

# Influence of Digital Technologies on the Labor Market of HR Specialists

Nestor Shpak<sup>1</sup>, Liana Maznyk<sup>2</sup>, Zoriana Dvulit<sup>1</sup>, Nadiia Seliuchenko<sup>1</sup>, Olena Dragan<sup>2</sup> and Kateryna Doroshkevych<sup>1</sup>

<sup>1</sup> Lviv Polytechnic National University, Bandera str. 12, Lviv, 79000, Ukraine

<sup>2</sup> National University of Food Technologies, Volodymyrska Str. 68, Kyiv, 01601, Ukraine

## Abstract

In this paper, we examine the impact of digital technologies on the labor market of HR professionals. With this purpose, digital trends in the creation of new operational processes in personnel management have been studied; the conditions for the implementation of digital technologies have been substantiated; the content of the main stimulants that contribute to the implementation of digital technologies in personnel management has been determined. The importance of digital culture as the basis of the organization's corporate culture according to the trends of world digital culture is emphasized; the influence of stimulants on the state of the labor market of HR specialists is assessed. The study is based on an array of official statistical information from the State Employment Service of Ukraine. The applied methodology of taxonomy made it possible to determine the degree of balance of the labor market of HR specialists in Ukraine in January 2020 - October 2021. And this methodically ensures monitoring of the situation in the labor market of specialists in the field as a whole. Factors that balanced the indicators of vacancies and unemployment in the labor market were identified. Recommendations have been formulated for the relevant state institutions that will help improve the situation in the labor market of HR specialists. In this paper, we consider the expert opinions of HRM practitioners who believe that the possession of relevant digital competencies for employees in this field is a basic condition for the formation of a modern labor market of HR professionals, confirming our results and conclusions.

## Keywords

Digital technologies, digitalization, human resource management, labor market, stimulators of development, information technologies, digital transformation, HR-specialists

## 1. Introduction

Since 2020, the labor market has changed under quarantine restrictions, and the global pandemic has catalyzed these changes. As a result, the need for remote work has increased exponentially. The pandemic has accelerated the use of digital technologies in any activity (business, education, services, etc.) where the main resource is the staff. With the development of digital technology, routine and cumbersome business tasks can be digitized and entrusted to intelligent systems, and human resources can be spent on more complex, strategic tasks.

Digitalization brings several positive changes, helping companies to identify the strengths and weaknesses of interaction with employees and to conduct a thorough assessment of staff from onboarding to offboarding employees; accelerate the process of finding candidates for vacant

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<sup>1</sup> COLINS-2022: 6th International Conference on Computational Linguistics and Intelligent Systems, May 12–13, 2022, Gliwice, Poland  
EMAIL: nestor.o.shpak@lpnu.ua (N. Shpak); solieri@i.ua (L. Maznyk); zoriana.p.dvulit@lpnu.ua (Z. Dvulit); nadiia.y.seliuchenko@lpnu.ua (N. Seliuchenko); eidragan@ukr.net (O. Dragan); kateryna.o.doroshkevych@lpnu.ua (K. Doroshkevych)  
ORCID: 0000-0003-0620-2458 (N. Shpak); 0000-0002-5387-7442 (L. Maznyk); 0000-0002-2157-1422 (Z. Dvulit); 0000-0002-2651-083X (N. Seliuchenko); 0000-0002-7606-2385 (O. Dragan); 0000-0003-3966-224X (K. Doroshkevych)



positions; ensure execution of the hiring process; monitor the dynamics of Human Resource Management (HRM) results in the company, etc.

Consideration of the synergistic impact of digital technologies on the labor market of HRM specialists makes it possible not only to accelerate the implementation of business tasks but also to improve their quality and efficiency. This is due to the identification and involvement of stimulators of digital technology in personnel management.

The effective implementation of digital technologies in the activities of companies is determined, in particular, by the relevant competencies of HRM specialists, which requires constant monitoring of the labor market situation by individual categories of workers and in general.

The described relevance of the research has necessitated the identification and study of the impact of digital technologies on the balance of the labor market of HR professionals in Ukraine. Our study aims to determine the impact of digital technologies on the labor market of HR specialists. To achieve this aim, as a task it is proposed to develop the Mining Data tools to create a methodology for monitoring the labor market of HR professionals.

## 2. Related Works

In their work [1], the authors emphasize that the labor market is characterized by an imbalance between the supply and demand of labor due to structural changes in the economy associated with the introduction of information technology. The rising unemployment is among the challenges of the labor market. According to the authors, the digitalization of the economy leads to the need to strengthen government regulation of business and provide social guarantees for workers.

In the study [2] it is proposed to evaluate the effectiveness of HRM activity based on cluster analysis, which belongs to the class of multidimensional analysis (statistical clustering methods). In the article [3] the authors used empirical and theoretical methods to study the impact of the pandemic on the labor market in the 4th industrial revolution.

Experts from the European Commission's science and knowledge service [4] emphasize that new technologies will change millions of jobs in the European Union (EU); digital and soft skills are becoming increasingly demanded in the context of the digitalization of society; technology is becoming a key driver of new forms of work; employment differentiation processes are taking place in the EU.

Researchers in [5, 6] emphasize that digitalization is the driving force of transformations in the field of employment and emphasize the prospects for the use of digital technologies to simplify procedures in job creation. The authors of [5] studied the differentiation of the level of the labor market in individual countries, which is associated with the influence of information technology.

