Correlation between HR-system efficiency and its formation based on the job competency model in the digital world

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Abstract – **The development of economic relations resulting from formation of the fourth industrial revolution, require a change in approaches to HR-management basic principles. One of these approaches in modern conditions might be a competency-based approach. The article describes an experiment on the formation of HR-management system based on the job competence models of four large metallurgical enterprises and its results by the system efficiency criteria. The system efficiency criteria, methodological basis of the chosen approach, HR-management system generation algorithms based on the job competency models are given in the article. It has the evidence base confirming the existence of a positive correlation between the effectiveness of the HR-management system and the method of its formation based on the job competency models and the competency-based approach. The article examine the relevance of this approach in conditions of the fourth industrial revolution and digital economy.**

Keywords – competence, competency, competency-based approach, HR-management based on the competency-based approach, job competency model, employee competency profile, deficit and surplus of competencies, digital economy, fourth industrial revolution.

I. Introduction

To form an enterprise management system is necessary primarily to ensure its functionality. Enterprise management is built on the interrelated operation of several systems. One of them is HR-management system. There are many theories of management, on which the various approaches to HR-management are formed. The choice of approach to HR-management is a strategically important step that the head of the organization takes. Selected approach becomes the foundation for building the HR-management system. A change in approach leads to a change in the HR-management system. Availability of studies confirming the effectiveness of

a particular approach in the formation of HR-management system is important scientific information, which becomes a practical tool in decision-making by the executives and managers of companies and corporations. Furthermore, in the context of the fourth industrial revolution, an important criterion for choosing one or another approach to HR-management becomes the criterion of its adaptability to change, as well as the presence of potential in the approach to ensuring changes in an organization through an HR-management system built on its basis. We have reviewed more than thirty approaches to HR-management, which in varying degrees are used in the formation of an HR-management system. HR subsystems were analyzed in the context of each of the proposed approaches. An analysis of the literature has shown us that existing methods and methodologies for the formation of HR-management subsystems are most often based on different approaches to HR-management and have no common basis, After analyzing the publications of many authors, we came to this conclusion that competency-based approach affects most of subsystems. In Spencer & Spencer, the competency-based approach is applied to three subsystems and five business processes: recruitment and management of employee records, management of employee development, and management of motivation and incentives. E.A. Mitrofanova, V.G. Konovalova, O.L. Belovo, A.Ya. Kibanov in designing the methodology for developing a competency-based model proposed the use of the approach in the formation of similar subsystems, but only for three business processes: recruitment, training and incentives (system elements).

Many authors who conducted research in the direction of developing the application of the competence-based approach focused only on one subsystem – recruitment management in the business process of assessment and recruitment. That includes such authors as D. McClelland, P. Boyacis, Guyon, Carol, E.S. Smirnova, N.F. Talyzina, N.G. Pechenyuk, L.B. Khikhlovsky, and many others in Russia, Europe and America. The effectiveness of this approach was analyzed by

the authors on performance indicators of subsystem processes of the distribution area.

The purpose of the study was to expand the applicability of the competency-based approach to the level of an integrated HR-management system. It was hypothesized that there is a correlation between the effectiveness of HR-management system and building it based on a single foundation - job competency models. The statement of the problem is due to the fact that in conditions the fourth industrial revolution and digital economy an important characteristic of an organization's activities becomes the rate of change within it. The rate of change is higher, the simpler the mechanism of change and the faster the communication between the systems of the organization. HR-management system is the connecting system in the organization. Its element - personnel is an element of any other systems. So the faster the rate of change in the HR-management system, the faster the rate of change of the entire organization. It means the methodology at which the maximum rate of change is achieved will be the tool for solving current problems of a market economy.

Consequently, we have developed a methodology for forming a job competency model for a large organization, detailed in other publications, and proposed algorithms for the formation of all major subsystems of HR-management on its base. We have conducted a study to determine the correlation between the effectiveness of an HR-management system and the approach to its formation based on the job competency model. The results of the study will be presented in this article.

