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INFORMATION TECHNOLOGIES IN THE SPHERE OF HR-MANAGEMENT IN ORGANIZATIONAL SYSTEMS

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Abstract. *This scientific work combines the processes of researching, generalizing and solving the actual scientific problem regarding the improvement the organizational management of human resources by developing progressive information technologies in order to support decision-making in the tasks of rational selection and management of organizational system's personnel. The analysis of existing methods, models and information technologies used for professional recruitment and training was conducted, which in turn allowed us to identify problematic tasks and to formulate requirements for the development of information support for the personnel turnover system in organizational systems, as well as to substantiate the stages of research and tasks of this research. Professional recruitment models using adaptive testing and competency assessment methods have also been developed, resulting in a reduction in subjectivity in staff performance evaluation. Moreover, the technology of obtaining and introduction information into the database was developed, taking into account the possibility of its further correction, which in turn allowed to automate the users work and significantly reduce the time for data processing.*

The structure of decision-making support system was developed taking into account the requirements of employers for candidates on vacant positions, which allowed to automate the work of the employee who makes the decision on admission and training of personnel in organizational systems. Developed information technology for the selection and training of personnel in organizational systems provides the enterprise with a universal tool that can be used by the manager during the process of assessing the characteristics of professional work of a particular specialist. Developed information subsystem for adaptive staff testing is a convenient tool for application of the proposed models, methods and algorithms. Experimental research and testing of the developed models on real systems was carried out and the results of the research were put into practice in organizational systems. The results of the work are of great scientific importance, they can be used as a problem-oriented toolkit for the purpose of informational support of the management process regarding the recruitment and training of personnel in organizational systems.

Keywords: *personnel, management, organizational systems, information technologies.*

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Introduction

The need for scientific substantiation and improvement of the effectiveness of management decisions regarding the formation of personnel policy at enterprises is connected with the objective economic development conditions of each country. Optimization of personnel selection, distribution and utilization systems is the most important part of every business or organization.

Changes in the economy lead to new requirements for the management of socio-economic systems, including the usage of advanced information technologies, and as a consequence, more emphasis is placed on the role of the human factor in these systems. Nowadays, new information technologies are being introduced into various areas of modern human activity. The area of recruitment is no exception. However, the existing information systems in this field do not meet the requirements and tasks of selection, preparation and management of human resources. For instance, information systems in the field of HRMS (Human Resources Management System) solves mainly the tasks of accounting, statistical analysis, planning and forecasting of the enterprises' personnel. As a consequence, the need for scientific substantiation of the methods of managing the personnel selection and distribution on enterprises and organizations using information technologies has arisen. As usual, during the recruitment process, the manager relies on his own experience and intuition, as well as evaluates the work experience and qualifications of applicants. Management of the selection and distribution of staff in some organizations is only about keeping personal records and collecting relevant data.

Nowadays, successful development of businesses and organizations requires new approaches to recruitment and evaluation of personnel performance. This leads to the usage of new information technologies that allow to solve the problems related to the rational formation of collectives, improving the employees productivity, the ability to reduce the costs of managing the collectives of enterprises and organizations.

In order to solve problems concerning the processes of recruitment and formation of collectives at enterprises and organizations, it is necessary to analyse regularly the general tendencies of rational recruitment and training of personnel.

Existing methods, models and automated HRM systems do not allow consider comprehensively all aspects of the applicant's personality, as well as when seeking solutions for the selection and allocation of personnel, these solutions are not always optimal.

The imperfection of the recruitment management process, the shortcomings of the models and information technologies used to manage personnel potential, prove the relevance of this study.

The purpose of the work is to improve the organizational management of human resources through the development of advanced information technology support for decision making in the field of rational selection and management of personnel of the organizational system.

Literature Review

The increased role of the human factor has led to radical economic reforms and active social policy, as well as democratization of society (Collings etc al., 2018). Therefore, it is increasingly important to work with the human resources that make up the human factor during the development of society.

This, in turn, imposes qualitatively new requirements on personnel management as a science, moreover, on the usage of the results of socio-economic and psychological-pedagogical studies in the practice of personnel work, and also leads to the creation of an optimal mechanism for personnel management in all spheres and areas of human activity (Plaskoff, 2017).

