

Article

Developing a System for Monitoring Human Resource Risks in a Digital Economy

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Abstract: Human resource (HR) risks are significant negative aspects of any organization. The main problem in the theory and practice of modern organizations is that there is no complex model and algorithm for managing HR risks. To define the essence of HR risks and basic approaches to their management, the authors conducted a survey of employees concerning the HR sphere. The authors used cluster and correlation–regression analysis to process the results of the survey conducted among employees about HR risks. Relying on general scientific research methods, data from open sources, including the review of scientific papers of foreign and national researchers and practitioners, and considering the opinions of the sociological survey respondents, the authors concluded that there is a need for carrying out close work with personnel to prevent conflicts in the working environment, increase the motivation for work, and involve the management team in regulating labor relationships. The scientific novelty of the study is that it considers the process of managing HR risks from a systemic perspective, while they are monitored based on the conceptual model suggested in the study. The models developed by the authors can be used in reality for managing HR risks faced by economic entities.

Keywords: HR risks; organization; personnel management; monitoring; cluster analysis



Citation: Babkin, Ivan, Valentina Pulyaeva, Irina Ivanova, Yulya Veys, and Guljakhon Makhmudova. 2023. Developing a System for Monitoring Human Resource Risks in a Digital Economy. *Risks* 11: 82. <https://doi.org/10.3390/risks11050082>

Academic Editors: Montserrat Guillén and Alejandro Balbás

Received: 27 October 2022

Revised: 9 January 2023

Accepted: 9 January 2023

Published: 27 April 2023



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1. Introduction

Due to the growing dynamism and uncertainty inherent in the current state of the socio-economic environment where economic entities operate, the number of risks faced by organizations today is increasing. The risks and their impact on the current state of an organization and its prospects should be studied in order to constrain negative consequences in operational activities and to prevent security threats in the future. Any risk should be considered given its multidimensional nature (Gorlenko and Mozhaeva 2017), which makes it necessary to study its relationships with all the processes in the management system of an organization, from the managers' mindset and threat acceptance to the analysis and assessment of possibilities to minimize it.

Today, the spread of digital technologies is accompanied by a sophistication of managerial decision making caused by the virtualization of many business processes. Problems are aggravating because personnel have to adapt to new working conditions. The problems of a generation gap in digital competencies are growing too (Ivanova and Pulyaeva 2022).

All these require the constant monitoring of an HR management system for its sustainable development and improvement.

The processes of HR management and HR risk management are insufficiently integrated with each other in a modern management model of an organization. They are often considered separately due to the wish to control negative situations in the work of personnel by different departments (internal audit service, economic security, etc.). This approach is adopted due to the definition of HR risk, which focuses on the existence of danger and undesirable scenarios that will have either a direct or indirect impact on the sustainability of the organization's activities. Thus, HR risks are mainly understood as a loss or shortage of income, the probability of deviation from the planned result, a threat to safety, or, in general, a decreasing efficiency of labor.

The wish to control HR risks has led to various classifications which can consider many factors causing HR risks. The conceptual basis of HR risk management consists of an objective to keep HR risks within the limits set by the personnel management strategy, the problems that have to be solved to ensure it, the object whose definition embraces the factors and sources of HR risks in the organization, the subject (participants in joint activities), as well as principles, functions, tools, and methods of management that can either prevent or compensate losses (Mitrofanova 2003). The analysis of the expert opinions in the field of personnel management and risks allows for the identification of the most common types of HR risks, including an imbalance of the age groups of the personnel, an insufficient monitoring of threats that are vital for the organization, a lack of measures for identifying and suppressing the personnel's undesirable actions, selecting personnel that is not competent enough, an insufficiency of measures aimed at forming the employees' motivation and loyalty, conflicts of interest between the employees and the employer, and the dismissal or resignation of key employees. In addition to the above, the existing specifics of HR risks' occurrence and management were considered, depending on the scope of the organization's operations and the relevance of a risk-based approach for controlling the HR processes of the organization. All of the above had an impact on this research work's purpose, objectives, and methods and the way in which the results obtained were interpreted.

The purpose of the work is determining an algorithm for managing HR risks based on monitoring their effects in the personnel management system of an organization, which is reflected in the conceptual model being developed. In order to achieve this purpose, the following objectives were fulfilled:

1. The HR risks of an organization were analyzed using the methods of the generalization of scientific sources and by collecting relevant information from participants of the sociological survey.
2. Significant correlations were identified in the respondents' answers to determine the significance and impact of HR risks on the security of the organization based on the cluster and correlation–regression analysis.
3. A conceptual model of HR risk management was developed.

The second section of this paper presents a review of the literature on the problems of HR risks. The section 'Materials and methods' presents the main methods used by the authors in their research. The 'Results' section describes the results of the correlation and cluster analysis. The 'Discussion' section presents a conceptual model of HR risks management and an algorithm of this process on the basis of the received results. The final section presents the conclusions of the research.

2. Literature Review

When interpreting risk as a probability of deviation from the planned result (Tapman 2002), it is only true with regard to the nature of risks present in the management system. The concept of HR risk is multidimensional and requires that many related aspects be considered, as confirmed in various studies. In 2015, it was revealed that there was no theoretical and methodological approach to human capital management, which would

contribute to the development of the best methods for analyzing HR risks associated with the development of qualities that influence income generation (Balykhin et al. 2015). According to experts, the main sources of HR risks faced by knowledge-intensive companies are external conditions, since such firms attract highly qualified personnel using a strategy of an open innovative market (Shpilina et al. 2019). It is important to highlight a study discussing the risk of key knowledge leakage from an organization due to the dismissal or resignation of highly qualified personnel (Jennex 2013).

Many scientists present the results of their research, which indicate the specifics of HR risk management given the industry affiliation of an organization. Thus, A. Tikhonov studied the experience of an organization operating in the Russian aviation industry. He developed his own approach to the classification of HR risks and identified four groups of them: HR structure risks caused by unsatisfactorily forming the personnel for the organization and/or its turnover; risks from using the personnel (problems with discipline and labor productivity); risks of the personnel reserve (inefficient personnel development and training); and risks of dismissal or resignation: the loss of the organization's reputation, the disclosure of commercial and confidential information, the low morale of the workforce, the deterioration of the psychological climate, the various court proceedings in the process of dismissal, etc. (Tikhonov 2020).

Scientists from Slovakia studied the impact of HR risks on the country's transportation sector (Masár and Hudáková 2020). They identified major HR risks such as the insufficient qualification of personnel, human errors, and a decreased involvement of personnel. Then, these scientists conducted a further larger-scale study together with researchers from Poland. As a result, it was found that the longer an enterprise operates on the market, the less its managers and owners feel the impact of HR risks, whereas young enterprises suffer mostly from market, financial, and economic risks (Hudáková et al. 2021). In these studies, the main method was an online or offline survey of entrepreneurs or experts. Scientists from Slovakia used Google forms for the survey, their uploading to MS Excel, and their statistical processing of the results, including the calculation of the Bartlett sphericity test and the calculation of the normality criteria for the statistical analysis (Anders Darling criterion, Ryan Joyner criterion, Kolmogorov–Smirnov criterion).