The article describes the experiment on the formation of HR-management system on the basis of the job competency model of four large metallurgical enterprises and its results by the criterion of system efficiency. This article also presents a number of indicators to determine the criteria for system effectiveness. As a result, this article will provide the evidence base confirming positive correlation between the effectiveness of an HR-management system and the approach to its formation based on the job competency model and the competency-based approach as primary.

II. LITERATURE REVIEW

The formation of the author's approach to the HR-management system's creation on the basis of job position's competence model is based on the analysis and development of the scientific approach, proposed by Spencer & Spencer, as well as A. Kibanov in collaboration with E. Mitrofanova, V. Konovalova and O. Belova in terms of the management of recruitment and employee records and talent management.

Regarding business process, there were approaches, described in modern scientific studies by such authors as: E. Bayeva, V. Baydenko, A. Bey, V. Bogdanova, Z. Gantemirova, L. Gashkova, I. Zimnyaya, O. Korneeva, A. Korneeva and other authors who conduct research in the field of pedagogy.

Proposed approaches are expanded through the application of the competence model in the subsystems, which were not previously described by authors, such as organizational development, personnel planning; subsystems, which are different in, content, such as: motivation and

stimulation, extended subsystems: training and career management. The model is presented in Figure 1.
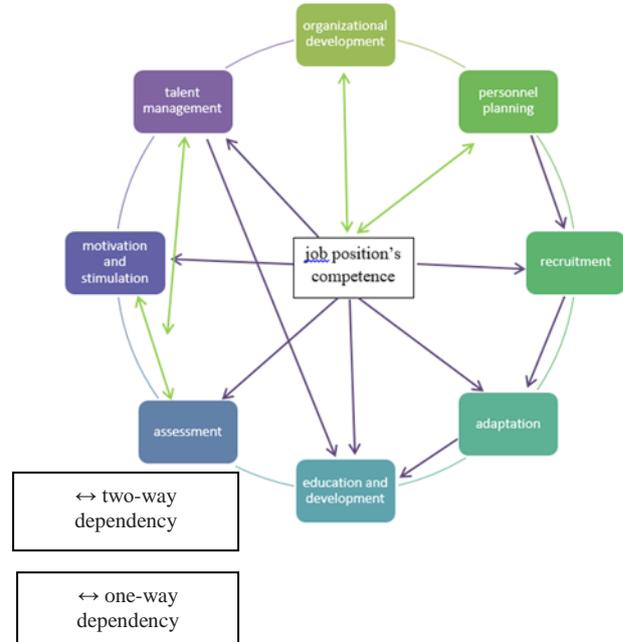

Fig. 1. The dependence between the processes of HR- management subsystems and job position's competence model (core processes) [1].

Algorithms of processes of HR-management subsystems, which were not previously described in scientific researches through the application of competence-based approach on the basis of job competence model, are shown below in Figures 2.3.
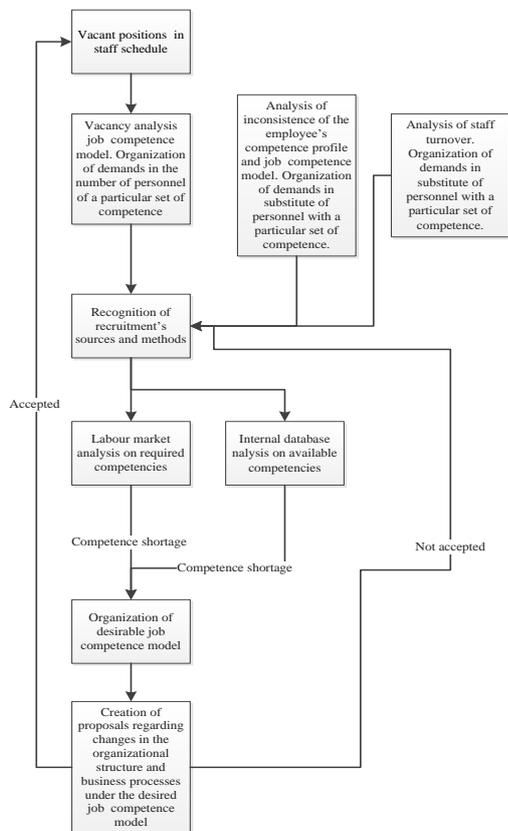
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[1] Created by the author