Improvement of HR-services and processes requires the identification of legal, organizational, economic, social and psychological problems (Marler etc al., 2017).

The solution to these problems is directly related to the diagnostics of the professionally important qualities of the employees, as well as the improvement of the level of their professional and qualification culture. (Delery & Roumpi, 2017). Thus, it is necessary to create a system of permanent education for managers of all levels of the hierarchy and staff inspectors, which will be

aimed at teaching them how to work with people, to develop the skills they need for management activities.

In this aspect, HRM-services have begun to pay more attention to the creative potential of each employee (Huemann etc al., 2008). The modern requirements for work with the staff turn them into scientific and practical centres of human factor activation. Therefore, the new scientific and practical direction regarding the usage of information technologies in personnel management is especially relevant nowadays.

This provides a comprehensive approach to the problems regarding optimal staff usage in organizational systems (Kianto etc al., 2017).

Modern conditions require the refusal from statistical and documentary forms of personnel work and the transition to a complex, systematic formation of effective personnel policy within organizational systems, which will lead to a significant improvement in all activities of these systems (Brewster, 2017).

Everything mentioned above necessitates the emergence of a new profession in the field of managerial work — HR-Manager who professionally carry out the functions of personnel selection and distribution (Liu etc al., 2017). Thus, the issue of his or her professional training and permanent training is very relevant.

Personnel policy of the organization starts with the definition of the purpose, tasks, directions, principles, forms and methods regarding personnel work organization. (Gill etc al., 2018). Meanwhile, structures and objects of management are determined, staff work is planned and forecasted, as well as staff needs and sources of satisfaction are identified.

Organization of personnel support in the structural units of organizational systems implies effective career guidance, hiring and selection of staff, as well as its placement, professional training and permanent professional development (Meyer & Xin, 2018).

The basic aspects for the formation of stable personnel collectives are the organization of the process of employees adaptation, the management of their motivation and mobility processes, ensuring their cultural and general growth, reduction of staff turnover and strengthening of the discipline. (Guest, 2017).

Methods

During the study, the following methods were used: system analysis, set theory, information modelling, project management, and process approach to develop information models for recruitment and training. Using peer review methods the criteria for assessing the quality of staff work in organizational systems, as well as methods for their classification and ranking have been explored.

Methods of algorithm theory, parameter estimation, and relational database theory were used in order to develop algorithms to support the recruitment and training processes; and the methods of knowledge engineering, the theory of software systems design - for the construction of information technology and software development.

Results

However, the level of work with human resources on the enterprises and organizations today does not correspond to the signs of a radical restructuring of economic management, as well as the realization of active social and personnel policy. It is difficult to implement scientific methods of assessment, placement and training using the results of research and relevant information technology in the practice of personnel services.

The level of organizational, legal and social-psychological culture of employees of departments and staffing agencies is insufficient, many of which do not even have the necessary education and also do not improve their skills for a long time. As a rule, the knowledge and skills in the field of personnel work, is not present in most entrepreneurs and managers, which, in turn, reduces the effectiveness of management. At the same time, knowledge of the personnel management basics, as well as its basic principles and methods, is extremely important for

managers and organizations involved into production processes. Training managers on the basics of personnel policy, organizing programs to prepare them and improve the skills of HR-management contribute to the formation of their understanding of the importance of effective, scientifically based work with people, enhancing the prestige of HR-services and improving the efficiency of human factor use in organizational systems. One of the most important working areas of recruitment services — is the careful selection of staff. However, the multi-level hierarchical organizational structure of many enterprises forces the recruitment services to recruit candidates without first agreeing with future direct executives. Since future executives are also a separate level of this hierarchical structure, they may not always influence the selection process.

A particular approach to the recruitment process can subsequently lead to a decrease in overall production performance due to differences in work team. In order to solve this problem, it is necessary to conduct preliminary computer testing of candidates for the position in the first stage, and in the second stage to involve future executives for interview with a future employee. I order to carry out this procedure it is necessary to provide the enterprise with modern computer equipment.