Scientists from Bogota determined that one of the sources of operational risks in the Colombian banking sector was fraud committed by personnel and problems in hiring procedures (Campo Elías and Miguel Alejandro 2021). A study of the banking sector was conducted in South Africa to learn about the attitude of the staff to the privacy policy, and it was found that representatives of generation Y were more positive towards these policies than generation X. Therefore, generation X staff needed targeted training to increase their awareness of the bank privacy policy (Swartz et al. 2021).

In 2019, a methodology for assessing 30 types of risk in a trade organization was developed and presented (Tselyutina et al. 2019). A total of 20 experts were involved in ranking 30 types of HR risks identified according to this methodology. As a result, a two-stage methodology was developed for determining the probability of HR risks in the personnel management system of a trade organization. The main method of research was the method of an expert survey and the cluster method of processing the responses of experts, thanks to which the main trends in personnel risks by groups of clusters were highlighted. At the second stage, they developed an algorithm for assessing the organization's personnel potential and the level of personnel risk using the Scenario Manager method.

HR risks in the process of training managerial personnel for educational organizations were also studied. The sources of such risks included the founder of an educational organization, its managers, and providers of advanced training programs (Guzairova et al. 2018).

Another research work worth mentioning studied the HR risks in Russian public authorities (Polyanin et al. 2018). It resulted in a list of HR risks for key elements of personnel management subsystems that mostly cover the assessment, formation, and development of civil servants' competences.

Scientists from the Czech Republic, Hungary, Poland, and Slovakia assessed the impact of corporate social responsibility (CSR) programs on the performance of small- and medium-sized business in the V4 countries. They found that if entrepreneurs carried out CSR programs, they perceived their personnel as their main capital, appreciated their employees' contribution, and were less afraid of HR risks and mistakes that could be made by their staff (Rozsa et al. 2021). The authors from Russia established a link between CSR, working conditions, and risks to staff health, including the increased mortality of industrial personnel (Kozlova et al. 2016).

It should be noted that, according to the results of an online survey, representatives of small- and medium-sized business think that HR risks are the most significant, although businessmen from the Czech Republic rate their staff as more qualified compared to the rankings of their peers from Slovakia. Businessmen from both countries stated that staff turnover was low (Kotaskova et al. 2020).

A special aspect in the study of HR risks is the falsification of financial statements and fraud. According to Russian authors, these should be assessed during an audit (Lishchuk and Zolotareva 2017). Some researchers consider HR risks as a part of economic security and the accounting and analytical functions of personnel (Illiasenko et al. 2020).

Russian scientists consider HR risks that arise when the labor market is precarious, with unreliable forms of employment emerging and workers being deprived of their basic rights (Solovova et al. 2021).

The digital economy has brought about new HR risks: cybersecurity violations, data leakages, malware, collusion with fraudsters, false information, forgery of personal data, including social media, etc. (Cunningham et al. 2018). Given the above, it is worth noting the study discussing the use of information platforms for reducing HR management risks (Veres et al. 2020). Authors from Russia studied the specifics of HR risks in the digital economy, identified the HR risks of a digital organization, and justified a model of key competencies that personnel must have in order to prevent them (Manakhova et al. 2020).

An important aspect in the study of HR risks is the definition of psychosocial risks—threats that can lead to negative psychological, physical, and social effects. These risks are a result of inefficient organizational structures and teamwork management (Paurova et al. 2020).

In summary, today, scientific literature accounts for a certain number of studies devoted to HR risks and various aspects of their occurrence. Most of the studies used the methods of sociological surveys and the statistical processing of results, as well as monographic and socio-economic methods. As a result, different types of HR risks, their specification, and approaches to assessment were obtained. However, so far, nobody has assessed how HR risks are perceived directly by employees. Different authors described various aspects of HR risks and offered their classification, but there was no research on how employees themselves perceive HR risks, though it is important, because the occurrence of many HR risks depends on the personnel. In addition, no model or algorithm of HR risk management have been developed. All these gaps in the scientific literature are addressed by this study. The conceptual model and algorithm of HR risk management developed by the authors will allow for heads of organizations to implement, in practice, HR risk management in all subsystems of personnel management.

3. Materials and Methods

To resolve the problems posed in this study, the authors reviewed national and foreign sources, conducted a sociological survey (Appendix A), with the questionnaire being presented in the Appendix A, used statistical methods, carried out analyses and syntheses, and generalized the results. The survey was conducted in an online format using Google forms. The survey was conducted between March and April 2022 on the territory of the Russian Federation. The reliability of the questionnaire was assessed using the method of calculating the α -Cronbach coefficient:

$$\alpha = \frac{N \cdot r}{1 + (N - 1) \cdot r} \quad (1)$$

where α is α -Cronbach's coefficient, N is the number of questions in the questionnaire, and r is the average correlation coefficient between each question and the sum of other questions.

The calculation of the α -Cronbach's coefficient for the questionnaire used in this study resulted in a value of 0.6798, which indicated the acceptable reliability of the questionnaire.

Study Participants

237 respondents took part in the study; 68.8% of them were women and 31.2% were men. The average age of the respondents was over 33. A total of 59.5% of the survey participants worked in large organizations employing over 500 people. The respondents are representatives of various sectors, including industrial production (8.5%), trade (7.8%), construction (7.8%), IT (11.3%), etc. Almost 70% of the respondents were working in their organization for more than 1 year. A total of 23.4% of participants held a managerial position.

Research Tools

Cluster analysis, correlation analysis

Data Processing. To process the data, the R programming language in an "Rstudio" environment was used. The tidyverse package was used for data preparation and manipulation, the psych package was used for regression analysis, and the cluster package was used for cluster analysis. The ggplot2 package was used for plotting. The built-in MS Excel functions were used for assessing the correlation ratio between the respondents' answers.

Correlation and cluster analyses were used in processing the answers of the respondents: correlation analysis was used to identify the closeness of the relationship between the answers and the correlation in the respondents' choices, and cluster analysis was used to identify homogeneous groups of respondents and a detailed analysis of their answers. The Pearson coefficient was used in the correlation analysis, and the Gower distance, k-means method, and silhouette method were used in the cluster analysis. All these tools made it possible to identify lawful patterns in the respondents' answers about personnel risks and requirements for the system of their management. Figure 1 shows the algorithm of this study.