The authors of [7] emphasize that digitalization will change the traditions of doing business and other areas. But such a phenomenon is becoming a serious challenge in the labor market. Therefore, the authors proposed to study the perceptions of EU citizens regarding digitalization and take into account the differences between individual socio-demographic groups. To achieve the objectives of the study, the authors used a combination of econometric methods and cluster analysis.

The authors of the study [8] combined the results of the study of the labor market with the phenomena of digitalization of the economy and concluded that it is necessary to make adjustments to provide digital skills in the technical education system in Brazil.

Digitalization is seen by some researchers as a threat to the balance of the labor market, which poses new challenges for workers and employers. These new challenges require new competencies from employees and new forms of work organization from employers [9].

Source [10] contains new methods of collecting and processing statistical information in the labor market, which would allow more informed decisions by market participants in the digital transformation of the economy and society.

Authors of [11] link the processes of digitalization with rising unemployment, thus identifying digitalization as one of the factors that cause social risks. Therefore, the authors conclude that it is necessary to develop an appropriate adaptive strategy at the state level to reduce the impact of such risks.

A team of researchers in [12] studied various areas of the labor market and the impact of digitization on them, assessed the consequences, and created forecasts of digital transformation for the labor sector through the prism of the phenomenon of "Gig Economy".

The authors of [13] proposed a model of digitalization management in the labor market, which provides different scenarios. According to the authors of this study, the forced scenario of digitalization is the most promising, and the model of probable transformations of the labor market is applied to this scenario. This study aims to improve the state strategy for labor market development in the context of digitalization.

Research [14], which is devoted to the development of effective HRM systems using modern digital technologies, in our opinion, is somewhat controversial, as it justifies the prospects of remote work with digitalization as a whole, that is, without distinction between digital transformations and Gig Economy.

In another study [15] the authors conclude the prospects for the impact of information technology on HRM based on the results of comparative analysis of traditional technologies and technologies for the digitization of personnel processes. They have analyzed the experience of such activities of many organizations around the world.

The conceptual and categorical apparatus in the field of digital technology is not sufficiently organized. For instance, there is parallel use of the categories such as "digitization", "digitalization" and "digital transformation".

Digitization is one of the stimulators of the development of digital technologies, which involves the process of converting information from paper and other media into digital format for further use in computer systems.

Digitalization lies in the conversion of operations, communications, business functions, business models, and processes into digital format, resulting in a combination of traditional business functions with digital ones (e.g., traditional human resource management with relevant digital tools).

Digital transformation is the evolutionary transformation of activities, processes, competencies, business models to make fuller use of the potential of technological change and opportunities of digital technologies.

Digitalization of personnel management is the most important change in the activities of modern organizations and its application is growing exponentially. HR must apply new methods and procedures to keep up with the rapid modernization of staff. The advantages of digital technologies are the creation of new operational processes of personnel management, which help to improve communication, collaboration, and access to analytical data [16].

At the very least, the implementation of digital technologies requires an appropriate level of digital competence, as formulated by A. Ferrari based on a thorough analysis of several national and international projects and initiatives. These include the set of knowledge, skills, attitudes (including abilities, strategies, values, and awareness) required to use information and communication technologies and digital media for performing tasks; problem-solving; communication; information management; cooperation; creation and dissemination of content; building effective, productive, responsible, critical, creative, independent, flexible, ethical, reflective tools for work, leisure, joint activities, learning, communication, meeting consumer needs and providing opportunities for the realization of rights [16].

### **3. Methods and Materials**

Methodological approaches to study the impact of digital technologies on the balance of the labor market of HR professionals are proposed. The proposed study is based on Data Mining tools as a methodology and process for identifying large data sets that accumulate on various information resources. These data are necessary for our study to make decisions in the sphere of impact on the labor market of HR Specialists.

The novelty of our study is the development in HR - the combination of Data Mining approaches. Traditional Data Mining methods are association, classification, cluster, forecasting, goal tree, neural networks, anomaly analysis, and pattern tracking methods.

These methods can be divided into descriptive and prognostic, which perform different functions. These methods can be implemented using technology, statistical, and machine learning methods.

Using the technology of statistical methods, Data Mining allows scaling the variability of the labor market of HR specialists, i.e., to reduce to a specific scale. These approaches involve assessing the dynamics of the unemployed and vacancies of HR professionals by individual categories of workers and an integrated assessment of the degree of balance of the labor market of HR professionals. Such an integrated assessment consists of a comparison of two taxonomic indicators (taxonomic vacancy indicator and taxonomic unemployment indicator) in dynamics.

The author of the study [17] emphasizes the importance of scientific and theoretical support for the proper qualification of employees and the acquisition of appropriate skills to match supply and demand in the labor market. The author proposed clustering as one of the Data Mining methods for effectively classifying information about vacancies.

Fundamental approaches to the application of taxonomic analysis in economic research are presented in [18]. The value of this approach lies in the possibility of creating an integrated assessment of a complex phenomenon. The taxonomic analysis is a subtype of methods of multidimensional analysis, which have recently become popular due to the growing complexity of economic systems. It should be noted that among the methods of multidimensional analysis, cluster analysis is most often used, and the potential of taxonomy is used insufficiently.

