Lack of skilled personnel as threat to HR security of industrial enterprises

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Abstract. The article assesses the needs of Russian industrial enterprises for skilled labor. The authors consider deficiency in qualified personnel as a threat to the human resources security of industrial enterprises, and analyze its causes. The study includes the criteria to distinguish highly skilled employees in the labor force (education level, occupation, correspondence of performed work to education), and analysis of the dynamics of their number. It identifies the internal and external factors that have a significant influence on the number of qualified personnel. The external factors include the size of the salary, population growth due to migration, the regional level of the socio-economic development. The applied methods of analysis are single-factor analysis of variance (F-test), multiple regression and descriptive statistics. The analysis is based on the materials of the Russian Federal State Statistics Service, as well as on the Russian Longitudinal Monitoring Survey - Higher School of Economics.

1 Introduction

The questions of attracting and retaining well-qualified employees are the key task of HR management at industrial enterprises. This fact is proven the data of nation-wide [1, 2] and regional studies [3].

The lack of highly qualified staff has a negative effect on the development of Russian industrial enterprises. According to the Monitoring the Business Climate in Industry that was conducted by the National Research University Higher School of Economics (NRU HSE) in 2016, 18% of Russian companies lacked qualified personnel. The greatest deficiency in skilled workforce was observed in companies that produce leather, shoes and goods made of leather (42%), machinery and equipment (36%) (Fig. 1).

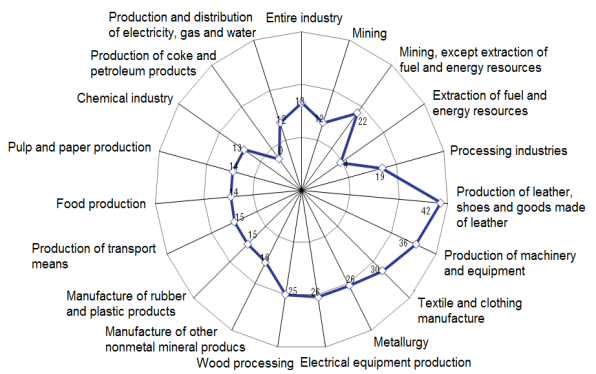

Fig. 1. The share of companies with deficiency in qualified personnel, % of their total number (as of November 2016).

2 Problem statement

Deficiency in qualified staff is one of the major reasons impeding the development of the innovation potential of the Russian industry [4, 5]; it is a threat to its human resources security [6].

The reasons for the qualified personnel deficit are: outflow of scientists and highly skilled professionals from the country since the beginning of the 90s [7], decline in the quality of vocational education, demographic crisis [8], lack of employees' motivation to improve their professional level, a low level of investments in education, training and retraining at enterprises [9], as well as a low level of salary and social protection, which do not allow companies to attract workers with the required qualification [10].

In this paper, we tried to answer the following research questions: What are highly skilled employees? Is there evidence that the industrial enterprises do have a deficit of qualified personnel, which threatens the human resources security? What factors have a significant impact on their quantitative parameters?

The information base of the research was the data of sample surveys of population on employment, the data of the Russian Federal State Statistics Service (Rosstat), the Russian Longitudinal Monitoring Survey - Higher School of Economics (RLMS-HSE).

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3 Criteria for determining a high qualification level

It should be noted that in the Russian Federation, the concept of "highly qualified workers" is still not formalized. These obviously include employees whose level of knowledge and skills required for a professional activity is at a "high" level. This approach to defining qualifications was laid down in the International Standard Classification of Education, and the Federal Law #273 "On Education in the Russian Federation" dated December 29, 2012.

It should also be noted that qualification can be considered as a professional activity characteristic not only in terms of its level (formal characteristic), but its content (qualitative characteristic) as well. In terms of content, the concept of "qualification" is often used as a synonym for a profession and its constituent work functions, skills and knowledge [11]. This approach to the estimation of employees' high level of skills was laid down in the All-Russian Classifier of Occupations OK 010-2014 (OKZ), approved by Order of Rosstandart #2020-st on 12.12.2014.

It is common to start the selection of high-skilled workers with a definition of their functions. Employees with a high level of qualification are connected with science and technology, solution of control tasks, management and coordination [12]; they are engaged in provision of analytical (information, financial, commercial, legal and social) services, involved in the production and processing of information that is based on knowledge [13] and capable to enrich and enhance this knowledge for its further practical application and training of others (OKZ).