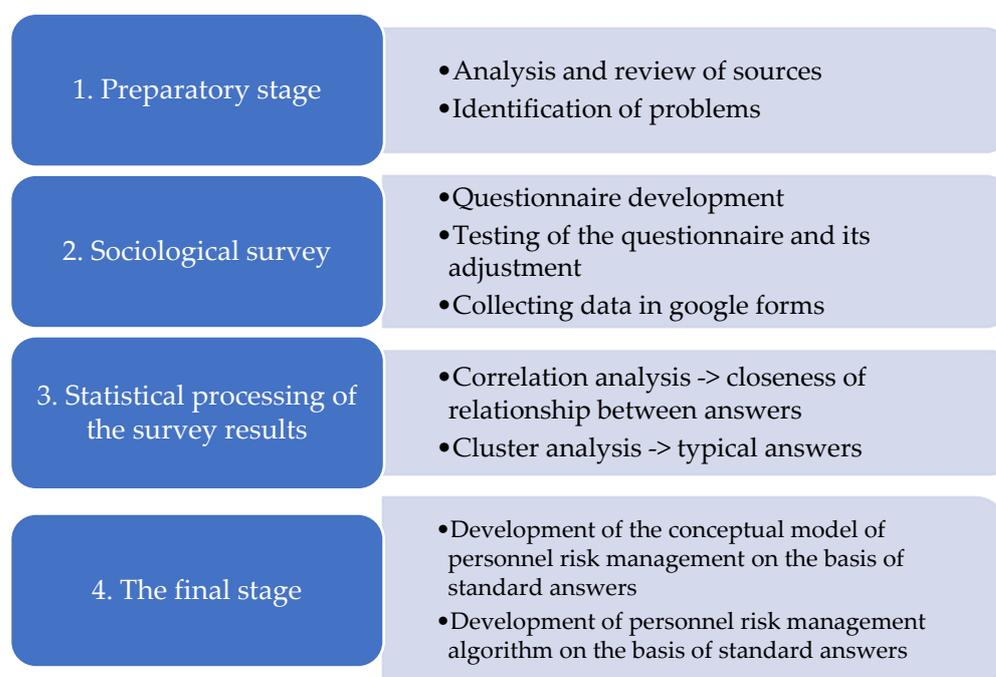


Figure 1. General algorithm of the research.

As a basis for clustering, the study used a dissimilarity matrix, which, in mathematical terms, described how different (distant) points in the dataset were from each other. It

allowed for the further grouping of those points (survey results from the questionnaires) that were closest to each other or separated the most distant ones from each other—that was the main idea of clustering. In this study, the Gower distance was used, which is the sum of the squares of the differences of the corresponding distances (Gower 1983). The matrix was constructed using the daisy tool from the cluster package. The result of this procedure was an idea of how the answers to the questions in different questionnaires were similar to each other, which was a prerequisite for the identification of clusters.

The next procedure was clustering itself, which divided the entire sample into k number of clusters based on the dissimilarity matrix by a certain criterion. The choice of the clustering method was the k -means method. In R, this method can be implemented by Diana from the cluster package. The estimation of the k -number of clusters, or, in other words, the search for the optimal number of homogeneous groups of interviewees, was carried out by silhouette estimation: the silhouette graph used as a measure of data consistency showed how close each of the points within one cluster was to points in neighboring clusters: sharp inflections of the graph show the optimal number of partitions. As a result, 5–7 homogeneous clusters were identified for each of the groups of questions from the questionnaire (three groups in total).

Among the parameters for assessing the quality of clustering, for example, one could refer to the parameter of the average silhouette width s_i . Its value can be described as a measure of the degree to which object i belongs. It can be calculated by Formula (2). The index ranged from -1 to 1 . It was assumed that if $s_i < 0.25$, objects were grouped “loosely”; in other words, clusters were heterogeneous, and clustering was performed poorly.

$$s_i = \frac{\bar{d}_{i \text{ to nearest cluster}} - \bar{d}_{i \text{ within}}}{\max\{\bar{d}_{i \text{ to nearest cluster}}, \bar{d}_{i \text{ within}}\}} \quad (2)$$

where $d_{i \text{ within}}$ is the distance to other objects from the same cluster, and $d_{i \text{ to nearest cluster}}$ is the distance to the nearest cluster.

The cluster analysis algorithm is shown in Figure 2.

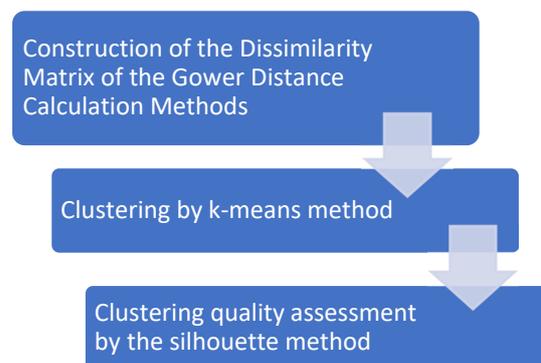


Figure 2. Stages of cluster analysis.

4. Results

4.1. Correlation Analysis

A correlation matrix was constructed for this study based on the values of the *Pearson correlation coefficient*, while the *Chi-2* coefficient and *p*-value significance level were calculated to highlight the strongest connections.

The biggest positive values of the correlation were obtained for Questions 2 and 6 ($r = 0.3$, p -value = 0.0005816167, $Chi-2 = 14.07598$), 5 and 17 ($r = 0.3$, p -value = 0.001364852, $Chi-2 = 40.78314$), 15 and 13 ($r = 0.3$, p -value = 0.001364852, $Chi-2 = 59.57001$), and 19 and 18 ($r = 0.3$, p -value = 0.0005368055, $Chi-2 = 42.96079$), while the biggest negative correlations by the module were obtained for Questions 8 and 9 ($r = -0.3$, p -value = 0.007486658, $Chi-$

2 = 25.65825), 4 and 16 ($r = -0.3$, p -value = 0.00308944, $Chi-2 = 25.65825$), and 13 and 18 ($r = -0.3$, p -value = 0.000983092, $Chi-2 = 24.43161$).

In general, most of the respondents (58.2%) understood HR risk as decreased labor efficiency. At the same time, the correlation analysis did not show any close relationship between the personal characteristics of the survey participants (Questions 1–6) and their understanding of HR risk (Question 7) (Figure 3).