The process of calculating the relevant taxonomic indicators included the following stages [18]: construction of a matrix of observations; standardization of elements of the observation matrix; formation of a matrix of standardized values; construction of a vector – a standard; determining the distance between the elements of the matrix and the vector – the standard; calculation of taxonomy coefficient in dynamics (Table 1). The value of the taxonomic indicator as an integral indicator of a complex phenomenon is in the range from 0 to 1, which makes it possible to create dynamic comparisons and states of individual objects as the development of data mining tools.

**Table 1**

Method of calculating the taxonomic index

Definition of indicators	Formula	Interpretation of formula indicators
Standardization of matrix indicators	$Z = \frac{X_i}{\bar{X}_1}$	$X_i$ – the initial value of the i-th indicator; $\bar{X}_1$ – the average value of the i-th indicator;
Determining the distance between a point unit and a standard	$C_{to} = \sqrt{\sum_{i=1}^n (z_{it} - z_{oi})^2}$	де $z_{it}$ – the standardized value of the i-th indicator in the period t; $z_{oi}$ – the standardized value of the i-th indicator in the standard; n – number of indicators;
Taxonomic indicator of development	$K_t = 1 - d_t$	$d_t$ – the deviation of the enterprise indicators for the t-th year from the standard;
Deviation of t-th indicators from the standard	$d_t = \frac{C_{to}}{\bar{C}_o}$	$C_o$ – the total distance between the indicators and the accepted standard for the analyzed period;
The total distance between the indicators and the standard	$C_o = \bar{C}_o + 2S_o$	$\bar{C}_o$ – the average distance between the indicators and the standard; $S_o$ – standard deviation;
Average distance	$\bar{C}_o = \frac{1}{m} \sum_{i=1}^n C_{io}$	m – the number of years for which the analysis is conducted;
The standard deviation	$S_o = \sqrt{\frac{1}{m} \sum (C_{io} - \bar{C}_o)^2}$	$\bar{C}_o$ – the average distance between the indicators and the standard

To substantiate the degree of balance of the labor market of HR professionals, a method of comparison was used, which consists in comparing the dynamics of taxonomic indicators of vacancies and unemployment over the study period.

To determine the prospects for the development of the labor market of HR professionals, the method of expert assessments was used. For this, the best practices of HRM and methods of rating HR professionals in Ukraine were studied, which also includes the sign of mastery of modern digital technologies.

Since the research issues are quite variable and the labor market as a whole, it is considered appropriate to use official statistical resources, information resources of consulting companies and professional associations, and the most relevant publications indexed in scientometric databases.

The calculations, the results of which are presented in the work, were performed using Google spreadsheets and spreadsheets Microsoft Excel 2016 MSO (64-bit version).

## 4. Experiment

The technology of the proposed study involves using the potential of taxonomic analysis to monitor the state and dynamics of the labor market. To this end, it is necessary to study the factors - stimulants that harmonize the labor market. From our point of view, the main stimulators of the implementation of digital technologies in personnel management are as follows:

1. Greening the approaches in the organization of HR specialists (by reducing the documentation in paper form). With the traditional use of e-mail and Microsoft Office, many HR processes are not carried out "paperless" in their daily activities. This results in a huge number of forms for orders, applications for benefits, applications for leave, and other documents that require considerable effort for tracking and organization, as well as the time spent on their processing. Execution of documents requiring interdepartmental approval means that one sheet of paper is moved across the floors of the building (between levels of hierarchy) to obtain the necessary signatures. Human resources departments in large organizations process hundreds or thousands of documents every day. Some companies hire clerks to enter data from paper documents in an Excel worksheet. This stimulant is a phenomenon of digitization.

2. The emergence of applications that promote greater independence of employees. The use of "smart" applications has simplified staffing processes for employees and changed the way employees interact with the organization. Deloitte [19] has developed a system that tracks the time spent by consultants with their clients, paid hours, and compares them with other companies. Based on the results of the comparison, the system provides suggestions for improving inefficient work styles.

3. Automation of routine processes of personnel records management. Automation eliminates hours of manual work. In addition, manual work contributes to random (systematic and non-systematic) errors. For example, such mistakes occur when writing plans and reports of the recruiter, planning meetings with candidates, finding vacancies, performing HR analytics, and so on.

4. Recruitment through social networks. Recruitment has changed with the advent of social networks. For example, LinkedIn has changed the traditions of social networks and facilitated the interaction of potential candidates for vacant positions and recruiters. The TalentNow website [20] contains information that 80% of employers have found passive candidates through social networks. It is also noted that 89% of companies plan to recruit candidates through social networks, which indicates that the trend will continue to grow.

5. Virtual reality (VR) to train and ensure the appropriate level of moral and psychological climate in the team. Learning outcomes are always improved through the involvement of practical experience. With the advent of virtual reality (VR), companies can model real-life examples while learning. For example, retailers use virtual reality technology to prepare employees for Black Friday sales. For example, simulations using experience and data will demonstrate how the crowd responds to products sold by measuring in-store customer traffic, as well as how to respond to confrontations and manage the crowd.

