

Zhou Huan

Phd student, Department of Information Systems and Technology,

<https://orcid.org/0000-0003-1187-8161>

Taras Shevchenko National University of Kyiv, Kyiv

INFORMATION TECHNOLOGY FOR THE MANAGEMENT OF HUMAN RESOURCES OF EDUCATIONAL PROJECTS

Abstract. *The work analyzed and established that there are gaps in the direction of the development of information technologies for human resource management, in particular electronic management. The research is incomplete and practically does not take into account the particular operating conditions of the organization and external undesirable influences: pandemic, economic crisis, and military conflict. At the same time, the interest of the private sector in the development of this direction is growing every year. Thus, the main directions for research related to the application of information technologies for human resource management in general and their adaptation to unique or critical conditions of operation are especially relevant. A mathematical formulation of the problem of selecting a team of educational project executors with existing limitations on the cost and number of executors of the relevant functions of the project has been constructed. The components of the information technology of human resources management of the university educational project are proposed: subsystems of announcement and advertisement of vacancies; health of applications, resumes, motivational letters; analysis of candidates based on specific criteria; assessment of candidates; forming a rating or ranking of candidates according to their suitability for vacancies; communication with candidates by sending letters, communicating with candidates, sending invitations to an interview; data storage and analytics, etc. The obtained results are essential for ensuring the unbiased formation of the project team and the management of human resources. The obtained results are essential for higher education institutions and managers of projects, including educational and scientific ones. In the future, it is planned to describe the results of implementing this technology in various higher education institutions.*

Keywords: *information technology; project management; human resources management*

Introduction

There is an opinion that public institutions and organizations, including in the field of providing educational services, are less productive and have a more inflated budget than private institutions that are managed based on performance and take into account real profits [1]. The human factor plays a vital role in the effectiveness of activities and the use of the budget. That is, the more professional environment is formed in the institution, the more influential the results of this institution will be. An essential component of the formation of a professional environment in an institution, in particular in an institution of higher education, is the presence of proactive motivation among employees [2; 3].

Expectancy theory explains why many workers are unmotivated and only fake work or at least put in minimal effort to achieve results, even when they receive high rewards. An important influence on employee performance is exerted by:

- professional working environment [4];
- leadership [5];

- job satisfaction [6];
- sufficient remuneration [7];
- career development [8].

In the last few decades, the development of technology has significantly changed the processes and practices of human resource management. A new direction of research has appeared: information systems of human resources. This direction develops tools and methods for solving tasks and problems managing human resources in various conditions. At the same time, methods of obtaining, presenting, storing, manipulating, and analyzing data about human resources in some organizations for personnel management and decision-making support are considered. The work [9] describes the peculiarities of this research direction. In works [10; 11], this area is considered more broadly and includes not only training and selection of potential employees and their compensation but also automation of salary calculation, etc. This expansion allows us to talk about the direction of electronic human resource management (eHRM). It includes the possibilities of using cloud technologies, self-service technologies and distance learning, which

allow to more efficiently and quickly solve a whole layer of tasks related to managing human resources in organizations. The development of information technologies for the electronic management of human resources is especially relevant in critical conditions: conditions associated with the pandemic and military operations in Ukraine and other parts of the world.

However, the analysis of recent studies needs to be more accurate in the direction of the development of information technologies for human resources management, particularly electronic management. The studies are incomplete and do not consider the special conditions of the organization's functioning. At the same time, the interest of the private sector in the development of this direction is growing every year. In the studies conducted on the edge of the technological leap of the early 90s of the last century [12], the analysis of changes in human resource management practices is little followed. However, it exerts a critical influence on the development of methods, models, and means of their implementation and, in the long run, can significantly improve efficiency in solving several tasks of human resources management.

There are different interpretations of problems that are solved within the new directions of human resources management. One of the first definitions of eHRM was conducting human resource operations over the Internet [10]. Others defined eHRM as implementing HR practices using web technologies [13]. In [14], eHRM was described as a mechanism by which organizational stakeholders, particularly managers, job candidates or employees, access HR information and functions via the Internet [15].