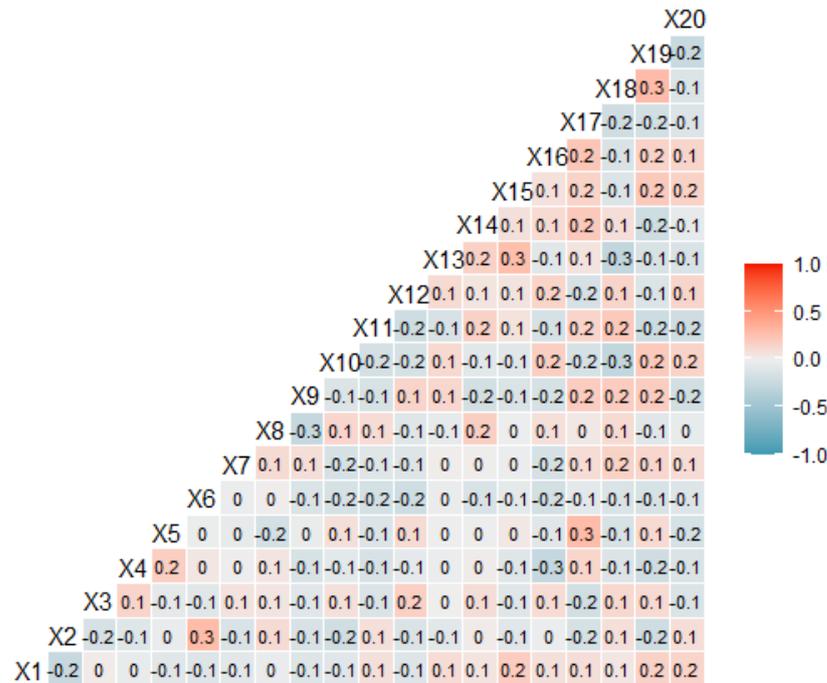


Figure 3. Correlogram of the respondents’ answers to the questionnaire. Note: Xi is the number of the question, the value in the Pearson correlation coefficient cell.

As for the stages of work with personnel at which there was the greatest probability of HR risks, the respondents were not unanimous in their answers to this question: 38.3% pointed out direct work with personnel, 31.9% pointed out the selection and assessment of candidates, 22.7% pointed out the dismissal or resignation of employees working in the organization, and 7.1% pointed out hiring (conclusion of labor relations). The correlation analysis of the dependence between the chosen answer to this question and the personal characteristics of the respondents also did not show that there was a close relationship between these data and the answers. In addition, the correlation ratio between the answers to the question about the concept of HR risk and the stages of personnel management at which it arose was assessed. In this case, no strong connection was established either ($r = 0.1$).

4.2. Cluster Analysis

The clustering process consisted of three steps:

- (1) The basis for clustering is a dissimilarity matrix, which, in mathematical terms, describes how the points in the dataset are different (remote) from each other. It allows for the further grouping of the points that are closest to each other or for separating the points that are most distant from each other, which is the main idea of clustering. This study uses *Gower’s distance*.
- (2) The *k-means* method was chosen as a clustering method.
- (3) The k-number of clusters was evaluated using a *silhouette evaluation method*: the silhouette graph used for measuring the data consistency shows how close each of the points within one cluster is to points in the neighboring clusters. The graph in Figure 4 shows the distribution of the silhouette width of the clusters (consistency

of the data within the clusters). The sharp inflections of the graph demonstrate the optimal number of partitions.

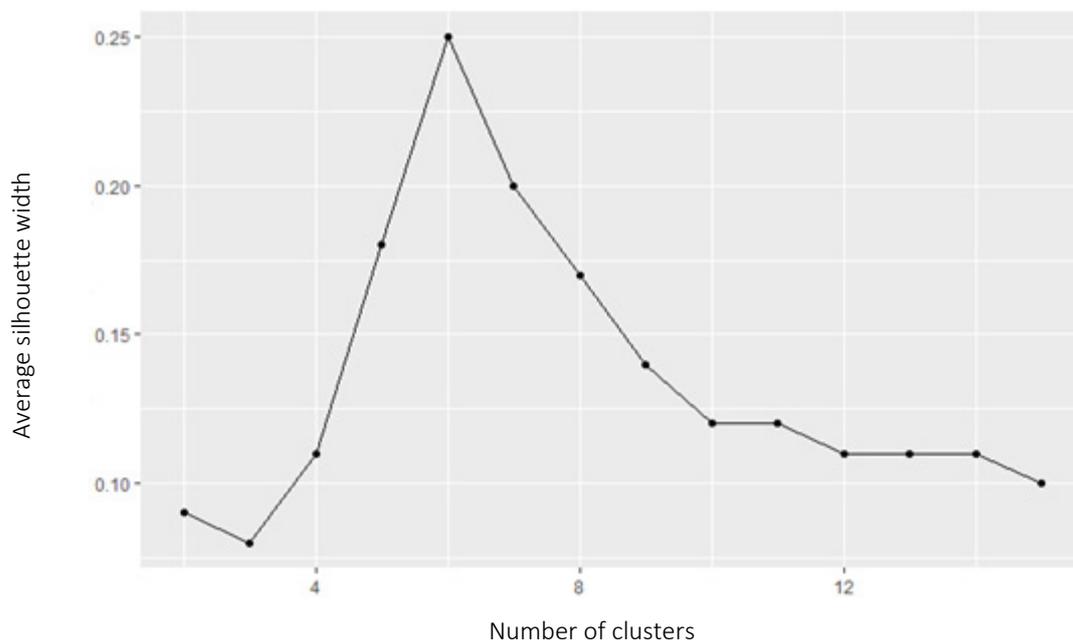


Figure 4. Visualization of the silhouette method applied for sample II. The optimal number of clusters is 5.

A total of 137 filled questionnaires that contained no unanswered questions were used for clustering. Clustering was carried out using three compositions of key questions of the questionnaire: I (2, 7, 11), II (4, 10, 12), III (3, 6, 19). Table 1 presents the characteristics of clustering.

Table 1. Characteristics of Clustering.

Group	I	II	III
Number of clusters	7.00	5.00	5.00
Sum of squared distances between observations in the cluster (<i>Gower’s distance.</i>)	25.32	35.94	17.65
Average silhouette width (s_i)	0.60	0.71	0.50
Size of cluster 1, people	21.00	16.00	25.00
Size of cluster 2, people	9.00	32.00	20.00
Size of cluster 3, people	70.00	67.00	86.00
Size of cluster 4, people	14.00	9.00	4.00
Size of cluster 5, people	9.00	15.00	4.00
Size of cluster 6, people	2.00		
Size of cluster 7, people	14.00		

As can be seen in Table 1, the Gower distance (row 2 in the table) varies from 17.65 to 35.94. The smaller the Gower distance is, the better it is. In this case, the values were relatively small. The average silhouette width s_i must be greater than 0.25. As can be seen in Table 1, this condition is satisfied everywhere. Thus, clustering was performed qualitatively.

Figure 5 shows a heat map of clustering by cluster groups I according to the following questions: respondent’s age (2), definition of HR risk (7), and type of personnel management functional subsystem in which risks mainly arise, according to the participant of the study (11).