6. Gamification in the work. Applying game dynamics in typical non-game contexts helps companies better engage employees. For example, companies may reward employees when they achieve their key performance indicators (KPIs), acknowledging their efforts in resolving difficult

situations. Companies can also implement real-time leader boards to create friendly competition between peers. This encourages employees to interact with each other and increase their productivity. For example, there is an experience in rewarding employees when they receive fewer sick leaves by points that can be used to purchase products manufactured by the company or NFT.

7. Study of employee needs. It is important that the understanding of the needs of the company's employees corresponds to the real scenario. Often companies tend to make assumptions or rely on industry benchmarks. As millennials join the workforce, companies must adapt to changing demographics and focus on the concept of generational theory. A separate area of such activities is to take into account the interests of employees with special needs.

8. Continuous learning. Training for beginners and employees in the digital age is no longer a problem. Cloud learning systems, online learning platforms solve this problem, where the only requirement is the ability to connect to the Internet. Text, video, and audio can be accessed at the touch of a button. The authors emphasize the need to constantly maintain the appropriate level of staff qualifications to ensure their validity [21]. In combination with VR technology, employees can also undergo practical training that can be conducted and repeated at any time.

9. Digital platforms. Digital platforms bring together two or more groups of people looking for or offering products and services. This creates a more distributed approach where people now have access to many options with just one click. This allows synchronizing information in real-time.

10. Digital culture. Digital platforms in various human resource management processes have created a new set of cultures related to the interaction of different generations. Due to the baby boomers and the retirement of Generation X, the company's staff will mostly consist of millennials. This group grew up with technology and understood how to use it to their advantage [22]. We propose to consider digital culture as the main element of the overall corporate culture of the organization. And the overall corporate culture of the organization must meet the trends of global digital culture. As the concept of digital culture is a new social phenomenon, there is a need to use the potential of digital transformation to integrate into the global digital culture. Given the trends in the introduction of blockchain technology in various fields of activity [23], the acquisition by HR specialists of skills in modern digital technologies becomes a necessary and sufficient condition for successful operation.

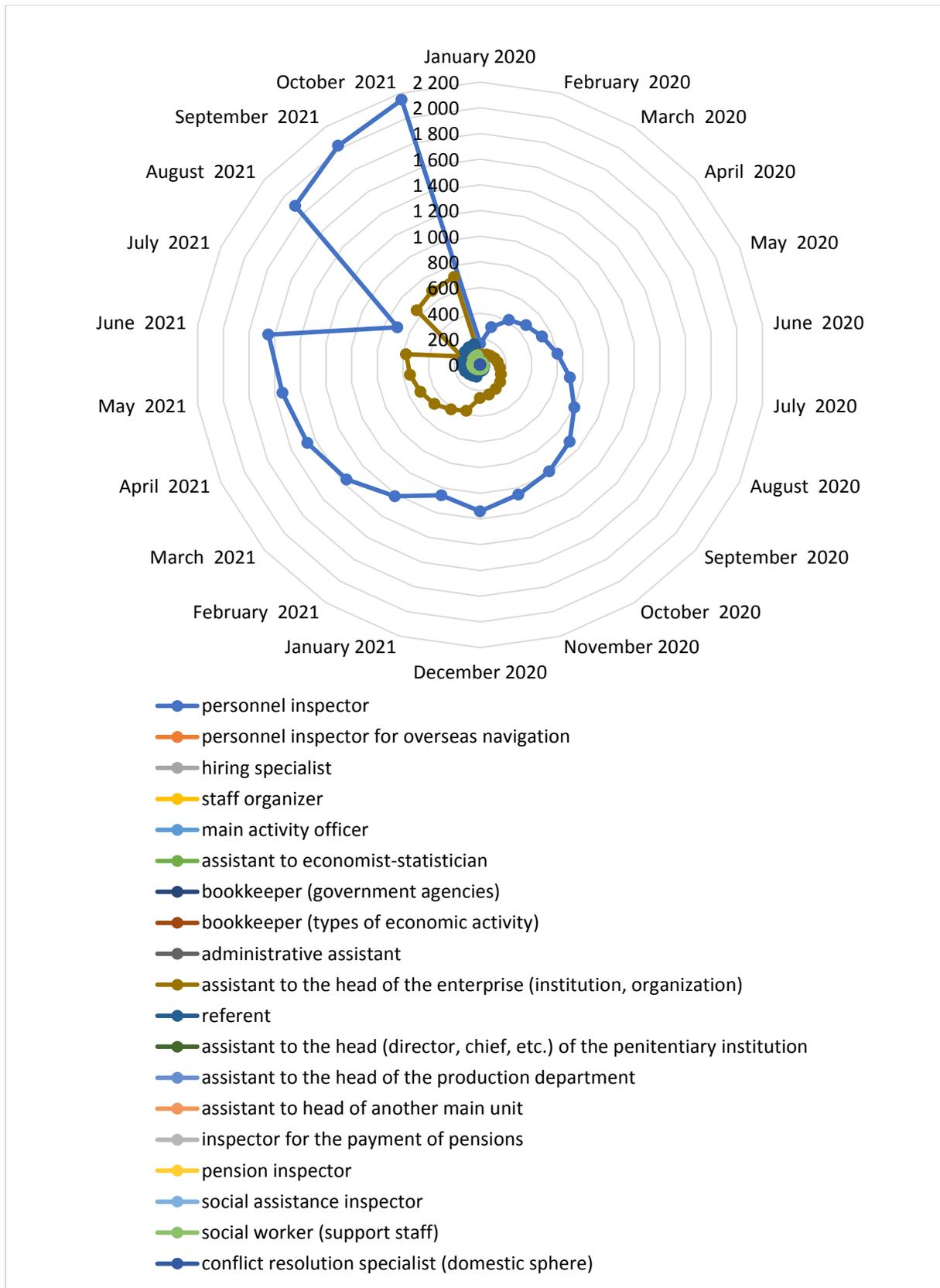
11. Introduction of quarantine restrictions. The introduction of quarantine restrictions transforms approaches to work organization, work regimes, stimulates the growth of remote workers and freelancers. Technological and technical support of these phenomena requires the use of modern digital technologies in personnel management.