Until recently, the development of technologies in human resource management has been based on the development of decision support systems and ERP systems for human resource management. The following leading vendors should be highlighted: SAP, Oracle, and PeopleSoft. At present, the dominant influence on the development of this direction is exercised by:

- implementation of cloud technologies for human resources management (leading vendors: Workaday, Success Factors);
- development of data analytics and Big Data to support decision-making in human resources management;
- use of mobile technologies, in particular applications and systems;
- social resources used to select potential employees of the organization.

Thus, the main directions for research related to the application of information technologies for human resource management in general and their adaptation to unique or critical conditions of operation are especially relevant. It is also essential to develop models, methods

and tools for resource management of specific organizations, in particular higher education institutions that have certain features, as well as educational projects that operate in these institutions and require the practical application of human resources management technologies.

At the same time, during the construction of information technology for the management of human resources of educational projects, related tasks also arise, in particular, the task of monitoring the scientific productivity of employees of higher education institutions [16; 17], the task of selecting potential executors of educational projects [18; 19] and, in general, the task of managing educational projects and programs [20; 21].

The purpose of the study is to formulate recommendations for the construction of information technology for the management of human resources of the educational project of the university: the construction of variables, constraints and a mathematical model to optimize the formation of the project team and the description of methods and means of their implementation to achieve the project's goals.

Problem statement

The task is the construction of information technology for the management of human resources of the educational project of the university. To do this, at the first stage, formulate a mathematical model for selecting potential executors of project functions for the project team.

Let $A = \{a_1, \dots, a_n\}$ is a set of applicants who are offered for inclusion in the team of the educational project of the university, $F = \{f_1, \dots, f_m\}$ is a set of functions that must be performed to achieve the goals of the educational project of the university.

Let $K = \{k_{ij}\}_{i=1, n}^{j=1, m}$ is a matrix of competencies of potential executors of the educational project a_i , $i = \overline{1, n}$, that are able to perform the corresponding function f_j , $j = \overline{1, m}$.

We will also set the integral matrix of values $P = \{p_{ij}\}_{i=1, n}^{j=1, m}$, which connects the cost of performing the relevant functions f_j , $j = \overline{1, m}$ by each of the potential executors of the educational project a_i , $i = \overline{1, n}$. Let's assume that if $p_{ij} > 0$, the executor a_i performs a function f_j , $i = \overline{1, n}$, $j = \overline{1, m}$. If the performer does not exclude the corresponding function, then $p_{ij} = 0$. We will also set a limit on the number of performers who can perform the function L_j , $j = \overline{1, m}$.

It is necessary to find the composition of the team to perform all the functions of the educational project, taking into account potential performers. Performers can be employees of a particular university or other universities or scientific institutions. The level of detail of the model depends on this.

In the simplest case, the matrix of the composition of the educational project, which will be denoted by $S = \{s_{ij}\}_{i=1, n}^{j=1, m}$ is a Boolean, that is, an element of the matrix $s_{ij} \in \{0, 1\}$. If $s_{ij} = 0$, then the executor a_i , who was selected for the team of the educational project does not perform the corresponding function f_j . If $s_{ij} = 1$, then the executor a_i , who is selected for the team of the educational project performs the corresponding function f_j , $i = \overline{1, n}$, $j = \overline{1, m}$.

Then we will build the target function for the task of building a project team in the form:

$$\begin{aligned} \sum_{i=1}^n \sum_{j=1}^m s_{ij} p_{ij} &\rightarrow \min, \\ \sum_{i=1}^n s_{ij} &\geq L_j, \quad \forall j = \overline{1, m}, \\ \sum_{j=1}^m s_{ij} k_{ij} &= 1, \quad \forall i = \overline{1, n}. \end{aligned}$$

This is an optimization task that may arise in the human resources management of the university's educational project. However, the functions of human resources management include many aspects that are related to activity monitoring, motivation systems, change management and dismissal of executors from the project in case of unsatisfactory performance of functions, etc.

