human capital needed to produce a production unit does not have significant regional differences, but is determined by technology level and labor management in different sectors of economy.

The second approach is sociological, which is based on carrying out a statistically significant employers' surveys concerning need for specialists with vocational education for enterprises / organizations in the region.

These two approaches are also used in the regions of Russia. Forecasting the recruitment needs and the need for their training is a state task that is entrusted to the executive bodies of the constituent entities of the Russian Federation in the sphere of labor and employment of the population, as well as in education management.

The collection of information on the systems and methods used for forecasting recruitment needs in the Russian Federation regions is based on the analysis of sources:

- official web-portals of regional executive authorities of the Russian Federation, which functions include forecasting requirement needs;
- informational-legal systems containing data on regulatory legal acts of Russian regions;
- direct requests for regional executive bodies of the Russian Federation, which functions include forecasting requirement needs and the need for their training.

2.2 Selection of criteria and indicators characterizing the effectiveness of forecasting the recruitment needs

In order to evaluate methods of forecasting recruitment needs, a system of criteria for assessing the effectiveness of the methodology was developed in terms of perspective analysis of the training needs.

The criteria were selected according to the methodology content analysis and its practical application in various regions of the Russian Federation. To evaluate the methodologies content, the following criteria were taken into account - scientific validity, systematic nature of the methods used, use of complex approaches based on macroeconomic models and target group surveys, completeness of the input data, multivariance of the forecast and the possibility of applying scenario parameters, breadth of the planning horizon and the continuity of the forecast, forecast details. Evaluation of the practical application of the methodology for forecasting recruitment needs implies the presence or absence of a program implementation of this methodology, approbation at regional and federal levels, verification of obtained forecast results, presence or absence of adopted forecasting regulations by executive authorities, involvement in forecasting process of authorities, employers, educational organizations, graduates, experts.

2.3 Typology of forecasting methods in the regions of the Russian Federation and selection of pilot subjects for analysis

In order to implement methodology for assessing recruitment needs of 85 regions of the Russian Federation, there were selected 15 pilot regions $M = 15$ and, respectively, M varieties of forecasting methodologies.

The analysis includes various types of methods to be applied - widespread macroeconomic complex methods, author's macroeconomic techniques and questionnaire methodologies for forecasting recruitment needs. Regions that use methodologies are selected as pilot regions by the criterion of the full text methodology accessibility for analysis.

The forecasting methods used in pilot regions of Russia can be divided into methods based on a sociological approach to forecasting and comprehensive macroeconomic techniques.

Methodologies based on a sociological approach to forecasting, imply information receiving from employers. In this case, a selective sample is formed, representing necessary characteristics of the general sample (employers), then the results of the survey extend to the entire general set of employers and are extrapolated to regional recruitment needs. In our study, we analyzed methods of such type, suggesting different approaches to surveys.

2.4 Algorithm for calculating rating of different methods for forecasting recruitment needs in Russian Federation regions

The rating shall be started with the formation of a set of indicators that characterize the effectiveness of forecasting recruitment needs of different Russian regions.

To evaluate the effectiveness and analysis of the methodologies, a system of $N = 12$ performance criteria was developed, including $P = 46$ indicators. The developed system of criteria and indicators takes into account basic principles of the content, wide-application and variability of forecasting. There are also taken into account - research intensity of the forecasting methods, verifications of the forecast indicators, possibility of the multivariability and alternativeness of the obtained forecast, horizon of a planning capability on the basis of the forecast data, practical orientation of the forecasting methodologies and forecast adequacy and profitability.

Parameters of two types were used as indicators: those assuming estimation as a *binary estimation*, where the presence (1) and / or absence (0) of the required indicators is analyzed, and a ball score that reflects the level of completeness /significance /complexity /values of measured parameters (from 0 up to 5 points). Thus, for the analysis, all 46 indicators for the evaluation of the effectiveness of forecasting methods were selected, where for the five indicators a score and a binary estimation for 41 indicators were used. The values of all P indicators for each of the M techniques are stored in the estimation table $Q = \{Q_{m,p}\} \mid m = 1..M, p = 1..P$.