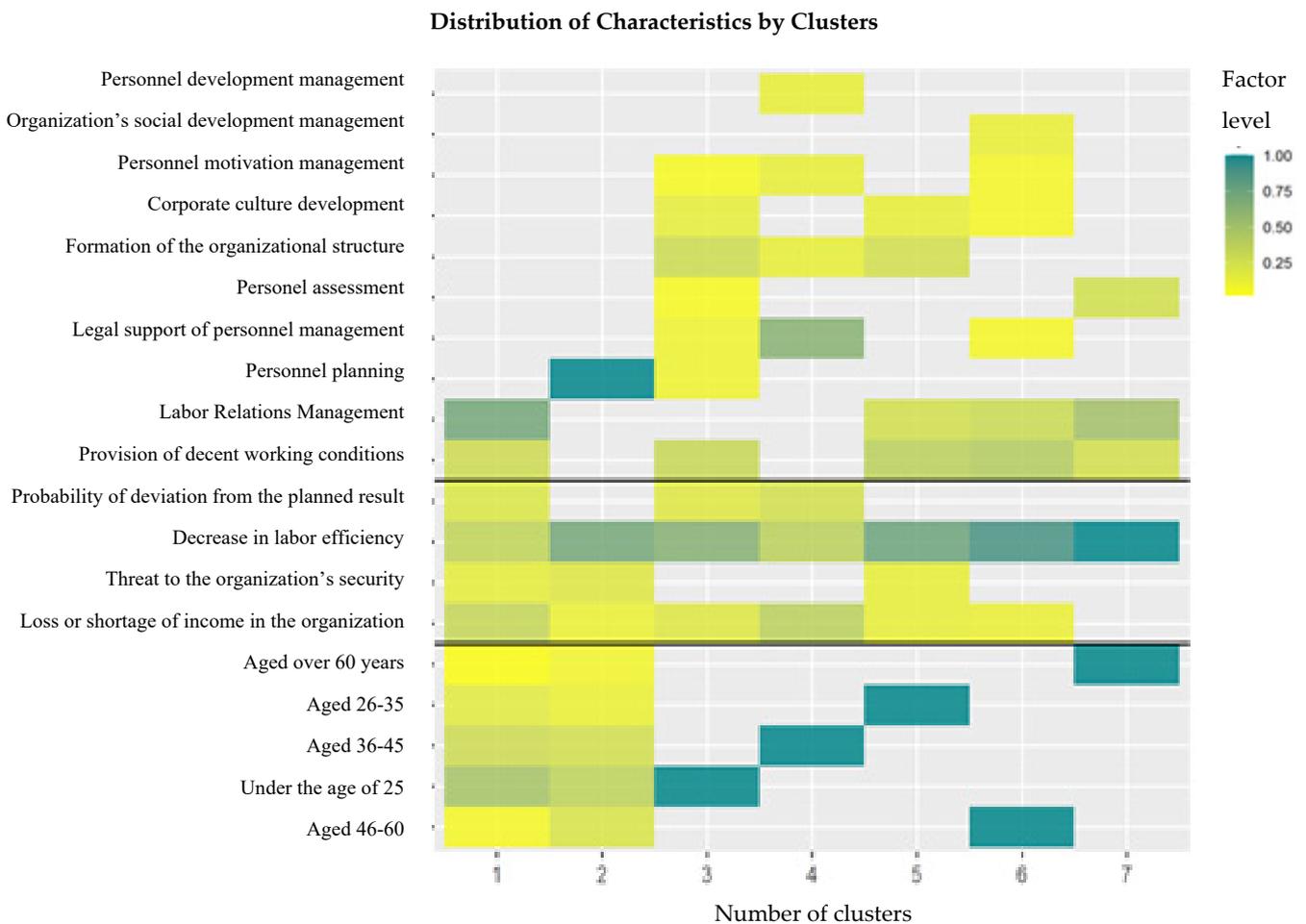


Figure 5. Heat map of the distribution of characteristics by the clusters of group I (2, 7, 11).

The cluster in Figure 5 illustrates that the age division is predominant among the participants. Figure 3 shows that clusters 3, 4, 5, 6, and 7 represent five age groups. The third cluster is the largest and includes an audience of participants under the age of 25 (70 persons). When asked about the functional subsystems in which HR risks mainly arise, they demonstrated a diversified opinion and did not choose one leading factor. In giving an answer about the type of functional subsystem in which HR risks mainly occur, the participants had different opinions. However, in most cases, the survey participants understood HR risk as decreased labor efficiency. In cluster 7, the attitude of respondents aged over 60 was more consolidated. When asked what HR risk was, all 14 respondents in this age category said that it was decreased labor efficiency, and the intensity of the effect of this factor was beyond doubt. The interrelations between the objects from a given set are most clearly shown in Figure 6.

Figure 7 shows a heat map of the distribution of characteristics by the clusters of group II, which include the following questions of the study: the organization's headcount (4), types of HR risks with the greatest threat to the effective operation of the organization (10), and the form of manifestation of HR risks in the organization (12).

The cluster in Figure 7 shows that the leading indicator is the size of the organization, as indicated by the headcount. The third cluster was presented by workers of a large organization employing 1000 to 5000 people. In their opinion, the greatest threat to the effective operation of the organization is the conflicts of interest between employees and employers.

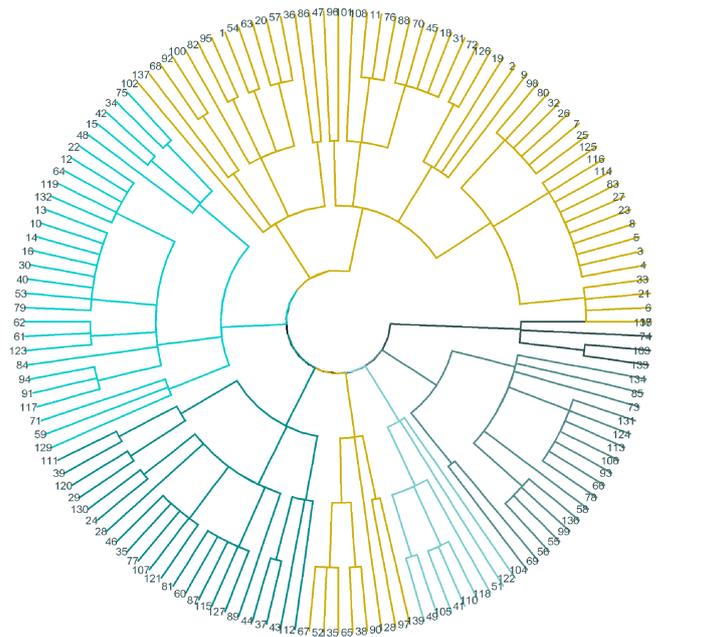


Figure 6. Circular dendrogram for the clustering of group I (2, 7, 11).