Fig. 2. The integrated algorithm of application of job competence model in a planning and HR marketing subsystem[2]

Fig. 3. The integrated algorithm of the competence-based approach application in the subsystem "Organizational structure management"

To repeat the experiment and obtain a similar result, it is important to apply the algorithms in accordance with the proposed ones. The systematic implementation of job competence model into management subsystems is an important criteria that determines relationship. A complete description of the algorithms is given in other articles of the authors.
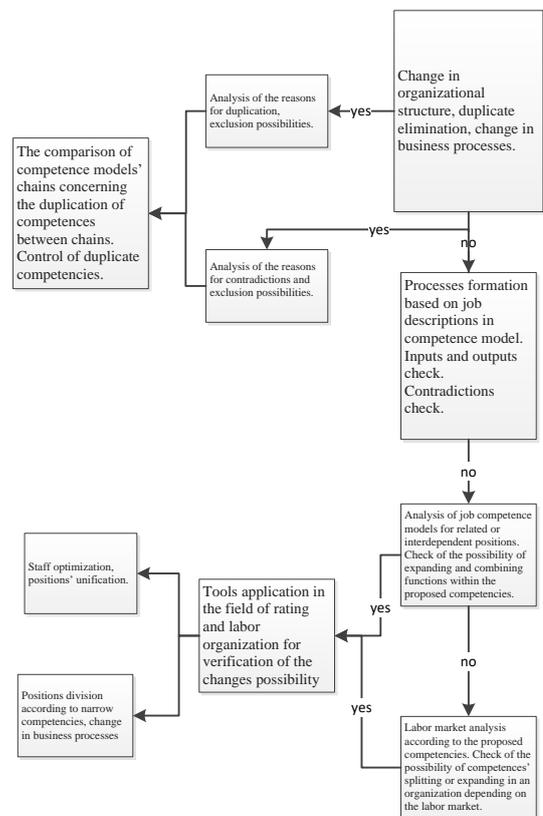
To determine the criteria for the effectiveness of the HR-management system, the following approach was chosen. The criteria for the processes effectiveness of various subsystems, which existed in the scientific literature, were analyzed. Cross-cutting things, which characterize the effectiveness of more than one process, were determined. In addition, from the set of criteria were selected those criteria that, in the author's opinion, are significant in the context of ongoing business changes caused by the fourth industrial revolution and digitalization, that is, reflecting the organization's ability to change faster and to function effectively. The result of the analysis is presented in table 1. Criteria that are most significant in the digital economy and the influence on them is the aim in selecting methods and techniques into any management system.

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[2] Created by the author

TABLE 1. DISTRIBUTION OF PERFORMANCE INDICATORS OF THE IMPLEMENTATION OF THE METHODOLOGY FOR HR-MANAGEMENT SUBSYSTEMS[3]

Subsystem	Performance indicators of the implementation of the methodology in the subsystem
Planning and marketing	– Staff turnover. – Payroll costs. – *The rate of change.* – *Productivity.*
Recruitment and accounting staff management	– Staff turnover. – Staff turnover in the first year of work. – *Time of staffing vacancies.* – Recruitment costs. – *Qualification training time.* – *The rate of change.* – *Productivity.* – Share of reclamations for unqualified employees. – Staff satisfaction by various groups of factors
Labor relationship nanagement	– Staff turnover. – Staff turnover in the first year of work
HR-development management	– Staff turnover. – Staff turnover in the first year of work. – Realization of a management reserve potential (appointment from a reserve). – Employees participation in the processes of HR-management subsystems on the conditions of self-promotion. – Training efficiency. – Training and development, recruitment and assessment costs. – *Qualification training time.* – *The rate of change.* – *Productivity.* – Share of reclamations for unqualified employees. – Staff satisfaction by various groups of factors.
Motivation and incentives management	– Staff turnover. – Payroll costs. – *Productivity.* – Staff satisfaction by various groups of factors
Organizational development	– *Regulated processes of HR-management subsystems*
Information management of the HR-management system	– Employees information awareness on the processes of HR-management subsystems. – *Regulated processes of HR-management subsystems.* – *The rate of change.* – Staff satisfaction by various groups of factors