Components of information technology for the management of human resources of an educational project

In a broad sense, for the formal statement of the problem of human resource management of an educational project, you need:

1. Identify all decisions that can be made regarding human resource management of a university educational project. For example, this may include the distribution of teaching staff, the size of research grants, or the choice of programs and courses to offer students.
2. Identify all the constraints and circumstances that affect decision-making in human resource management. This may include budget constraints, limitations on the available number of teachers or students, project deadlines, and more.
3. Define the goal or objective to be achieved through the human resource management of the university education project. This objective function can be expressed

mathematically, for example, maximizing the quality of education or minimizing costs.

4. Formulate a mathematical model of the problem using variables, constraints, and an objective function. This usually takes the form of an optimization problem that can be solved using optimization techniques such as linear programming, dynamic programming, other numerical methods, etc.

5. Solve the mathematical model of the problem to find optimal or rational solutions for the management of human resources of the university educational project.

After building a mathematical model and determining the methods of their solution, it is necessary to form a structure of information technology that will solve a complex of tasks related to human resources management.

The information technology of human resources management of the educational project of the university combines technological solutions and processes for effective management of faculties, students, teachers and other resources in the educational institution. This system helps to improve the quality of training and human resources management, simplifies administrative tasks and provides access to the necessary information.

The components of the information technology of human resources management of the university educational project include or may include the following elements:

1. The information system should provide the possibility of posting vacancies and announcements about the need for executors of the educational project. This can be on the university website or specialized platforms.
2. Collection of applications, resumes, motivational letters and other documents.
3. Automated analysis of candidates based on specific criteria such as education, work experience, skills, etc. It can select candidates who meet the requirements of the vacancy.
4. Candidate assessment tools, such as knowledge testing, interviews, or other methods that help identify top performers.
5. Forming a rating or ranking candidates according to their suitability for the job. It helps to make objective decisions regarding the management of human resources of the educational project.
6. Communication with candidates by sending letters, communicating with candidates, sending invitations to interviews and other communications.
7. The information system must reliably store data about candidates, their applications, CVs and other documents for further use and archiving.
8. The system should provide reports and analytics on the selection process, including the number of applications, recruiting efficiency, time to vacancy, etc.
9. The system should be able to integrate with other university systems, such as student and faculty databases, to enable information sharing.

10. Ensuring the security and confidentiality of candidate data is an essential component of the system, especially taking into account the requirements for the protection of personal data.

Auxiliary functions and subsystems can be electronic registers, financial and resource management systems, student data management systems, etc. All these components or subsystems must be adaptive to possible changes in the conditions in which the organization implements the information technology of human resources management functions. That is, the work of the team selection system for the implementation of the educational project, monitoring of its results and overall management of the project's human resources must take into account turbulence in the external environment: economic crises, military conflicts, epidemics and pandemics of infectious diseases, etc. Especially in the last decade, this function of such systems is very relevant.

Conclusions

1. The work includes a review of human resource management systems, in particular electronic human resource management of educational projects

implemented in higher education institutions. It was established that there are gaps in the direction of the development of information technologies for human resource management, in particular electronic management, research is fragmentary and practically does not take into account the special conditions of the organization's functioning and external undesirable influences: pandemic, economic crisis, military conflict.

2. A mathematical formulation of the task of selecting a team of educational project executors was built with existing limitations on the cost and number of executors of the relevant project functions.

3. The components of the information technology of human resources management of the university educational project are proposed.

In the future, it is planned to describe the results of the implementation of this technology in institutions of higher education of the People's Republic of China and to show the effectiveness of its application to ensure the formation of a team of educational projects and the performance of its functions for the obtained planned result.