Therefore, making digital decisions for human resource management processes is very important for the organization, because they provide many benefits to reduce the number of unnecessary or repetitive tasks, reduce the risk of errors and allow to focus on critical tasks. There is a common misconception that digitalization is difficult to accept, but these eleven areas can be an incentive to reduce the entry barrier into the use of digital technologies in personnel management. To confirm the influence of these stimulants, we researched the labor market of HR professionals [23].

## 5. Results

The dynamics of the number of vacancies of HR specialists in January 2020 – October 2021 (Fig. 1) is characterized by a growing trend until June 2021 in the study period. The formed trend began to reproduce (grow) from July 2021 to October 2021. This can be partly explained by: employment of graduates of higher education institutions with a bachelor's and master's degree, who have a specialized education; established traditions of remote work with the use of modern digital technologies (messengers, promotion of virtual offices, planners (for example, "Jira"), and other applications that facilitate the rhythm of remote work and control over its implementation). Such traditions are explained by long-term quarantine restrictions; reduction in the number of jobs due to the pandemic, especially in the field of small and medium-sized businesses.

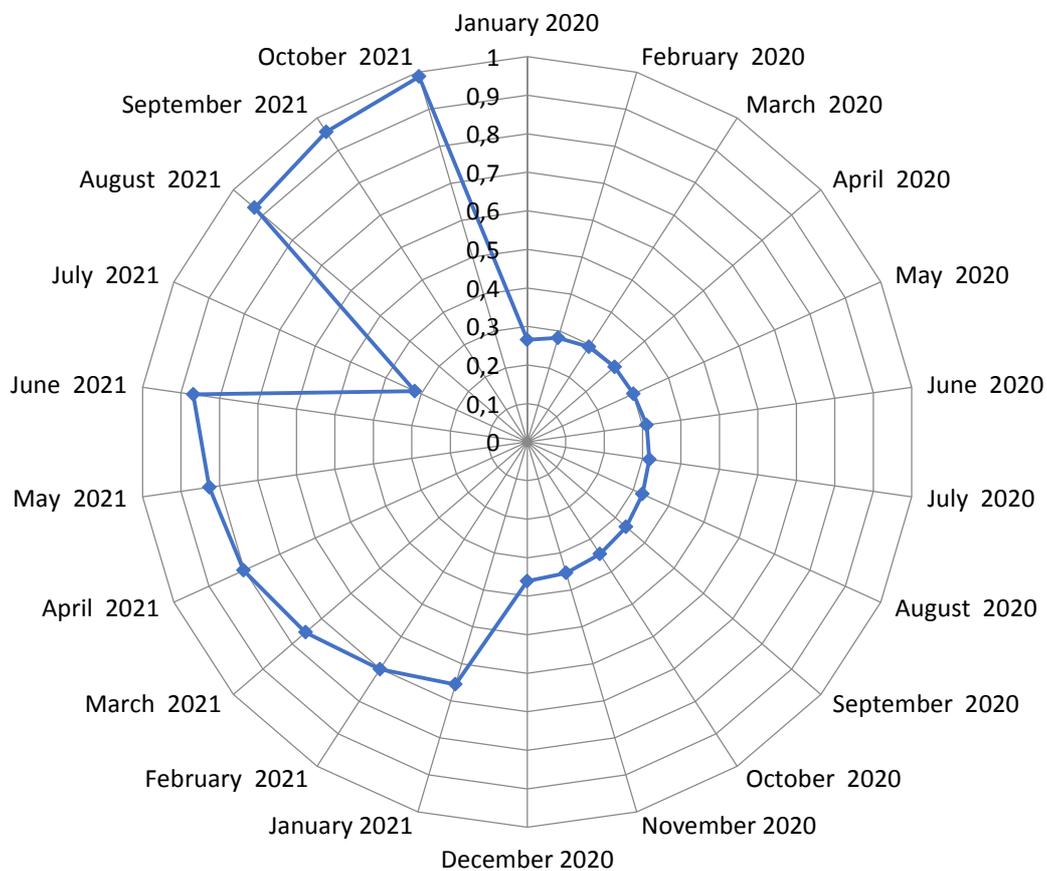
To study and identify the main trends in the dynamics of vacancies, it is necessary to use a tool that will allow multidimensional analysis. Taxonomic analysis can serve as such a tool [16]. The versatility of this method allows it to be used to analyze the properties of one unit, which is characterized by the values of the features given in the form of time series.