Formulas for selected performance criteria are described below:

– Staff turnover or staff turnover factor:

$$F_T = \frac{Nf}{NEM} \times 100 \qquad (1)$$

where F_T – staff turnover or staff turnover factor, %; N_f – number of employees who left the organization, because of staff turnovers (voluntarily, for absenteeism, for violation of safety, and for other reasons not caused by production or national need) during the period; NEM – average number of employees over the same period;

– Staff turnover in the first year of work or staff turnover factor in the first year of work:

$$F_T1 = \frac{Nf1}{Nh} \times 100 \qquad (2)$$

where F_{T1} – staff turnover in the first year of work or staff turnover factor in the first year of work, %; N_{f1} – number of

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employees who left the organization, because of staff turnovers (voluntarily, for absenteeism, for violation of safety, and for other reasons not caused by production or national need) during the period, with work experience at the end of the period was less than 1 year; N_h – number of hired employees during the period;

– Time of staffing vacancies:

$$T = \frac{\sum_{i=1}^{n} Ti}{n} \qquad (1)$$

where T – the average time needed to staff the vacancies; T_i – the time needed to staff each vacancy; n – number of vacancy during the period.

– Share of reclamations for unqualified employees:

$$R = \frac{\sum_{i=1}^{n} R_i}{n} \times 100, \qquad (2)$$

where R – number of reclamations for unqualified employees, %; R_i – reclamations for unqualified staff, 1 unit.; n – number of claims reclamations during certain time;

– Staff satisfaction by various groups of factors:

$$S = \frac{\sum_{i=1}^{n_1} Si}{n_1} ; \; S_i = \frac{\sum_{i=1}^{n_2} R_i}{n_2} \qquad (3)$$

where S – staff satisfaction by average groups of factors; S_i – staff satisfaction by one factor; R_i – respondent satisfaction rating; n_1 – number of factors; n_2 – number of respondents;

– Rate of change. This indicator is analyzed by a sociological survey method. During the implementation of change, which is significant in the system, a sociological survey is formed. The survey measures staff readiness to accept or not accept changes. A similar sociological survey is organized 3 months after the implementation of changes, where, in addition to the measurements described, time that spent on new methods of work is analyzed. Such analysis should be carried out before and after the implementation of the competence-based approach. The reduction of time required to the system restructure, the increase of staff who accept changes in two surveys give the possibility to evaluate the dynamics of the rate of change implementation;

– Productivity:

$$P = \frac{V_{tonn}}{NEM_{ps}} \qquad (4)$$

Where P - labor productivity, V tonn – volume of production (tonnage) for a certain type of work; NEM_{ps} – number of employees (production staff);

– Payroll, training and development, recruitment and assessment costs;

– Qualification training time, (man/hours):

$$T = \sum_{i=1}^{n} (T_i \times S_i) \qquad (7)$$

where T – time needed to train staff, (man/hours); T_i – time of a certain type of training, (hours); S_i –number of staff in a certain type of training, (number of people).; N – number of training during a certain period of time;

– Training efficiency (average score based on the results of feedback questionnaires of the informative part of training);

– Regulated processes of HR management subsystems (the presence or absence of regulations on the basic processes of subsystems);

– Employees information awareness on the processes of HR-management subsystems. It is evaluated by methods of

sociological survey, questionnaires, interviews. Dynamics of criteria is observed. The increase in staff informational awareness due to the use of the competence-based approach, which influence staff involvement and career;

– Employees participation in the processes of HR-management subsystems on the conditions of self-promotion. Evaluated by dynamic observation of the growth rate in absolute terms over periods;

– Fulfilling the potential of management reserve (index number of people who is appointed to the position from a management reserve):

$$F_a = \frac{N_{amr}}{N_{am}} \times 100\% \qquad (8)$$

where F_a – assignment factor of people who is appointed to the position from a management reserve; N_{amr} – number of people who is appointed to the position from a management reserve, (people).; N_{am} – total number of appointed managers, (people).

III. Methods and materials

The experiment was conducted on the basis of 4 large metallurgical enterprises, with a total of 28,000 people, located in three regions of the Russian Federation.