Scientific studies show that highly skilled employees differ from others in many ways. The have higher learning rates [14], a specific capital that prevents inter-company and occupational mobility [15, 16, 17], higher indicators of job satisfaction [15, 18], and higher levels of salary and better employment terms [19].

The criteria of distinguishing highly skilled employees in the labor force are summarized in Table 1.

Table 1. Overview of approaches to the criteria of qualified workforce evaluation.

Approach	Evaluation criteria	The structure of qualified workforce
National Research University Higher School of Economics (R. Kapelyushnikov)	Tertiary education	Workers with higher or secondary vocational education
The methodology of calculation of the indicator "The share of the number of highly skilled workers in the total number of skilled workers in the region, per cent" (approved by Order of Rosstat #70 on 21.02.2013)	Higher or post-graduate education, correspondence of the performed work to education, occupation (profession/ position at the basic work is included in Groups 1-3 of the OKZ occupations)	Executives, specialists of high- and middle-level qualification
	Higher or secondary vocational education, correspondence of the performed work to education, occupation (profession/ position at the basic work is included in Group 7 of the OKZ occupations)	Skilled workers of industrial enterprises, construction, transport, geological exploration and prospecting
All-Russian Classifier of Occupations OK 010-2014 (approved by Order of Rosstandart #2020-st on 12.12.2014)	Higher or secondary vocational education (professional training) and experience (length of service) of practical work	Workers with higher or secondary vocational education and experience (length of service) of practical work
Evaluation of the qualification level within the national qualification system (Order #148n of the Ministry of Labor and Social Protection of the Russian Federation dated 12.04.2013)	The qualification level is determined by the skills, knowledge, education in relation to the authority and responsibility of the worker	Employees who meet the requirements of Qualification Levels 5-9

Thus, the main criteria, which may help to determine highly skilled workers, include the level of education, occupation, and correspondence of the performed work to education.

1.1 Changes in the number of highly qualified personnel

Rosstat has been publishing data on the number of highly skilled workers since 2012. The purpose of this statistics is to assess the implementation of the Russian Federation President's Decree #597 "On measures of implementing the state social policy" dated May 7, 2012. According to this Decree, the number of highly skilled workers must be increased by 2020, so that it is not less than one-third the number of skilled workers. In 2015, only 30% of the RF regions managed to come close to this value.

For Russia in general, the proportion of highly skilled workers in the total number of qualified personnel was 32.5% in 2015, having increased by 6.9% over four years (Table 2).

The difference in the index values for the RF regions was more than 3 times (the largest value was registered in Moscow (48.5%), the smallest one - in the Chechen Republic (16.1%)). The Central Federal District is

leading among the federal districts, the Siberian Federal District is an outsider.

Table 2. The proportion of highly skilled workers in the total number of qualified personnel.

Territory	2012	2013	2014	2015	Growth rate, 2015 vs. 2012
Russian Federation, including	30.4	31.5	31.9	32.5	106.9
Central Federal District	36.3	37.4	37.0	38.1	105.0
Northwestern Federal District	32.6	32.9	31.9	39.1	119.9
Southern Federal District	27.0	28.4	29.4	29.3	108.5
Volga Federal District	26.7	28.3	28.8	29.6	110.9
Urals Federal District	28.8	30.5	32.2	32.0	111.1
Siberian Federal District	25.7	26.4	27.5	28.5	110.9
Far Eastern Federal District	28.7	30.5	31.5	31.9	111.1
Crimean Federal District	-	-	-	30.9	-

Which groups of employees have the greatest impact on the value of this indicator? In other words, what is the qualitative structure of highly skilled workers?

While analyzing the dynamics of employment in the context of various occupation groups (i.e. the potential availability of highly qualified personnel in the labor market), it may be noted that the number of managers is leading in terms of increase over the past ten years (29.5%), while the general increase in the number of people employed in economy is 4.7%. The number of specialists with high qualification has increased by 25.3%, the number of specialists with midrange qualification – by 11.9%. The number of employees mentioned in Group 7 of the OKZ, on the contrary, decreased by 12.8%, which may be an indirect evidence of deficiency in highly skilled workers.

The proportion of these occupational groups by the end of the indicated period reached 57.3% of the total employment (please, compare it with 53.9% in 2005), which can be regarded as a positive trend.

The distribution of employment by length of service (Table 3) shows that high qualification often not only requires long training, but contributes to the formation of a specific capital, which prevents inter-company mobility.

It is mostly typical for managers (46.6% of them worked for more than 10 years), as well as for specialists with high qualification (41.8% respectively).

Table 3. Distribution of employment by length of service at the basic work.