The dimension of the estimation table for all forecasting methods is 46x15, which complicates the perception and analysis of the influence factors on the final result.

To reduce the dimension of the estimation table, it was decided to reduce the number of indicators from $P = 46$ to the number of criteria $N = 12$. To this end, for each m- method, aggregated indicators were $G = \{G_{m,n}\} \mid m = 1..M, n = 1..N$.

Values of aggregated indicators were calculated by formula

$$G = Q \times A^T,$$

where $A = \{A_{n,p} = \{0,1\}\} \mid n = 1..N, p = 1..P -$. Boolean incidence matrix that determines whether the exponent p criterion n.

Further, the column values were normalized $\overline{G_{m,n}} = \frac{G_{m,n}}{max(G^{\langle n \rangle})}$.

The final rating of forecasting methodologies is a certain integral indicator of efficiency and is calculated by the additive convolution method by the formula

$$I_m = \sum_{n=1}^{N} \alpha_n \times \overline{G_{m,n}}$$

Where α_n – weighted coefficients of aggregated indicators, $\alpha_n > 0$, $\sum \alpha_n = 1$.

In the developed methodology, it is assumed that all weights are of equal importance ($\alpha_n = {1}/{N}$).

3 RESULTS

Comprehensive data collection allowed to obtain information on the used forecasting methods for all subjects of the Russian Federation. In half of the Russian regions, a sociological approach to forecasting the recruitment needs is common. From this group the following methods were selected for analysis:

- methodology of a medium-term forecasting of recruitment needs for the formation of training volumes in the vocational education system of Samara region [7],

- methodology for calculating recruitment needs in prioritized sectors (areas of development) of economy of the city of Sevastopol in skilled personnel for the medium term]. [8],

- methodology for forecasting the labor market demand in skilled personnel, taking into account the socio-economic development of the Republic of Udmurtia [9].

In 19 regions the forecasting system of "IBS Group" was used, in 5 regions- methodologies developed by Budget Monitoring Center of PetrSU and in 7 regions local author's methods were applied. These

forecasting systems are based on a macroeconomic approach. To evaluate the effectiveness, the following forecasting methods were selected:

- Methodology for calculating medium-term and long-term recruitment needs for regions of the Russian Federation, economic sectors and the largest employers of the Ministry of Labor and Social Protection of the Russian Federation and the Ministry of Education and Science of the Russian Federation [10],

- Methodology for forecasting recruitment needs [11],

- Software complex methodology for forecasting recruitment needs to ensure social and economic development of the Smolensk region for the medium and long term [12],

- Methodology for forecasting, planning and monitoring recruitment needs in Vladimirskaya oblast [13],

- Methodology for determining city's recruitment needs [14],

- Methodology for city's determining recruitment needs: improved (taking into account surveys), the Budget monitoring center of PetrSU [15];

- Methodology for forecasting recruitment needs of the Vologda region, the Budget monitoring center of PetrSU [16];

- Methodology for forecasting recruitment needs for ensuring socio-economic development of the Republic of Sakha (Yakutia) for the medium and long term, the Budget monitoring center of PetrSU and CJSC «Prognoz» [17];

- Methodology for monitoring and forecasting of the Tomskaya Oblast economy in human resources, the Budget monitoring center of PetrSU and CJSC «Prognoz» [18],

- Methodology for developing the forecast of recruitment needs for the Krasnoyarsk Territory in skilled workers and specialists for the forecast period [19],

- Methodology for forecasting the recruitment needs, demands and proposals of labor market for the Khanty-Mansiysk Autonomous Okrug - Ugra [20],

- Methodology for forecasting recruitment needs of the Irkutsk region (developer D. V. Markov [21].

Figure 1 shows the geographic spreading of different forecasting methods for recruitment needs across Russia selected regions according to the principle of uniqueness and universality.