References

1. Bercu, A.-M. & Grigoruță, M. V. B. (2012). Human Resource Involvement in Romanian Public Organizations under the Financial Constraints. *Procedia Economics and Finance*, 3(12), 451–456. [https://doi.org/10.1016/s2212-5671\(12\)00179-7](https://doi.org/10.1016/s2212-5671(12)00179-7)
2. Luo, M. M. & Chea, S. (2018). Cognitive appraisal of incident handling, affects, and post-adoption behaviors: A test of affective events theory. *International Journal of Information Management*, 40, 120–131. <https://doi.org/https://doi.org/10.1016/j.ijinfomgt.2018.01.014>
3. Sudana, I. P. (2015). ScienceDirect Sustainable Development and Reconceptualization of Financial Statements. *Procedia -Social and Behavioral Sciences*, 211, 157–162. <https://doi.org/10.1016/j.sbspro.2015.11.023>
4. Frederiksen, A., Lange, F. & Kriechel, B. (2017). Subjective performance evaluations and employee careers. *Journal of Economic Behavior and Organization*, 134, 408–429. <https://doi.org/10.1016/j.jebo.2016.12.016>
5. Zimmermann, A., Hill, S. A., Birkinshaw, J. & Jaeckel, M. (2019). Complements or substitutes? A microfoundations perspective on the interplay between drivers of ambidexterity in SMEs. *Long Range Planning*, August, 101927. <https://doi.org/10.1016/j.lrp.2019.101927>
6. Sikora, D. M. & Ferris, G. R. (2014). Strategic human resource practice implementation: The critical role of line management. *Human Resource Management Review*, 24(3), 271–281. <https://doi.org/10.1016/j.hrmr.2014.03.008>
7. Werner, J. M. (2000). Implications of OCB and Contextual Performance for Human Resource Management. *Human Resource Management Review*, 10(1), 3–24. [https://doi.org/10.1016/S1053-4822\(99\)00036-4](https://doi.org/10.1016/S1053-4822(99)00036-4)
8. Sotomayor, S. (2020). Long-term benefits of field trip participation: Young tourism management professionals share their stories. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 100285. <https://doi.org/10.1016/j.jhlste.2020.100285>
9. Kavanagh, M. J., Thite, M. & Johnson, R. D. (Eds.). (2015). *Human resource information systems* (3rd ed.). Thousand Oaks, CA: Sage
10. Lengnick-Hall, M. L. & Moritz, S. (2003). The impact of e-HR on the human resource management function. *Journal of Labor Research*, 24, 365-379.
11. Gueutal, H. G. & Falbe, C. M. (2005). eHR: Trends in delivery methods. In H. G. Gueutal & D. L. Stone (Eds.), *The brave new world of eHR* (pp. 190-225). San Francisco, CA: Jossey-Bass.
12. Kavanagh, M. J., Gueutal, H. G. & Tannenbaum, S. I. (1990). *Human resource information systems*. Boston: PWS-Kent.
13. Ruël, H., Bondarouk, T. & Looise, J. K. (2004). E-HRM: Innovation or irritation. An explorative empirical study in five large companies on Web-based HRM. *Management Revue*, 15(3), 364-380.
14. Stone, D. L. & Dulebohn, J. H. (2013). Emerging issues in theory and research on electronic human resource management (eHRM). *Human Resource Management Review*, 23(1), 1-5.
15. Johnson, Richard D.; Lukaszewski, Kimberly M. and Stone, Dianna L. (2016). The Evolution of the Field of Human Resource Information Systems: Co-Evolution of Technology and HR Processes. *Communications of the Association for Information Systems*, 38, 28.

16. Kuchansky, A., Biloshchytskyi, A., Andrashko, Y., Biloshchytska, S. & Faizullin, A. (2022). The Scientific Productivity of Collective Subjects Based on the Time-Weighted PageRank Method with Citation Intensity. *Publications*, 10(4),40, 1–17.

17. Andrashko, Y., Kuchanskyi, O., Biloshchytskyi, A., Pohoriliak, O., Gladka, M., Slyvka-Tylyshchak, G., Khlaponin, D. & Chychkan, I. (2023). A method for assessing the productivity trends of collective scientific subjects based on the modified PageRank algorithm. *Eastern-European Journal of Enterprise Technologies*, 1(4 (121)), 41–47.