All the enterprises have gone through a global technological modernization; they are subjects of the digital economy, on the path of transformation mechanisms dictated by the influence of the fourth industrial revolution.

At first, the HR-management system of enterprises were measured by selected key performance indicators. The study analyzed the dynamics of the selected indicators for 3 years, during which there were no system changes in the approaches to the formation of a HR-management system.

At the second stage, we introduced the method of forming the job competency model. Description of the methodology is given in the article "Methods of forming a competency model for a large enterprise" by Pozolotina E.I. Competency models have been developed for all positions in the company.

At the third stage, the business processes of the main HR-management subsystems were reengineered. Examples of algorithms for forming business processes of subsystems are given in the next section.

At the conclusion after the first year of work, a re-measurement was carried out on selected key indicators characterizing the performance of the HR-management system after the implementation of the competence approach when forming a personnel management system based on job competence models.

The result of the experiment was a statistical comparison of the measurement results before and after the changes. The establishment of a positive relationship was confirmed by the growth of all key performance indicators of the personnel management system of the enterprise, which made it possible to conclude that the result of the experiment was positive. An important development, in terms of transformational mechanisms, was that by using the described system, staff readiness to change increased and it is the key criteria to the transformation of the economy in general and the organization as its subject in particular. And this means the proposed methodology is one of the possible tools for the adaptation and transformation of any enterprise to the current economic conditions.

Research findings

As a result of the study, the positive dynamics of the selected performance indicators of the HR-management system for four enterprises was determined. The results of measurements before and after the implementation of the competence approach in building an HR-management system are shown in Table 2 below.

TABLE 2. DYNAMICS OF CHANGES IN INDICATORS BEFORE THE START OF THE EXPERIMENT AND ON THE RESULTS OF IMPLEMENTATION[4]

Indicator	Enterprise 1 (number of staff 6015)		Enterprise 2 (number of staff 6095)		Enterprise 3 (number of staff 10024)		Enterprise 4 (number of staff 5816)	
	2013	2017	2013	2017	2013	2017	2013	2017
Staff turnover, %	6,9	6,0	6,5	7,0	6,1	5,4	8,1	8,6
Staff turnover in the first year of work, %	11,7	15,8	13,1	12,8	13,1	10,7	4,2	3,5
Time of staffing vacancies (on average), months.	> 1	< 1	> 1	< 1	> 1	< 1	> 1	< 1
Share of reclamations for unqualified employees, %	56	19	58	25	45	12	48	25
Staff satisfaction by various groups of factors (remuneration, development, career growth), average score	5,6	7,0	6,7	7,0	Not conducted	7,9	5,9	7,8
Acceptance level	Increased. integral estimate based on the number of changes implemented per year; results of sociological studies conducted simultaneously with changes and assessing the readiness and level of acceptance of changes							
Productivity (in tons), t/p.	117	122	92	103	95	99	102	110
Payroll expenditures, mln.rub.	2 543	2 857	2 583	2 923	4 291	4 908	2 450	2 665
Training and development costs, mln.rub.	16	17	20	13	23	24	18	11
Recrutment costs (direct), assessment, mln.rub.	Not conducted	1,5	Not conducted	2, 7	Not conducted	3,0	Not conducted	1,1
Training time, per.-h	198 672	141 720	541 008	412 400	292 800	187 160	379 776	246 520
Training efficiency	4,4	4,8	4,1	4,7	4,1	4,4	Not conducted	4,7
Regulated processes of HR-management subsystems, %	30	70	45	70	32	70	48	70

⁴ Compiled by the author based on the study

Information awareness of employees of the organization on the processes of personnel management subsystems	Increased. According to the results of sociological research						
Participation of employees in the processes of HR-management subsystems on the conditions of self-promotion	No	Yes	No	Yes	No	Yes	No	Yes
Appointment from reserve, %	55	70,6	68	70,3	33	72,4	80	87,1