**Figure 1:** Dynamics of the number of vacancies of HRM specialists (by professional composition) in January 2020 - October 2021

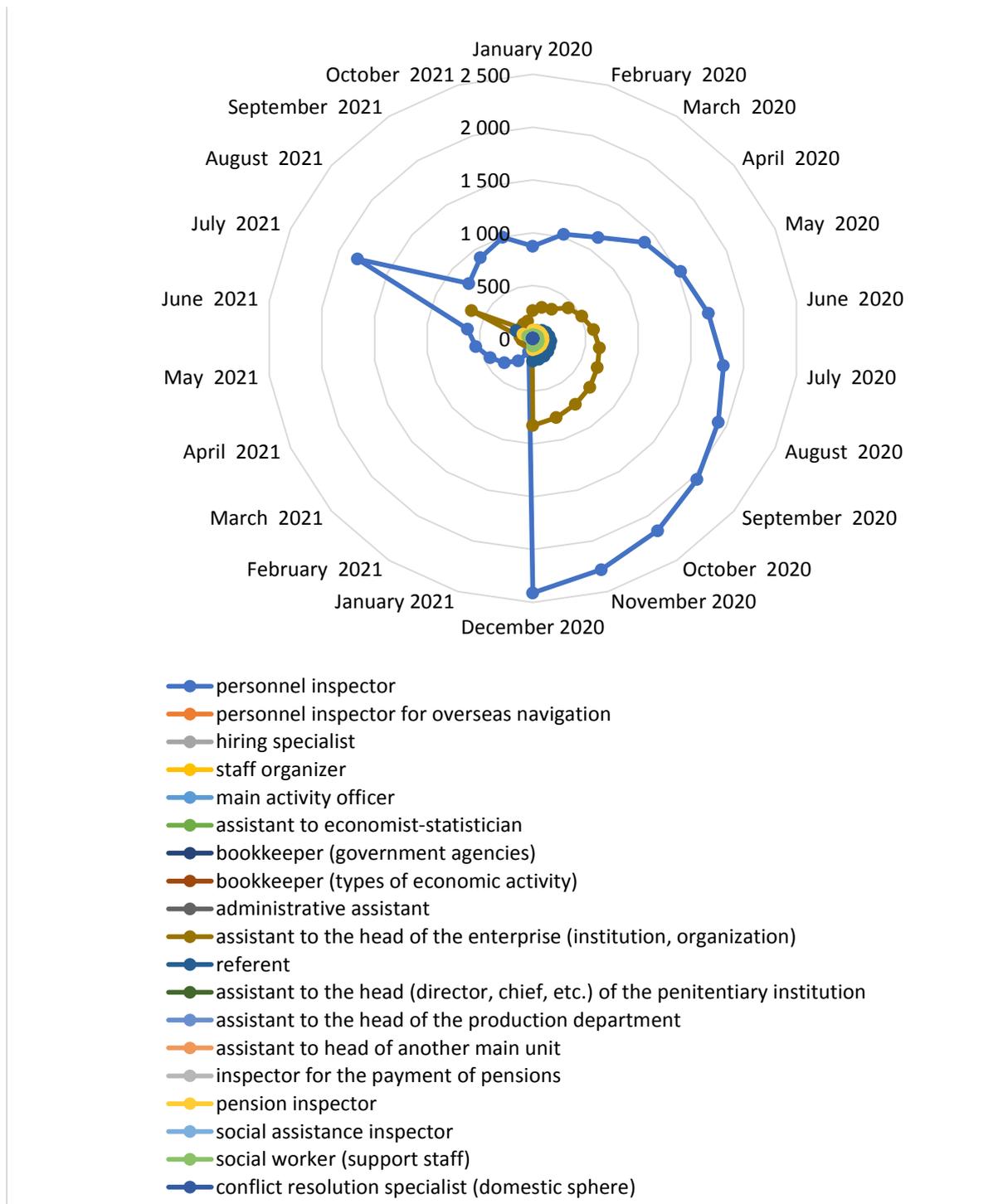
This statement of the problem allows us to obtain a general picture of the dynamics of the labor market as a whole in the study period (January 2020 – October 2021). And this, in turn, allows us to see the imbalances that occur in the labor market in a consolidated form. Using taxonomic analysis, it is possible to compile multidimensional statistical material related to the labor market and obtain a generalized description of the state of the labor market of HR professionals based on the methodology (Table 1). These trends in vacancies (according to the professional composition of the field of HR specialists) are roughly consistent, but not unambiguous, they are not completely symmetrical, but the taxonomy allows us to see the general trends in the need for HR professionals in the labor market.

The results of the calculation of the taxonomic indicator of HRM vacancies between January 2020 and October 2021 are shown in the figure (Fig. 2). The dynamics of this indicator are unstable, the lowest value in 2020 is observed in January, and in 2021 the lowest value is observed in July. The maximum values in 2020 are observed in December ( $K_i=0,36$ ), and in 2021 in October ( $K_i=0,99$ ). This can be explained by the shortage of specialists who possess sufficient information technology skills, i.e., the demands of employers and, accordingly, the qualification requirements for such specialists have changed rapidly.