Legend:
- IBS Group
- Budget monitoring center PetrSu
- Author's macroeconomic methodologies
- Methodologies based upon surveys
- No data, no methodology

Figure 1. Types of forecasting recruitment needs in regions of the Russian Federation

It should be noted that macroeconomic forecasting methodology of Budget monitoring center at PetrSU, "IBS Group" and "Prognoz" can be characterized as complex methods, as they accumulate micro- and macro approaches to forecasting recruitment needs, taking into account a large number of input forecast parameters, allow to form scenario modeling, have automated information systems for making forecasts, and, thus, find wide practical application at regional level.

3.1 Criteria and indicators of the methodology for assessing the effectiveness of forecasting recruitment needs in terms of the Russian Federation regions

The selected forecasting methods were studied in detail and were evaluated according to a system of 46 indicators. Table 1 provides a list of criteria with explanations on the basis of which the prediction methods are appropriately assigned.

Table 1. *Methodology criteria for assessing the effectiveness of forecasting recruitment needs in terms of the Russian Federation regions*

№ п/п	Criterion	Criterion with explanations	Indicators forming the criterion
1	Description of the mathematical apparatus	Description of mathematical methods and approaches used in calculating the recruitment needs, labor market demand and supply, taking into account strategic plans for socio-economic development of the subject of the Russian Federation	description of mathematical apparatus; source data; a refining sociological survey by categories: employers, experts, invest project-managers, young people, system of difference interrelated equations with discretization in time; neural networks; non-linear approximation; optimization, multiple regression
2	Input data	Description of the categories of "input" parameters in forecasting.	federal statistics; regional statistics; additional detailed statistical forms (VPO-1, SPO-1); strategies and forecasts of socio-economic development sociological surveys: employers, experts, invest project-managers, young people
3	Projected indicators	List of key indicators for forecasting, incorporated in forecasting methodology.	General recruitment need (Average annual number of employees); annual additional demand of regional recruitment need; component of annual additional recruitment need for jobs replacement ("for replacement"); component of annual additional recruitment need for optimization of production capacities ("for growth"); component of annual additional recruitment need taking into account investment projects implementation ("for development"); volumes of HR training by organizations of higher and secondary vocational education; volumes of labor migration; volumes of unemployed citizens

4	Scientific basis of a forecasting methodologies	Availability of publications in scientific journals on forecasting methods indexed in VAK of Russia, WoS, Skopus, RINC; number of monographs on forecasting methods; presence of a research team that takes part in developing the methodology, availability and number of defended dissertations on this topic.	research team (permanent, temporary, absent) number of published articles in scientific journals (VAK, WoS, Skopus) on the forecasting technique, number of monographs on forecasting method, number of defended dissertations by scientific team (Candidate/Doctor of Science)
5	Possibility of adapting the forecasting methodology to various subjects of the Russian Federation	Analysis of the possibility of applying the forecasting methodology in other regions of the Russian Federation, taking into account specifics of their socio-economic development.	Possible/impossible
6	Federal status of forecasting methodologies	Estimation of a level of use of forecasting methodologies.	Regulation approving methodology at regional level; publication of forecasting results in public domain on the Internet
7	Peculiarities of the regions	List of strategic documents (regional development strategies, sector strategies, investment strategies) and forecasts of social and economic development of Russian regions, which are taken into account in the methodology when forecasting the supply and demand of recruitment needs in a labor market.	branch; socio-economic; Investment
8	Detailed forecasting indicators	Sections of predicted indicators that can be obtained using the methodology: educational level; enlarged groups of specialties / training areas; municipalities; types of economic activity; groups of occupations (by OKZ), occupations in accordance with the OKPDTR.	level of education; enlarged groups of majors (UGSN); municipalities; types of economic activity; major; groups of occupations by OKZ ; occupations by OKPDTR
9	Prediction horizon	Time period of forecasting under the methodology.	Short-term; Mid-term; Long-term
10	Periodicity of updating (adjustment)	Required frequency of update / correction of forecasting results, under the methodology.	Assumed/not assumed
11	Scenario modeling	Presence of scenario modeling in the methodology and number of scenarios provided.	Number of proposed scenarios
12	Software implementation of the methodology	Analysis of methods of implementation of the methodology: Web-oriented information-analytical system; multi-user server version, etc.	Web-oriented information and analytical system; multi-user server version

The developed scientifically-grounded list of criteria and indicators allows to analyze both methods of forecasting the recruitment needs and their implementation in forecasting systems taking into account both forecasting goals and systems applications.