The economic effect of improving the indicator of regulated processes of HR-management subsystems				
Reducing the NEM of personnel service.	19	8	22	20
Payroll savings - direct economic effect, rub.	9 576	3 897	11 088	8 880
The economic effect of improving the appointment of personnel reserve				
Payroll savings (surcharges)	52			
Saving costs for external selection	70			
Cost of dismissal of unsuitable employees	210			
Savings payroll (50% of the salary of the head of the first 6 months of work - the adaptation period, low work efficiency)	210			
General economic effect	542			
The calculation of the economic effect of the improvement in the appointment of personnel reserve for 1 year				
The number of vacancies of managers (increase, staffing of the reserve)	6		21	
General economic effect, rub.	2 710		11 382	

The total economic effect:

– in kind – 338 pcs. number optimization;

– in the received economic benefit – 212 mln.rub. annually, or 1.5% cost.

Considering that the personnel management system built on the principles of the competence approach applied to the formation of all subsystems through the post competency model, functions for one year, we expect the system to increase in efficiency over the next three years, when all processes of the main subsystems will work at the maximum level of efficiency.

Conclusions

The results of the experiment allow us to draw some conclusions:

The change or choice of approach in the formation of the HR-management system affects the efficiency of the system.

The application of one key approach in building HR-management system creates the foundations of integrity and improves the efficiency of the system.

The dependence of the system efficiency on the chosen approach is determined empirically.

The effectiveness of using the competency-based approach and the formation of HR-management system based on the proposed competency model of the position and algorithms for building business processes of the main subsystems has been proven for large enterprises in a stable market using the example of 4 enterprises located in different regions of the Russian Federation.

The study creates prerequisites for the hypothesis of the possible distribution of the results to other large enterprises, as well as medium-sized enterprises, where there is a reasonable need for standardization of management systems, and therefore its universality.

The study proves the effectiveness of the proposed tools and methods for building HR-management subsystems in the conditions of digital economy and business transformations resulting from the fourth industrial revolution.

It is important to note that the results of research correlate with other studies that have used a similar approach. For example, the effectiveness of the selection system with the

As you can see from the given data, more than 90% of the criteria showed a positive trend. Thus, the cumulative efficiency of the HR-management system has grown after the implementation of the proposed approach. System efficiency is the ratio between the estimates and the used resources (glossary of economic terms). Thus, the resource base in comparable conditions has declined. This is evident from the calculation of the economic effect illustrated in the calculations in table 3 below.

TABLE 3. CALCULATION OF THE ECONOMIC EFFECT OF THE INTRODUCTION OF THE COMPETENCE APPROACH IN THE HR-MANAGEMENT SYSTEM.5

Indicator	Ent.1	Ent.3	Ent.2	Ent.4
Calculation of the annual economic effect in terms of staff turnover				
Turnover deviation, %	0,9%	0,7%		
The number of vacancies to reduce	51	70		
The cost of staffing one vacancy, rub.	5 500	5 500		
Payroll size for the recruitment period, rub./month.	42 000	40 600		
Savings on recruitment, rub.	280	385		
Payroll savings, rub.	3 211	4262		
Reducing the number of replacement staff	10	14		
Payroll savings of replacement staff, rub.	642	852		
General economic effect, rub.	4 275	5 692		
The economic effect in terms of recruitment time				
Payroll savings (surcharges), rub.	7 119	11 225	8 904	9 546
Reducing the number of replacement staff	7	9	7	9
Payroll savings of replacement staff, rub.	3 528	4 384	3 528	3 996
General economic effect, rub.	10 647	15 609	12 432	13 542
The economic effect in terms of " training time"				
Saving hours	56 952	105 640	128 608	133 256
Reducing the number of replacement staff	28	53	65	67

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5 Compiled by the author on the basis of research, calculations.

competence approach was proved by Spencer and Spencer, Kibanov. The practical implications of this study are that the proposed approach can be used by HR-services, heads of any large enterprise - the metallurgical industry without modifications, other industries with minor modifications of the competence directory. In addition, the proposed methodology and approach can be used in training programs in the direction - labor economics, HR-management as a practical tool that has proven its effectiveness on a large sample. The considered approach, as shown in the study, is the basis for revising approaches to HR-management. It allows to achieve a significant acceleration of labor processes, which is one of the key factors for the transition to the fourth industrial revolution.

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