Category of the employed population	Number of employees by length of service, %					
	less than 1 month	from 1 month to 1 year	from 1 year to 3 years	from 3 to 5 years	from 5 to 10 years	10 years and more
Total employed population	0.9	9.1	15.5	14.8	23.9	35.8
Managers	0.3	4.8	10	12.2	26.1	46.6
Specialists of high qualification	0.4	6.3	13.6	13.8	24.1	41.8
Specialists of midrange qualification	0.5	6.9	14.2	13.7	23.1	41.6
Skilled workers of industrial enterprises, construction, transport, geological exploration and prospecting	1.2	9.9	14.8	14.8	23.7	35.6

1.2 Highly skilled employees' subjective assessment of their professionalism

It is obvious that employers do not regard tertiary education and work experience as an indication of employees' high qualification. A more important characteristic for them is employees' professionalism, which means a high degree of mastery in a certain profession that is characterized by a high skill and competence [20]. For employees, a high level of professionalism guarantees, to a certain extent, a high level of income and employment stability.

Let us consider how Russian employees evaluate their level of professionalism (Fig. 2). This indicator was developed on the RLMS-HSE questionnaire: "Imagine a "professional skill ladder" consisting of 9 steps, where step 1 - is the level of a beginner, a student, and step 9 is the level of a "high-class professional." Which of them would you place yourself?".

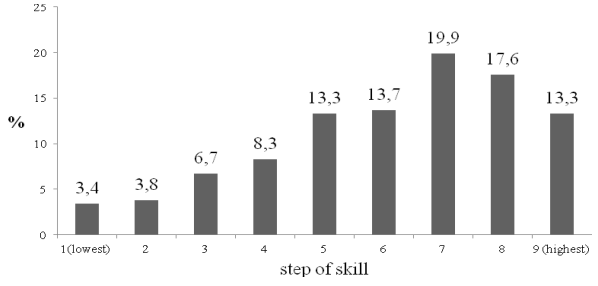

Fig. 2. Distribution of employees by the steps of professional skills, RLMS-HSE.

Fig. 2 shows that the subjective assessment of the professionalism level is quite high. The first three steps of the professional skill ladder are occupied by only 13.9% of respondents. In the second third of the ladder, there is a little more than a third of respondents (35.3% of the total number of the respondents who gave an assessment). The highest steps (7 to 9) of professional skills belong to more than half of the respondents - 50.8%, with only 13.3% of the respondents on step 9 (the level of excellence). Thus, the subjective self-evaluation of professionalism by the employed population generally coincide with the data of the official statistics. It is interesting to compare employees' professional skill assessments in the context of the analyzed occupation groups (Table 4).

Table 2. Assessment of professional skills by occupation groups.

Occupation group	Average rating of the professional skill level, points	The proportion of the respondents being on the indicated step of professional skills, %		Absolute deviation from the average value (in the group of the respondents being on the indicated step)	
		Steps 4-6	Steps 7-9	Steps 4-6	Steps 7-9
Senior and middle managers	7.01	24.9	67.3	-8.4	11.3
Specialists of high qualification	7.05	24	69.9	-9.3	13.9
Specialists of midrange qualification	6.51	33.6	54.2	0.3	-1.8
Skilled workers engaged in manual labor	6.54	33.3	54.9	0	-1.1
Skilled workers using equipment	6.67	30.2	57.2	-3.1	1.2
Unqualified workers	5.56	40	32.5	6.7	-23.5
Average value	6.46	33.3	56.0	-	-

Despite the fact that employees from the group of highly skilled workforce gave higher ratings to their professional skills compared with others, a high level of professional skills is characteristic of less than 70% of the respondents. For managers, the highest levels of professional skill ladder are specific only for 67.3% of the respondents, for the specialists with high and midrange qualification - 69.9% and 54.2%, respectively, for skilled workers - 57.2% with the average value of 56%.

4 Identification of factors affecting the number of highly qualified employees

It is important to answer the question of what factors influence the number of highly skilled workforce. It evidently correlates directly with the personnel policy implemented by industrial enterprises in the sphere of labor force recruitment (ensuring competitive salaries, maintaining stable relationships with educational institutions, etc.), as well as its retention (managing the personnel turnover, maintaining a high level of qualification through staff training and motivation, etc.). However, the number of highly skilled workers is largely determined by personnel policy at the level of regions.