Nowadays, there are a sufficient number of computer systems using which we can obtain a complete psychological portrait of a candidate for a vacant position. Computer testing helps the employer to find the necessary employees, and employees in turn to show their abilities, taking into account some organizational and psychological aspects related to future work. Computer testing eliminates in future such unfavourable factors for the employee as implementation of the hated work, which in turn contributes to a harmonious climate in the team and reduces overall motivation and work efficiency. An employee who performs uninteresting work, spends a lot of time and effort to achieve the goals, destroys the inner harmony of his personality, which, ultimately, leads to the emergence of industrial diseases.

High level of theoretical training of the manager, form the main directions in the university management training.

Among them are the following directions: theory of state economic policy, the basics of the theory of cooperation and forecasting systems, knowledge of credit, banking, financial and tax insurance systems, system analysis, decision-making theory and others. The training program for executives should include topics that will provide concepts about the forms of organization and principles of business activity, the operation of commodity and stock exchanges, as well as the conduct of leasing and currency transactions, participation in auctions and fairs, the peculiarities of joint ventures, psychological and aesthetic aspects of negotiations, etc.

The enterprise is a complex organizational, technical and socio-economic object, so one manager is not able to manage it independently.

As a rule, a manager creates his or her work team, and most management functions are delegated to the lower levels, constantly interacting with them.

Each manager should take into account the needs and values of employees, regulate relationships between people, based on the general theory of collective activity, scientific principles of team formation, information selection of personnel, rules for building a model of personality and social norms.

Since the manager works with people, he is obliged to understand the following existing phenomena in the team functioning: psychic processes, psychic states of the individual, psychic characteristics of the individual, socio-psychological phenomena, etc. As the leader is not only responsible for the team, but is part of it, he is obliged to set an example for the team in terms of ethics, morals and professional skills.

During the rapid pace of scientific and technological progress development, another challenge for modern managers is to ensure effective management and protection of the environment. In order to do this, managers must have a clear understanding about the connection between the intensification and environmental aspects of production, as well as plan for sustainable usage of nature, resource conservation and environmental protection.

In practice, hardware, software and software-hardware methods of algorithms, test and functional selection of personnel professional composition parameters are applied.

Equipment (hardware) are the main means of implementing the hardware method for selecting the professional parameters of personnel. The hardware tools for selection of personnel professional composition parameters are structurally independent from the object of research and are connected to it only if it is necessary to carry out the process of selection of personnel professional composition parameters. Models construction is a classic example of the hardware method implementation regarding the selection process of personnel professional composition parameters. Using the decomposition method, the system under study is divided into subsystems, thus creating new models. The result is a set of models that combine into a single model system for each object. The application of this approach is not rational in complex systems, because it is impossible to clearly describe the dependence of the efficiency of production processes on their parameters. It is not always appropriate to apply statistical models because of insufficient statistical information. Since it is necessary for each local quality criterion to build its own model and then to integrate this system into a single system of models, this in turn complicates and makes the classical approach more expensive.

The tasks of optimizing complex systems for the selection of professional frame parameters can be classified as extreme and solved using search optimization methods. These methods are based on the usage of the local information about the object's properties, which is optimized by consistently improving the quality of solutions to optimal problems in conditions of uncertainty. By using optimization theory, the most convincing results were obtained for the first and second order methods. In the process of comparing direct search methods with first- and second-order methods, the latter are preferred over the rate of convergence.

When solving practical problems, there are some complexities for applying first-order methods that use derivatives. Therefore, it is necessary to have a clear mathematical model of the optimized research object, which describes the dependence of the output (target function) on the input, and also it is necessary to know the derivatives of the minimized function.

In this case, direct search methods are used, which, as input parameters, require the value of the objective function for certain input effects on the optimization object. These methods allow to solve optimization problems without using a certain model. Sometimes they are called experimental optimization methods.

There is another problem that moves direct search methods to first place compared to first order methods. It arises in the process of difficulty of obtaining derivatives in the form of analytical functions. For instance, if the objective function is given by a system of equations belonging to different subsystems of a given system, then an analytical or numerical determination of the derivatives becomes impossible. Thus, in this situation, direct search methods are used.