Distribution of Characteristics by Clusters

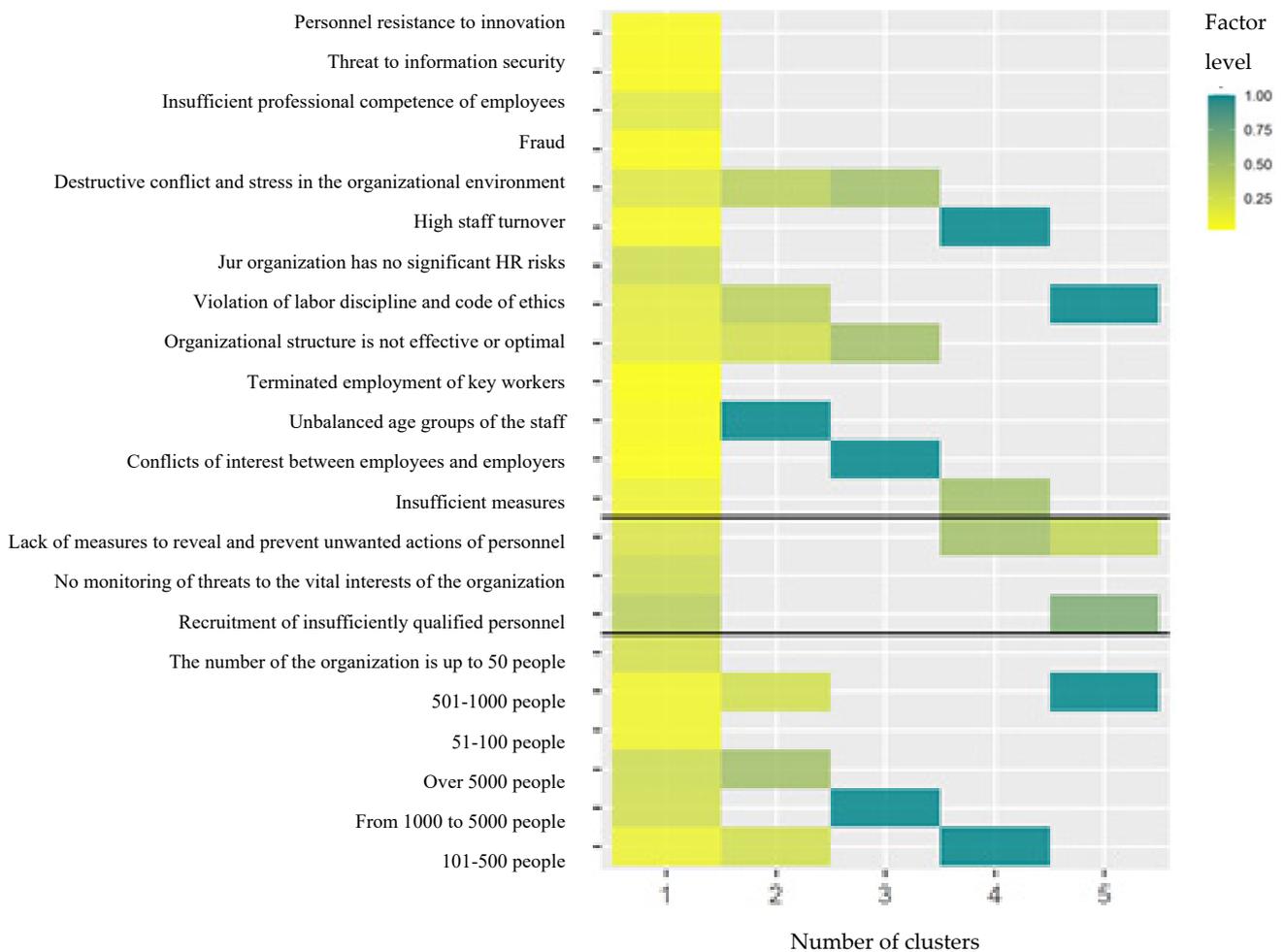


Figure 7. Heat map of the distribution of characteristics by the clusters of group II (4, 10, 12).

For the representatives of the fifth cluster, who worked in medium-sized organizations, the most pronounced form of HR risks manifestation was the violation of the labor discipline and code of ethics. The interrelations between the objects from a given set are most clearly shown in Figure 8.

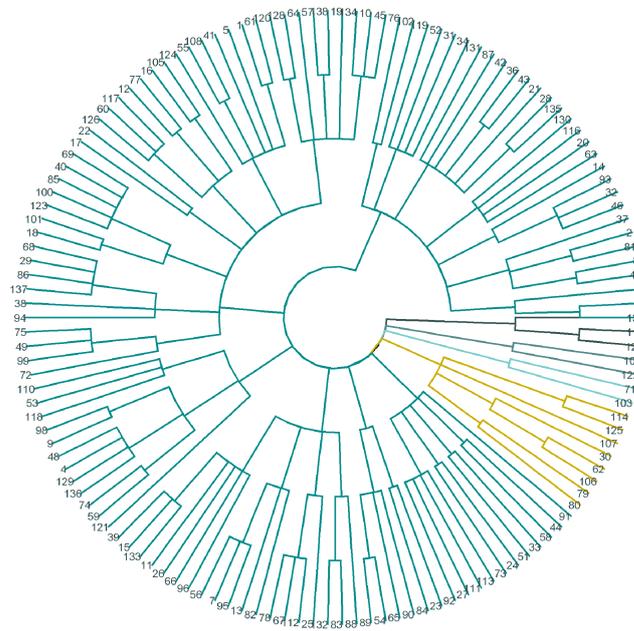


Figure 8. Circular dendrogram for the clustering of group I II (4, 10, 12).

Figure 9 shows a heat map of the distribution of characteristics by the clusters of group III, which refer to the following problems of the study: industry of the organization (3), participant's status (position) (6), and properties essential for the methodology for managing HR risks in the organization (19).

The leading indicator was the position held in the organization. There were respondents holding a managerial position in cluster 4, 5, but by number, this was the smallest group of respondents working mainly in the field of education. In their opinion, the main properties of the HR risk management methodology were flexibility and low labor costs of implementation. For cluster 3, the largest group of respondents, the central feature of the HR risk management methodology was also the low labor costs of implementation.

The interrelations between the objects from a given set are most clearly shown in Figure 10.

The respondents believed that HR risks cause maximum damage to the financial and personal qualification spheres of the activity of economic entities. The greatest threat to the efficiency of the organization was the recruitment of staff with insufficient competences and a conflict of interest between employees and the employer. According to the survey participants, HR risks mainly occur in labor motivation management (first place), the provision of decent working conditions (second place), and labor relations management (third place). HR risks in the organizations where the respondents work take one of the following forms: the insufficient professional competence of employees; the high turnover of personnel; the personnel's resistance to innovation; the destructive conflict and stress of the organizational environment; the organizational structure is neither effective nor optimal. At the same time, 26.1% of the respondents believed that there were no significant HR risks in their organization.