Let us introduce the following dependent variables: y_p – the proportion of the number of highly qualified personnel, y_n – the number of highly qualified personnel, persons. In order to identify the factors that have the greatest influence on one of the dependent variables (y_p or y_n), we introduced the following independent variables:

- x_1 – Nominal salary, thousand rubles;
- x_2 – Migration growth rates per 1000 of population;
- x_3 – The level of the population economic activity;
- x_4 – The average age of the employed population, years;
- x_5 – The innovative activity of enterprises;
- x_6 – The volume of innovative products, works and services, million rubles;
- x_7 – Gross Regional Product per capita, million rubles;
- x_8 – Unemployment rate;
- x_9 – Preparation of qualified personnel per 10000 people of employed population, persons;
- x_{10} – The volume of shipped own produced goods, works performed and services rendered by own forces per capita, thousand rubles;
- x_{11} – Investments in fixed capital per capita, thousand rubles;
- x_{12} – The average subsistent minimum per capita, thousand rubles;
- x_{13} – Actual final consumption of households per capita, thousand rubles;
- $x_{14} = \begin{cases} 2, \text{high level} \\ 1, \text{medium level} \\ 0, \text{low level} \end{cases}$ – Human Development Index [21];

- $x_{15} = \begin{cases} 2, \text{high level} \\ 1, \text{medium level} \\ 0, \text{low level} \end{cases}$ – Quality of life index [22];
- $x_{16} = \begin{cases} 3, \text{high level} \\ 2, \text{above average} \\ 1, \text{below average} \\ 0, \text{low level} \end{cases}$ — The level of socio-economic development of the region [23].

At the beginning of the study, we checked the following hypothesis (assumptions) for each of the dependent variables individually: H_0^1 - the relation of the region to a particular federal district (there are seven groups: Central, North-Western, Volga, Southern, Far Eastern, Siberian, Urals, North Caucasus) has no significant effect on the values of y_p or y_n; H_0^2 - the Human Development Index (there are three groups in the index value: high, medium, low) does not have a substantial impact on the value of y_p or y_n; H_0^3 - quality of life index (there are three groups in the index value: high, medium, low) has no significant effect on the values of y_p or y_n; H_0^4 - the level of socio-economic development of the region (there are four level groups: high, above average, below average, low) has no significant effect on the values of y_p or y_n.

The results are presented in Table 5.

Table 5. The results of single-factor analysis of variance (F-test).

Hypothesis	Dependent variables			
	The proportion of highly skilled employees in the total number of skilled workers (y_p)		The number of highly skilled employees (y_n)	
	The coefficient of determination (R^2), %	Conclusion	The coefficient of determination (R^2), %	Conclusion
H_0^1	4.4	accepted	5.0	accepted
H_0^2	8.0	rejected at a good level of significance	17.0	rejected at a high level of significance
H_0^3	17.0	rejected at a high level of significance	35.5	rejected at a high level of significance
H_0^4	19.63	rejected at a high level of significance	40.0	rejected at a high level of significance

Thus, three of the four above-mentioned factors have a significant impact on the values of the proportion of highly qualified personnel and the number of highly qualified personnel. Here, one factor - relation to a Federal District – is not significant, which can be explained by the strong differentiation of regions in terms of socio-economic development within their Federal District. The strongest factor is the level of socio-economic development of the region.

As a result of regression analysis applied to build models that describe linear relationship between the number of highly qualified personnel and all the independent variables of the form $y = a + b_1x_1 + b_2x_2 + ... + b_{16}x_{16}$, it was found that only 3 variables (out of 16 ones under study) are very significant; they are the variables x_1, x_2, x_{16}.

The final model, which represents the dependency of the number of highly qualified personnel on these three factors, is as follows:

$$y = -214{,}596 + 10{,}15x_1 + 2{,}22x_2 + 153{,}44x_{16} \quad (1)$$
$$(t = -1{,}81) \quad (2{,}63) \quad (3{,}14) \quad (2{,}79)$$

This model is suitable according the Fisher criterion, i.e. the hypothesis about absence of linear functional relationship is rejected at a high level of significance. The coefficient of determination is equal to 40%; the 40% variation in the number of highly qualified personnel can explained by the variation of three indicators: nominal salary (thousand rubles0, migration growth rate per 1000 of population, the level of socio-economic development of the region.

5 Conclusions

We can conclude that the number of highly qualified personnel is directly dependent on the level of socio-economic development of the economy. Concerning the external factors, a positive effect on the attraction of employees with required qualification is provided by improvement of the regional population life quality.

The number of highly qualified personnel at most of industrial enterprises is currently insufficient for their innovative development, and threatens their human resources security.

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