3.2 Forecasting methods rating for the recruitment needs of the Russian Federation pilot regions

As a result, the integral index values were obtained by means of the additive convolution method taking into account both binary and ball score-method for 46 indicators for each of the 15 forecasting methods of the recruitment needs. The results were ranked and based on methodologies rating for the recruitment needs forecasting of the Russian Federation regions according to the integral efficiency index value. Figure 2 shows the final evaluation result of the forecasting methodologies effectiveness.
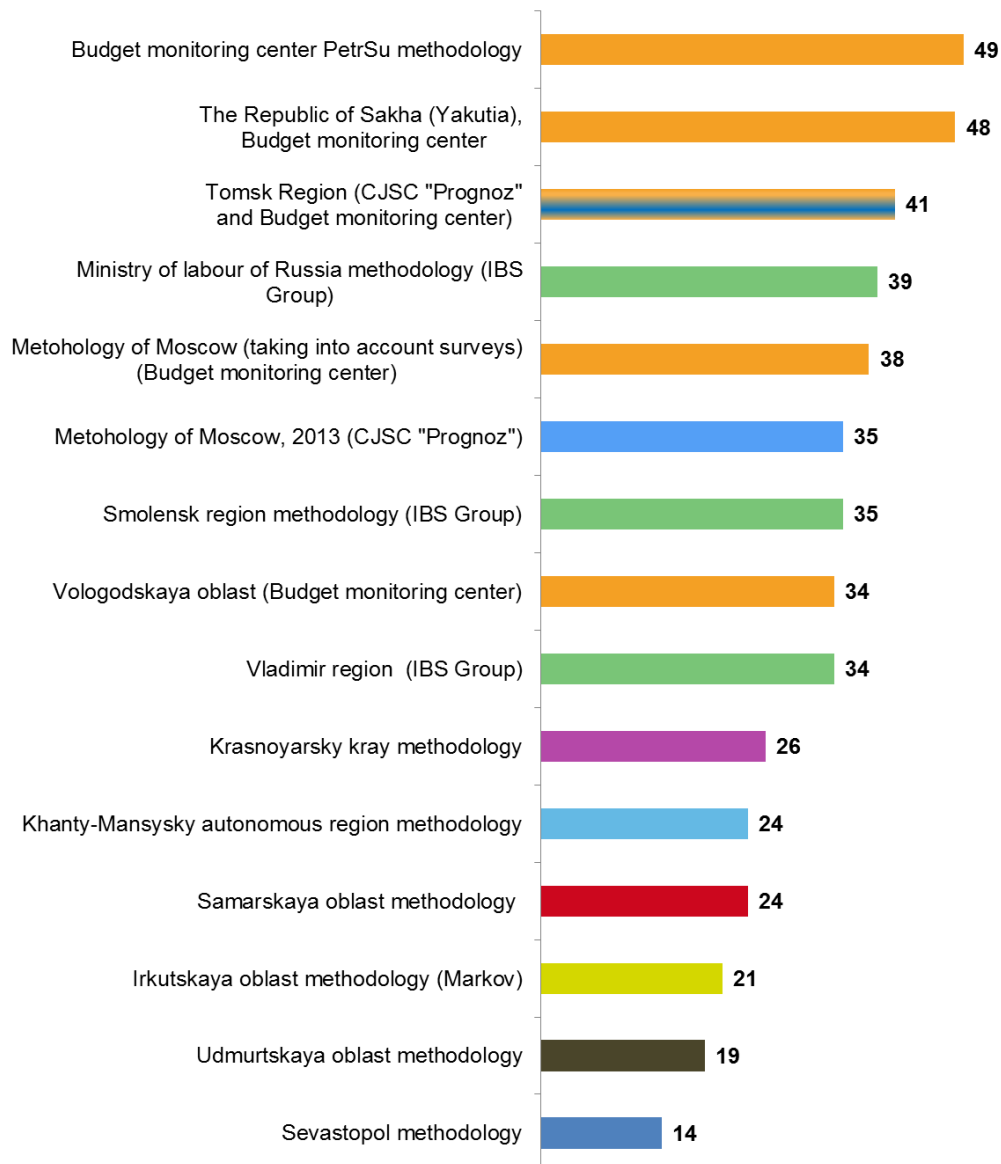