There is a wide range of options for solving the problems of optimization of algorithms regarding the selection of personnel professional composition parameters, what does not allow to fulfil the task completely. Therefore, further refinement of known methods is needed by creating new models and analysing complex solutions. Thus, the development of an information system for the qualitative selection of professional parameters for personnel is quite relevant, in which it is advisable to use direct search methods during the expert decision-making process.

Information analysis systems to support decision-making processes are relevant nowadays, so they are being implemented in various fields of science and production. These systems are designed for economic, information and other systems. Timely and correct decision-making can facilitate effective operations to find the best solution for multi-factor input characteristics, which can help to increase the efficiency of the organization, while the person can not make the most objective decision for a limited time. In the routine recruitment process at the enterprise, the data of the system can form a complete description of the professional qualities of the applicant for the vacant position, as well as provide more objective answer to the question regarding employee's compliance with the proposed vacancy.

All these data can be analysed in order to create a complete and objective characterization of the person. The findings of the study allow us to form a conclusion about professional suitability

and can provide guidance regarding the working process, for instance, in what environment or department a particular person should work.

Many factors must be considered in order to form the modern information-analytical decision support system. Let's consider the process of forming an information environment for developing a decision support system (DSS). The bases for the classification of this environment are the following four groups of characteristics: the purpose of the system, the characteristics of the human link, the type and structure of the machine link and the type of their interaction.

According to the purpose of the DSS are divided into:

- training, such as simulators (provide the development of certain human skills);
- information searching systems (provide the search, accumulation and obtainment of information necessary for a particular person);
- research, for example, information-expert systems, modelling stands, measuring devices (used in the analysis of certain phenomena, as well as in the search for information).

Particular attention should be paid to the information-analytical systems used to automate the basic activities of an organization based on operational data, as well as other available data sources that can be used to make certain decisions. The prominent representatives of such information-analytical systems are systems that use online analytical processing (OLAP) and Data Mining technologies. These systems are the most effective examples of DSS in comparison with information searching systems, because they not only accumulate information but also process analytical information.

The following typical tasks are solved in organizations through the usage of information-analytical systems: analysis of the organization's activity and its branches and divisions, conducting a comprehensive assessment of the organization's activity, preparation of consolidated reporting, as well as control over the execution of orders.

The development of information-analytical systems involves the creation of databases for the purpose of storing operational information, implementation of OLAP tools and Data Mining elements for analysis of information and making strategically important decisions.

The introduction of information and analytical systems into the organizations’ practice gives its users the following significant advantages: the ability to assess the prospects of organizational development, a significant increase in the suitability of management decisions, the availability of powerful tools for analysis and reporting, which in turn allow to extend the strategic management of the organization.

According to certain characteristics of the human link in the information system is divided into several monosystems (they include one person and one or more technical devices) and polysystems (consisting of a employees` team who interacts with a range of technical devices).

The following systems can be distinguished by the characteristics of the machine link:

- tool systems (their composition includes tools and instruments as technical devices);
- simple systems (include fixed and non-stationary technical devices, as well as people using these devices);
- complex systems, such as power set, computing complex (include, besides the humans, a set of technologically related but functionally different devices and machines aimed at producing a single product);
- system-technical complexes (the most complex systems “man-machine-environment” with a number of employees involved into the usage process of these systems, without well-defined connections).

According to the type of human-machine functional connections, the systems “human-machine-environment” are divided into systems of continuous interaction, in which the person maintains constant control over the movement of the object or management over the technological process, and systems of episodic interaction, in which control and management are carried out irregularly.

Considering the analytical system that is designed in the environment “man-machine-environment”, it should be noted that it must have specified properties, which are determined during

the design process and implemented during the exploitation process. Its objective features, which are manifested in the operation process, are considered as the properties of this system.

In the first designing stage of the “Personnel” system, involved into decision making support, certain groups of potential users and their information needs were identified.

The following groups of potential users of DPS “Personnel” can be distinguished: ordinary users (inspectors of the HR-department and the training department of employees); experts; executives; administrator.