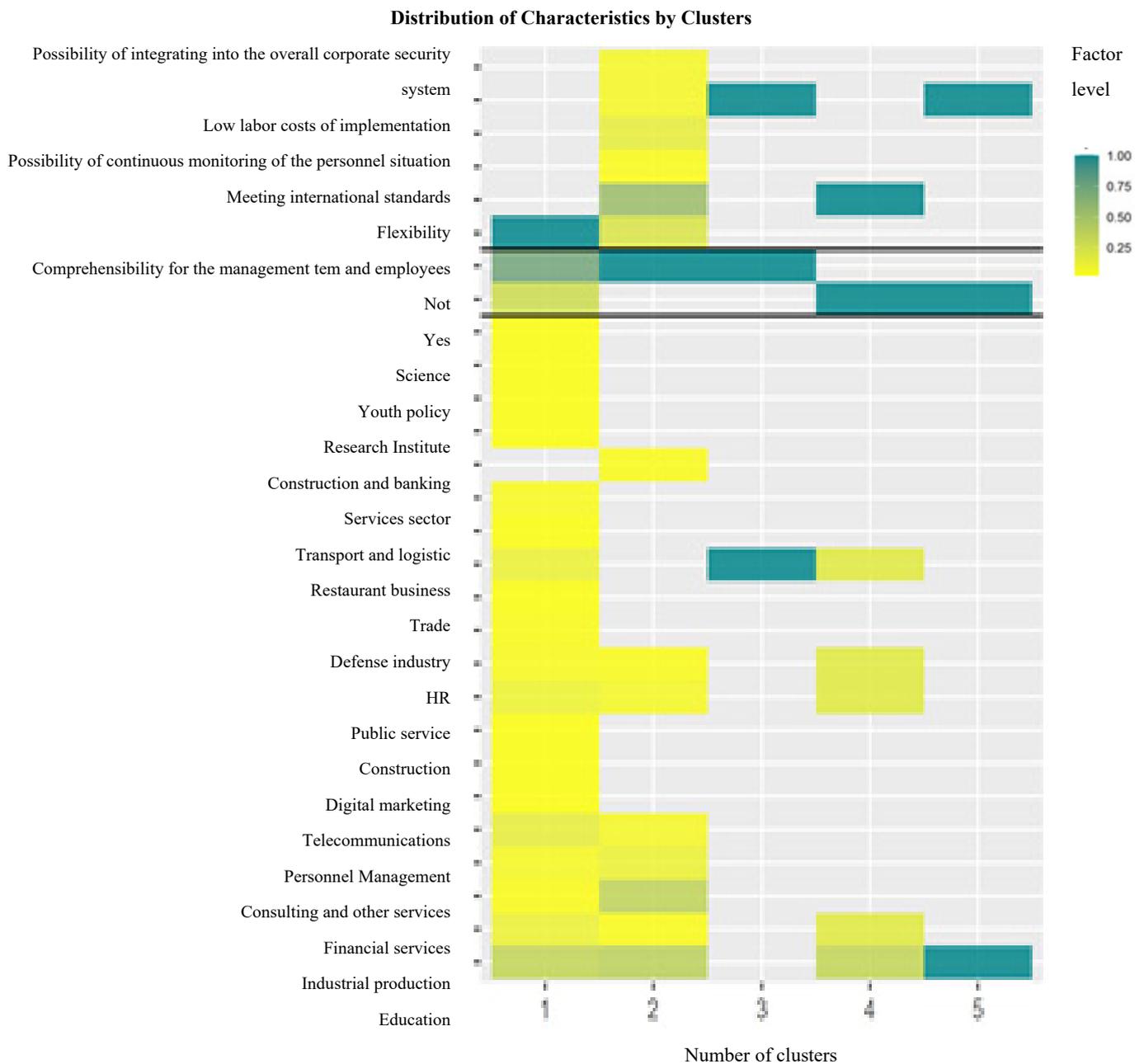


Figure 9. Heat map of the distribution of characteristics by the clusters of group III (3, 6, 19).

When answering if they have encountered employees’ mistakes in their professional activity that entailed serious negative effects for the organization (legal costs, financial and/or material losses, expired deadlines and broken agreements, etc.), the respondents replied “rarely” (respondents holding a managerial position) and “very rarely” (respondents not holding a managerial position). At the same time, only 16.0% of the survey participants sometimes encountered situations in which the organization incurred significant costs upon terminating the labor contract with a key employee. The rest of the respondents said they had encountered such a situation rarely, very rarely, or never at all. Those who faced it rarely now work as executives in five cases out of six.

It should be noted that the consensus of the survey participants was that the key role in various HR risks was played by remuneration: low paychecks as a common reason for staff turnover (70.7%) and the imperfect remuneration system as a cause of workforce conflicts (54%).

Thus, the results of the processed answers of the respondents revealed a heterogeneous perception of HR risks among employees. However, the survey participants were unanimous in determining the areas and forms of HR risks and the factors causing them.

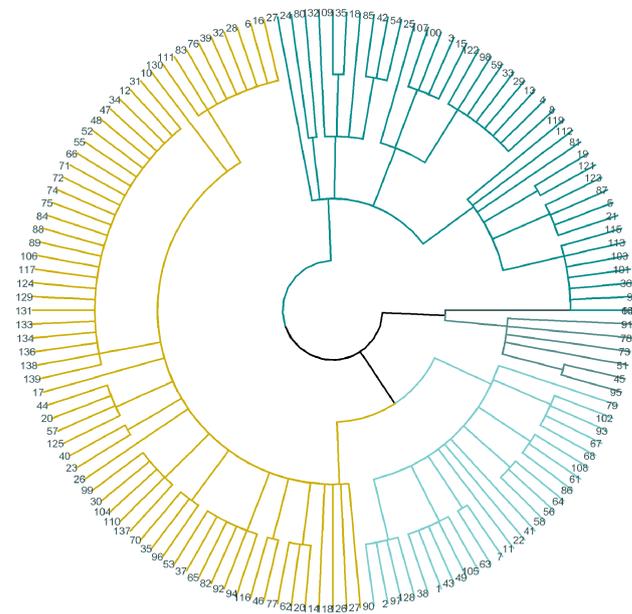


Figure 10. Circular dendrogram for the clustering of group III (3, 6, 19).

5. Discussion

The data obtained as a result of generalizing the experts’ opinions and the survey carried out among the respondents of various organizations prove that in order to assess risks and make good management decisions aimed at eliminating the effect of these risks on the security of the organization, an algorithm has to be developed for indicating the sequence of system actions and measures.