Figure 2. Forecasting methods rating for the recruitment needs of the Russian Federation pilot regions

Approbation of the forecasting methodology effectiveness assessment showed that the most effective practical-oriented methodologies are developed by Budget monitoring center PetrSU and "IBS Group". These methods have not only a broad mathematical apparatus, additional analysis of main forecasting actors, but also a web-based forecasting system that allows to form forecast parameters both quickly and accurately taking into account deep granularity of statistical input parameters. Methodologies based on a sociological approach to forecasting take the edge positions in our rating system.

However, such methods should be taken into account and used to form forecast indicators for the short term, since these methods are based on representative surveys and reflect the real employers' recruitment needs terms of occupations/positions, educational levels, types of economic activity.

All the analyzed forecasting methods of recruitment needs can be used both to adjust the key enrollment figures for specialists admission and to carry out project-oriented career guidance for young people for the most popular majors and occupations for the future. At the same time, the most effective, according to our rating, is a comprehensive approach to forecasting proposed by Budget monitoring center PetrSU.

4   CONCLUSIONS

The proposed methodology of forecasting recruitment needs in terms of the Russian Federation regions make it possible to evaluate methods used by every region quite objectively. The system of criteria and indicators takes into account forecasting features adopted in scientific community, such as research intensity of the forecasting methods, verifications of the forecast indicators, possibility of the multivariability and alternativeness of the obtained forecast, horizon of a planning capability on the basis of the forecast data, practical orientation of the forecasting methodologies and forecast adequacy and profitability. As a result of the forecasting methodologies assessment it was found that the most effective are the complex forecasting methodologies based on macroeconomic approach that take into account target groups surveys containing an interactive system of forecasting recruitment needs. Such methods include the Budget monitoring center of PetrSU methodology and methodology of the "IBS Group". Methodologies based on sociological approach to forecasting are more appropriate to short-term forecasting in compliance with all surveys requirements, since these methods take into account the recruitment needs in terms of occupations from a direct labor market actor – an employer.

The developed methodology can be applied by executive authorities responsible for forecasting the recruitment needs in order to make an objective decisions dealing with the forecasting quality of a specific region, and in order to choose a forecasting methodology that would meet the requirements and opportunities of a region.

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REFERENCES

[1]   Employment Projections. Official Web-site of Bureau of Labor Statistics of United States Department of Labor, 2010. URL. http://www.bls.gov/emp/optd/

[2]   D. E. Hecker, Occupational employment projections to 2014. Monthly Labor Review, Division of BLS Publishing, NE Washington, DC – November 2005.

[3]   S. Richardson, Y. Tan, Forecasting future demands: what we can and cannot know. Proceeding of National Institute of Labour Studies, Flinder Uneversity, 43 p. 2005.

[4]   P. B. Dixon, M.T. Rimmer, Forecasting and Policy Analysis with a Dynamic CGE Model of Australia// Centre of Policy Studies Monash University. Preliminary Working Paper No. OP-90, June 1998.

[5]   S. Junankar, O. Lofsnaes and Ph. Summerton, MDM-E3: A short technical description// Cambridge Econometrics, Working Paper, March 2007.

[6]   Ch. Lutz, M. Distelkamp, Bernd Meyer, Marc Ingo Wolter, Forecasting the Interindustry Development of the German Economy: The Model INFORGE// GWS Discussion paper 2003/2.

[7]   S. Alasheev, T. Kuteynitsyna, Method of medium-term forecasting of personnel needs of the regional economy for the formation of training in the system of vocational education, Samara, 84 p. 2014.