**Figure 2:** Dynamics of taxonomic indicators of HRM vacancies in January 2020 – October 2021

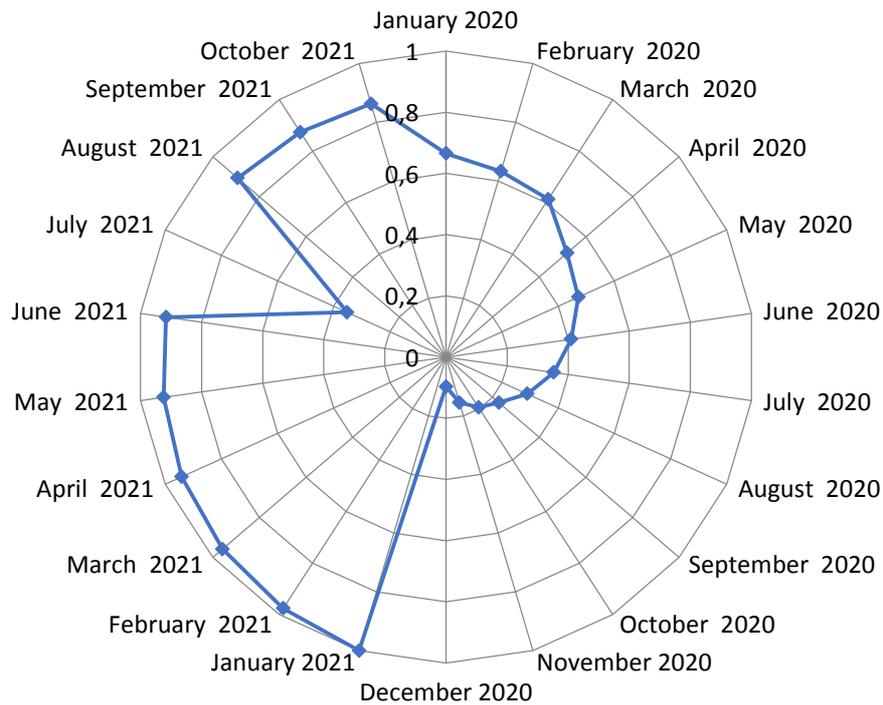
The dynamics of the number of unemployed from January 2020 to October 2021 have significant fluctuations (Fig. 3). Thus, from January 2020 to December 2020 there was a general increase in the number of unemployed. In January 2021 there was a significant reduction in the number of unemployed, which is partly due to: legislative regulation in the field of employment (for example, change of retirement age and the possibility of early retirement); professional development, in particular the acquisition of the necessary skills in the field of information technology, which, although not sufficient, is due to the activity of the state employment service [23]. Most of the unemployed in the field of HR professionals are women over 55 years of age.



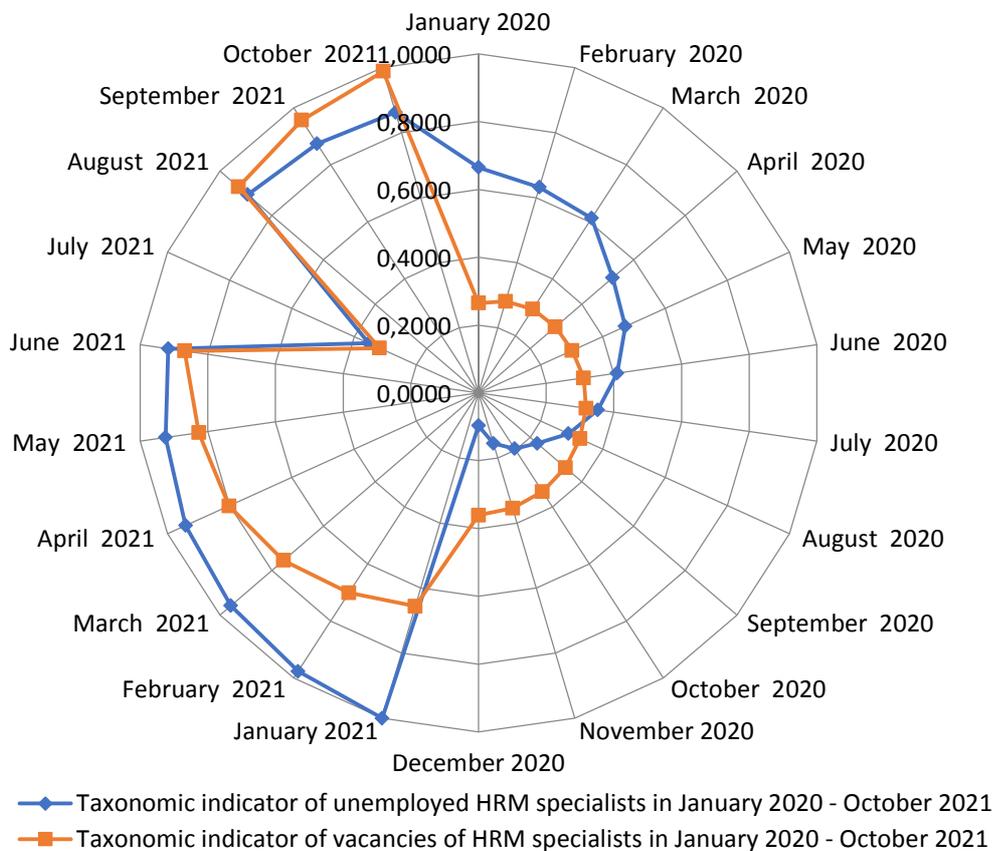
**Figure 3:** Dynamics of the number of registered unemployed HR specialists (by professional composition) in January 2020 – October 2021