18. Biloshchytskyi, A., Kuchansky, A., Andrashko, Y. & Wang, Y. (2022). Devising a competence method to build information spaces for executors of educational projects in a dynamic environment. *Eastern-European Journal of Enterprise Technologies*, 1(3(115)), 66–73.

19. Biloshchytskyi, A., Andrashko, Y., Kuchansky, A., Faizullin, A. & Toxanov, S. (2022). Model of multi-criteria selection of scientists and higher education institutions for the scientific organization. *Scientific Bulletin of Uzhhorod University. Series of Mathematics and Informatics*, 41(2), 7–15 (in Ukr.).

20. Kolomiets, A., Morozov, V. (2021). Investigation of Optimization Models in Decisions Making on Integration of Innovative Projects. *Lecture Notes in Computational Intelligence and Decision Making*, 51–64. doi: https://doi.org/10.1007/978-3-030-54215-3_4

21. Lukianov, D., Bespanskaya-Paulenka, K., Gogunskii, V., Kolesnikov, O., Moskaliuk, A., Dmitrenko, K. (2017). Development of the markov model of a project as a system of role communications in a team. *Eastern-European Journal of Enterprise Technologies*, 3 (3 (87)), 21–28. doi: <https://doi.org/10.15587/1729-4061.2017.103231>.

Received 28.05.2023

Хуань Чжоу

Аспірант кафедри інформаційних систем та технологій, <https://orcid.org/0000-0003-1187-8161>
Київський національний університет імені Тараса Шевченка, Київ

ІНФОРМАЦІЙНА ТЕХНОЛОГІЯ УПРАВЛІННЯ ЛЮДСЬКИМИ РЕСУРСАМИ ОСВІТНІХ ПРОЄКТІВ

Анотація. В роботі проведено аналіз і визначено, що в напрямі розвитку інформаційних технологій управління людськими ресурсами (зокрема електронного управління) є розриви, дослідження є фрагментарними і практично не враховують особливі умови функціонування організації та зовнішні небажані впливи, як-от: пандемія, економічна криза, військовий конфлікт. При цьому інтерес приватного сектору щодо розвитку цього напрямку з кожним роком зростає. Отже, основні напрями для досліджень стосуються застосування інформаційних технологій для задач управління людськими ресурсами в цілому, а особливо актуальними є їх адаптація до особливих або критичних умов функціонування. Побудовано математичну постановку задачі вибору команди виконавців освітнього проєкту з наявними обмеженнями на вартість та кількість виконавців відповідних функцій проєкту. Запропоновано складові інформаційної технології управління людськими ресурсами університетського освітнього проєкту: підсистеми оголошення і реклами вакансій; збір заявок, резюме, мотиваційних листів; аналіз кандидатів на основі певних критеріїв; оцінка кандидатів; формування рейтингу або ранжування кандидатів відповідно до їхньої придатності для вакансії; комунікації з кандидатами шляхом надсилання листів, спілкування з кандидатами, надсилання запрошень на співбесіду; збереження даних та аналітики тощо. Отримані результати важливі для забезпечення неупередженого формування команди проєкту й управління людськими ресурсами. Отримані результати мають значення для закладів вищої освіти і керівників проєктів, у т.ч. освітніх та наукових. У майбутньому планується описати результати впровадження роботи цієї технології у різних закладах вищої освіти.

Ключові слова: інформаційна технологія; управління проєктами; управління людськими ресурсами

Link to the publication

- APA Zhou, Huan. (2023). Information technology for the management of human resources of educational projects. *Management of Development of Complex Systems*, 55, 128–132, dx.doi.org\10.32347/2412-9933.2023.55.128-132.
- ДСТУ Чжоу Хуань. Інформаційна технологія управління людськими ресурсами освітніх проєктів. *Управління розвитком складних систем*. Київ, 2023. № 55. С. 128 – 132, dx.doi.org\10.32347/2412-9933.2023.55.128-132.