[8] Methodology for calculating the demand for personnel in the priority sectors (areas of development) of the economy of the city of Sevastopol in skilled personnel for the medium-term period. Order of the Department of Labor and Social Protection of the City of Sevastopol from 06.09.2016 No. 409.

[9] On the forecasting of the labor market needs of the Udmurt Republic in skilled personnel, taking into account the socio-economic development of the Udmurt Republic. The order of the Government of the Udmurt Republic of July 7, 2014 No. 445-p (as amended on April 13, 2015 No. 165). URL. http://mintrud.udmurt.ru/about2/kadry/Metodika_5_2.doc

[10] On approval of the Regulation on the system of medium-term and long-term employment forecasting in order to plan training needs in educational organizations that implement educational programs of secondary vocational and (or) higher education at the expense of budget allocations of the federal budget, and methods for calculating the medium- and long-term needs of the subjects The Russian Federation, the economic sectors and the largest employers in professional cadres. Order of June 30, 2015 No. 407/641. Ministry of Labor and Social Protection of the Russian Federation, Ministry of Education and Science of the Russian Federation. URL. http://docs.cntd.ru/document/420289564

[11] Methodology for forecasting the Budget monitoring center of Petrozavodsk State University. The labor market and the market of educational services. Regions of Russia. URL. http://www.labourmarket.ru/metodika

[12] Methodology of the software complex for forecasting the demand for professional personnel to ensure the social and economic development of the Smolensk region for the medium and long term. Department of Economic Development of the Smolensk region. URL. http://econsmolensk.ru/prognoz_kadr

[13] Methodology for forecasting, planning and monitoring personnel needs in the Vladimir region. URL. http://job.vlsu.ru/files/FZPRO/pril.%202.pdf

[14] Methodology for determining the needs of the city's economy in professional personnel. CJSC "Prognoz". URL. http://www.dszn.ru/upload/documents/Методика_(2013).rtf

[15] The methodology for determining the needs of the city's economy in the professional staff improved (taking into account surveys). The Budget monitoring center of Petrozavodsk State University. URL. http://www.dszn.ru/upload/documents/Методика_(с_учетом_о.docx)

[16] The methodology was established by the Budget monitoring center of PetrSU within the framework of rendering services for the implementation of the program-methodical complex of predictive modeling of the needs of the Vologda region in qualified personnel for the needs of the Department of Labor and Employment of the Vologda Region. State Contract No. 137 of November 7, 2011.

[17] The methodology was created by the Budget monitoring center of PetrSU within the framework of rendering services to develop methods and dynamic models for forecasting personnel requirements for ensuring the social and economic development of the Republic of Sakha (Yakutia) for CJSC «Prognoz». Contract-зз-20858-л84 / sub of December 17, 2014.

[18] The methodology was established by the Budget monitoring center of PetrSU and CJSC «Prognoz» within the framework of providing services to develop methodological and technological support for the automated system for monitoring and forecasting the needs of the Tomsk Oblast economy in personnel for CJSC «Prognoz». Contract No. 2016/8-DTZN_TO.

[19] Z. Vasilyeva, I. Filimonenko, N. Raznov Development of a methodology for forecasting supply and demand in the labor market and educational services for the economy of the municipalities of the Krasnoyarsk Territory. Demand and supply on the labor market and the market of educational services in the regions of Russia: a collection of reports on the materials of the Fifth All-Russian Scientific and Practical Internet Conference. Petrozavodsk, pp. 54-55, 2008.

[20] Forecast of personnel needs of the Khanty-Mansiysk Autonomous Okrug. The official website of the Department of Education and Youth Policy of the Khanty-Mansiysk Autonomous Okrug. URL. http://www.doinhmao.ru/professionalnoe-obrazovanie/prognoz-kadrovyh-potrebnostej-yugry

[21] D. Markov Technique of forecasting the region's demand for personnel. Izvestiya of the Irkutsk State Economic Academy, №4, pp. 116 – 120, 2009.