Information needs of ordinary users are met by the block regarding the input of initial data, which is used to enter information into the database and its subsequent maintenance.

The information needs of the experts are met at the expense of the analysis block, which evaluates the work of staff.

Information needs of executives are met at the expense of the modelling block, where a multicriteria decision is made.

The administrator's information needs are met at the expense of the database administration block (DA), which maintains a centralized data archive and supports the DSS’s operation.

The core of an information system is a special database. In order to build our database, we are going to use the following database construction method based on structural analysis and design methodology.

On the basis of information about the subject area, which comes from experts, its functional model is built, with the help of which the ER model (Entity — Relationship Model ERM) of the subject area is built.

User needs analysis — is an important stage in during the database development process. At this stage, the general knowledge on the requirements for the future system is transformed into precise definitions.

At this stage, the following characteristics are defined:

- system architecture, its functions, external conditions, basic facilities and development technologies;
- interfaces and distribution of functions between the person and the system;
- software requirements and information components of the software, necessary hardware resources, database requirements;
- physical characteristics of software components, their interfaces.

The next stage — design. The main task of this stage is to study the structure of the system and the logical interconnections between its elements, however, it does not address issues related to implementation on a specific platform.

At the stage of needs analysis, a functional model is being built. There are several ways for creation of this model within the framework of structural analysis and design methodology:

- SADT (Structural Analysis and Design Methodology) Model. Within this methodology, a model system is constructed, consisting of diagram pages, texts, figures and a glossary. The pages of one model form a corresponding hierarchy, the upper levels of which represent diagrams of complex functions, and the lower level presents textual descriptions of elementary functions.
- DFD Model (Data Flow Diagrams). It is a tool for modelling functional requirements. With the help of diagrams these requirements are divided into functional components (processes) and represented in the form of a network whose summits are connected by data flows. The main purpose of such tools is to demonstrate how each process transforms its input data to output, as well as to identify the relationship between these processes.
- Business model. Business model is the simplest tool of functional modelling. It is used when there is no need to build a detailed model of relevant problems. This is mostly happen in case when the main purpose of the designer is to build an information model. Then the business model allows to divide the overall task into subtasks. This model is limited only by viewing the lists of major business processes without decomposing them. In a business model, business processes are called functions.

The second aspect of the model is the data classes that represent semantically unified information objects that arise in the process of performing a function or needed for its functioning. Data classes are high-level prototypes of future entity ranges (ER-model) and relationships (relational model).

In fact, the business model is a matrix whose rows correspond to functions and columns to data classes. The label is placed at the intersection of columns and rows, which means that this class of data is involved in performing the corresponding function. Later, during the process of informational modelling, functions will determine independent stages of modelling. Eventually, the independent information models of each individual function will be integrated into the overall model of the whole system.

The following structures are considered within the ER model: the set of entities; multiple connections; role; set of values; attribute. Next, we describe the structure of certain tables for the created “Personnel” database. The information on the candidate for the vacant position is introduced into the table Applicant.

Table 1. Applicant

№	Title	Section symbol in database table	Section type	Value
1	Applicant code	KODSOISKAT	INT	not NULL
2	Name of the applicant	FIOSOISKAT	CHAR	25
3	Applicant`s date of birth	DATAROGDEN	DATE	not NULL
4	The address of the applicant	ADRESSOISKAT	CHAR	50
5	Gender of the applicant	POL	CHAR	10
6	The marital status of the applicant	SEMPOL	CHAR	15

Source: author's development

There are four steps involved in designing a database using the entity-essence model: identifying entity sets and connection sets; identification of semantic information in multiple connections; defining attributes; organizing data in the relation form of an “entity/connection” and identifying initial keys.

Definition of integrity constraints: restrictions on the allowed values in their set; limits on the allowed values for the particular attribute. In some cases, not all valid values in the value range are allowed for some attributes.

Tables are the basic elements of any database. They store all the data available in the database, as well as the structure of the database (sections, their types and properties). The DB table is created in two stages. In the first stage, its structure is identified: the composition of the fields, their names, the type of each section, its size and other properties of the sections. In the second stage, the table is filled with data, special records are formed.