To substantiate the relevant unemployment trends of HR professionals by professional composition, it is also necessary to make an integrated assessment using the methods of multidimensional analysis (Fig. 4). The dynamics of the taxonomic unemployment indicator is characterized by instability, as well as the dynamics of the taxonomic vacancy indicator for the study period. Thus, the lowest value in 2020 is observed in December, and in 2021 in July. The maximum values in 2020 are observed in January ( $K_i = 0,67$ ), and in 2021 also in January ( $K_i = 1,00$ ). This can be explained by the redundancy of specialists who do not have enough information technology, i.e., do not meet the needs of employers. By imposing the 2 graphical representations of taxonomic

indicators (unemployed and vacancies), it is possible to visually assess the degree of balance of the labor market of HR professionals (Fig. 5).



**Figure 4:** Dynamics of taxonomic indicators of unemployed HRM specialists in January 2020 – October 2021



**Figure 5:** Dynamics of the degree of balance of the labor market of HR specialists in January 2020 - October 2021

The balance of the labor market in terms of taxonomic indicators of vacancies and the number of unemployed took place in the third quarter (June, July, and August) of 2021. Instead, the most unbalanced market was in the first quarter (January, February, March) in 2020 and in January 2021. The degree of balance is assessed by calculating the distances between the value of the taxonomic indicator of vacancies and unemployment in the period.

Our research compared the dynamics of taxonomic indicators of HR vacancies and dynamics of taxonomic indicators of unemployed HR specialists is one of the areas of using Data Mining tools in the sphere of labor market research.

## 6. Discussion

The results obtained in this research are confirmed by trusted sources in the field of HRM practices:

1. Experts of the Ukrainian Association HRPro [24] emphasize that digital skills are becoming not only a tool but also a philosophy in the activities of HR professionals. Digitalization, according to experts, is a driving force in harmonizing and balancing the labor market.

2. The editorial board of the magazine "TOP-100. Ratings of the largest" [25] conduct the traditional rating of the best HR directors according to a certain set of characteristics. The expert jury and editorial board of the publication selected 30 finalists from more than 150 participating companies. Each participant of the rating is evaluated by experts with the help of special questionnaires, which are sent to them after the final formation of the long list of the rating. In determining the finalists of the rating, several special criteria are taken into account, including automation and gamification of HR processes in the activities of the companies from which they are nominated;

3. According to the results of research [25], every year the relevance of information technology skills in professional activities is growing. Therefore, the goals and program learning outcomes of HR graduates should be reviewed following the requirements of specialty development and employers.

It is concluded that several factors, in particular, quarantine restrictions; general development of information technologies, and digital transformation of the national economy have created conditions that balanced the indicators of vacancies and unemployment in the labor market.

In the article [17] the author focuses on studying the demand for different categories of IT specialists rather than assessing the balance with the corresponding supply in the labor market. The practical application of the proposals submitted by the author, in our opinion, is very fundamental but limited only by the situation in the labor market and IT specialists. We agree that the vast majority of highly specialized segments of the labor market require separate and specific studies that would consider industry specifics.

The results we obtained during the research are confirmed by HRM experts. Experts believe that the possession of relevant digital competencies for employees in this field is a necessary condition for the formation of the labor market of HR professionals. Prospects for the development of the labor market of HR professionals should be based on following the principle of lifelong learning. To adjust the activities of the State Employment Service of Ukraine, including ensuring proper retraining of unemployed HR professionals following modern labor market requirements, it is considered expedient to take into account such factors as stimulants, results of monitoring the degree of labor market balance, and expert judgments.

## 7. Conclusions

This research on the impact of digital technologies on the labor market of HR professionals has allowed:

1. To study digital trends in the creation of new operational processes in personnel management;
2. Substantiate the conditions for the implementation of digital technologies, including ensuring the appropriate level of digital competence;
3. Determine the content of the main stimulants that contribute to the implementation of digital technologies in personnel management. These include greening of approaches in the organization of

work of HR specialists; the emergence of applications that promote greater independence of employees; automation of routine processes of personnel record keeping; recruitment through social networks; virtual reality (VR) to train and ensure the appropriate level of moral and psychological climate in the team; gamification in work; study the needs of employees; lifelong learning; digital platforms; digital culture; introduction of quarantine restrictions. The research emphasizes that it is advisable to consider digital culture as the basis of the corporate culture of the organization, which should meet the trends of global digital culture. Thus, it is a new social phenomenon that in some way determines the digital transformation and will allow harmonious integration into the global digital culture;

4. Use the technology of statistical methods, Data Mining that allows scaling the variability of the labor market of HR specialists, i.e., to reduce to a specific scale.

5. Assess the impact of these stimulants by studying the market of HR professionals. This research was based on an array of official statistics. Since the traditional processing of statistical data does not allow to assess the state of the labor market as a whole, the method of taxonomy was used, which determined the degree of balance in the labor market of HR professionals in Ukraine in January 2020 – October 2021. Comparing the values of taxonomic indicators of HRM vacancies and the unemployed indicates significant distortions in the labor market from January 2020 - to October 2021. This trend is partly due to the influence of unlikely random factors but with substantial consequences.

In our opinion, the proposed approach is a useful tool for monitoring the situation in the labor market of specialists in the field as a whole.

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