Conclusion

The current state of information technologies in the sphere of personnel management in organizational systems was considered. The basic directions of personnel management at the enterprises and in the organizations were identified. Classification of personnel was performed depending on the type of work they are involved in. An overview of the information systems used for integrated management of labour resources was conducted.

Due to the high cost of such systems, it was proposed to develop a system of recruitment and training, which would take into account the individual data of applicants for vacant positions.

The analysis of literature sources regarding the selection, placement and training of personnel has shown that, nowadays, the scientific research related to the presentation and processing of knowledge about this sphere is insufficient.

It was also suggested to use a mathematical apparatus in order to describe the tasks of recruitment, placement and training in banking sphere, which allows to apply the intelligent methods to the developed mathematical models.

The general characteristics of DSS and a range of system's quality indicators, which affect the human activity in the given system and at the same time depend on its activity, were presented. Moreover, groups of potential users of the DSS “Personnel” and their information needs were described.

The application of ADO technology - data access technology, as well as the peculiarities of using Microsoft SQL Server 2008 and Delphi environment in the process of developing a prototype of the DSS “Personnel” were described. A developed database of “Personnel”, which is used to store input and output data, and outlines the overall relationship between the tables of this database was represented.

The algorithm and the principle of the module “Adaptive testing” were presented, the results of testing this program on a real example were given.

The working principle of the module “Recruitment” was described, the block scheme and the scheme of usage options regarding this module was given.

A description of the software prototype, as well as the screen forms of the work example and a part of the program code are presented in the corresponding appendices.

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References

Brewster, C. (2017). The integration of human resource management and corporate strategy. In Policy and practice in European human resource management (pp. 22-35). Routledge. https://doi.org/10.4324/9781315231426

Collings, D. G., Wood, G. T., & Szamosi, L. T. (2018). Human resource management: A critical approach. In Human resource management (pp. 1-23). Routledge. https://doi.org/10.4324/9781315299556

Delery, J. E., & Roumpi, D. (2017). Strategic human resource management, human capital and competitive advantage: is the field going in circles?. Human Resource Management Journal, 27(1), 1-21. https://doi.org/10.1111/1748-8583.12137

Gill, C., Gardner, W., Claeys, J., & Vangronsvelt, K. (2018). Using theory on authentic leadership to build a strong human resource management system. Human Resource Management Review, 28(3), 304-318. https://doi.org/10.1016/j.hrmr.2018.02.006

Guest, D. E. (2017). Human resource management and employee well-being: Towards a new analytic framework. Human Resource Management Journal, 27(1), 22-38. https://doi.org/10.1111/1748-8583.12139

Huemann, M., Keegan, A., & Turner, R. (2008). Human resource management in the project-oriented organization. International Journal of Project Management. Volume 26, Issue 5, pages 577-585. https://doi.org/10.1016/j.ijproman.2008.05.005

Kianto, A., Sáenz, J., & Aramburu, N. (2017). Knowledge-based human resource management practices, intellectual capital and innovation. Journal of Business Research, 81, 11-20. https://doi.org/10.1016/j.jbusres.2017.07.018

Liu, D., Gong, Y., Zhou, J., & Huang, J. C. (2017). Human resource systems, employee creativity, and firm innovation: The moderating role of firm ownership. Academy of Management Journal, 60(3), 1164-1188. https://doi.org/10.5465/amj.2015.0230

Marler, J. H., & Boudreau, J. W. (2017). An evidence-based review of HR Analytics. The International Journal of Human Resource Management, 28(1), 3-26. https://doi.org/10.1080/09585192.2016.1244699

Meyer, K. E., & Xin, K. R. (2018). Managing talent in emerging economy multinationals: Integrating strategic management and human resource management. The International Journal of Human Resource Management, 29(11), 1827-1855. https://doi.org/10.1080/09585192.2017.1336362

Plaskoff, J. (2017). Employee experience: the new human resource management approach. Strategic HR Review, Vol. 16 No. 3, pp. 136-141. https://doi.org/10.1108/SHR-12-2016-0108