Figure 11 shows a conceptual model of an HR risk monitoring system. The existing personnel management system of an organization is chosen as the object of management. The content and processes in it act as an internal environment (of the system). The structure of the external system has constituent elements such as: authorities of various levels and the organization’s owners and founders. Their activities contribute to the formation of a legal, economic, informational, and administrative mechanism that determines the main regulation aspects of HR processes in the organization and establishes norms and standards they must comply with. The HR risk monitoring system includes some indicators of the state of the personnel management system and a number of factors that have to be considered in the assessment: socio-cultural, legal, and economic factors and the information environment of the organization. The HR risk monitoring system can be used to identify compliance with security standards and prevent security threats, which is accomplished through diagnosing the current state of the personnel management system.

Table 2 shows the stages of HR risk management. Their practical significance is preconditioned by the wish to create a transparent and flexible methodology for HR risk management. It is especially important to highlight the need for ensuring the continuous monitoring of the personnel situation and the possibility of integrating such monitoring into the overall corporate security system of the organization, given the requirements of international standards. The employees who took part in the survey carried out by the authors also highlighted important characteristics of the HR risk monitoring and management system such as flexibility and comprehensibility (78% of respondents).

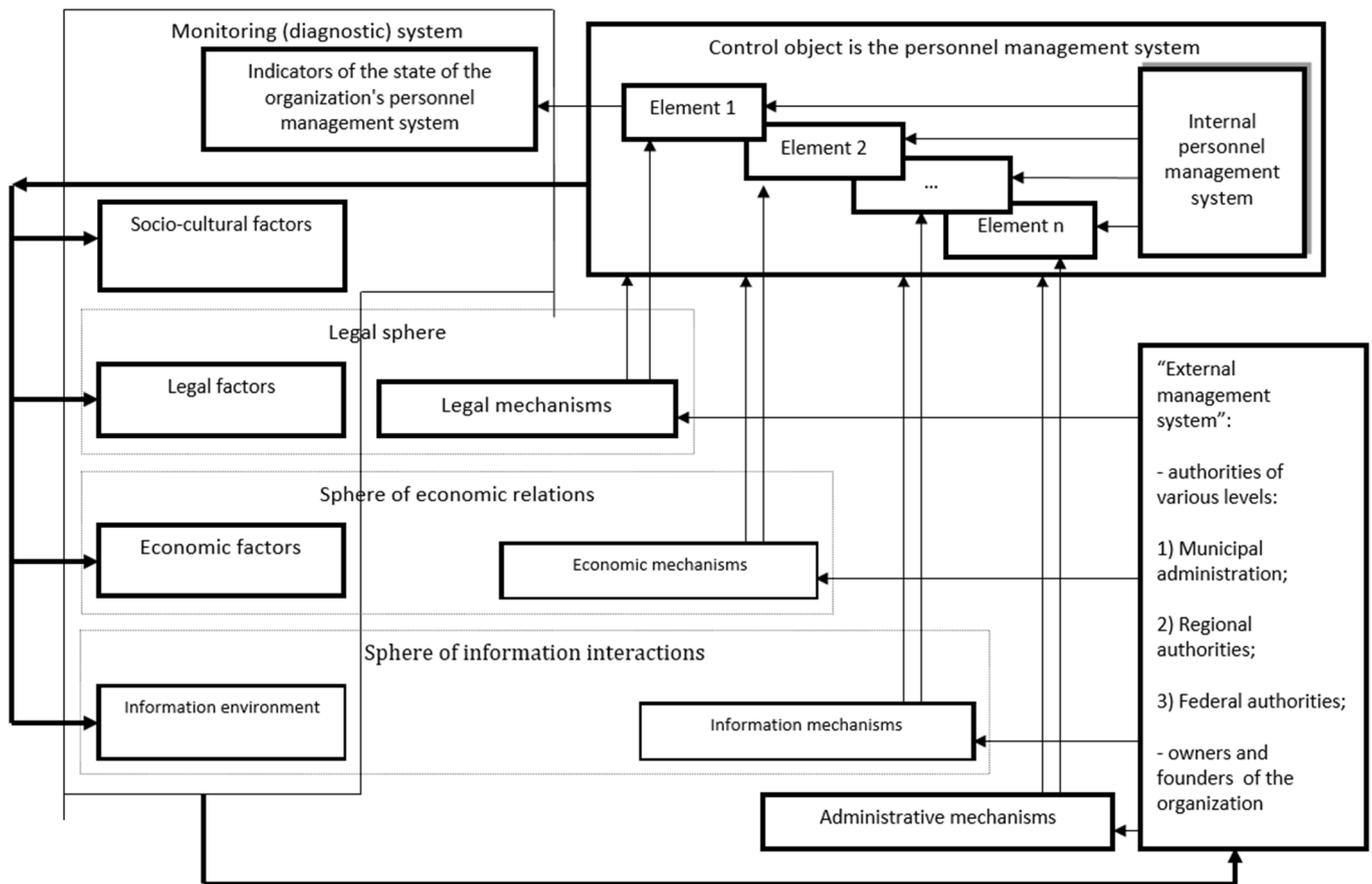


Figure 11. Conceptual model of the HR risk monitoring system.

The survey revealed the riskiest areas in personnel management, namely: motivation, the stimulation and remuneration of workers, ensuring normal working conditions, and the management of labor relations. Thus, the respondents more often specified such manifestations of personnel risks: the insufficient level of the professional qualification of the workers; the high turnover of the personnel; the unreceptivity of the personnel to innovations; the destructive conflicts and stress load of the organizational environment; the organizational structure is not effective and not optimum. The following managerial conclusions can be drawn from the obtained results: it is important to provide suitable working conditions for employees, including an optimal organizational structure, safe working conditions, and the localization and resolution of conflicts. It is necessary to provide a high level of motivation for personnel to work effectively and improve qualifications, as well as to create conditions for building long-term relations with the personnel (personnel reserve, increase in loyalty, etc.). All this is reflected in the presented algorithm of personnel risk management. The distinctive feature of the developed model and algorithm is the consideration of the system approach to HR risk management, which is manifested in each of the seven stages of the algorithm (Table 2). In contrast to the results of earlier studies, the proposed model allows for managing HR risks at all stages of personnel management.

Table 2. Stages and measures for HR risk management.

Stage	Content	Measures
1	Analytical	1.1 Analyze the external and internal environment of the organization. 1.2 Form a strategy for HR risk management. 1.3 Benchmarking
2	Development of a consistent vision of the organization's future	2.1 Determine the key competences of the organization. 2.2 Set goals and objectives of HR risk management. 2.3 Determine the needs of HR risk management subjects (information–analytical, administrative, etc.) 2.4 Determine metrics for evaluating the results of HR risk management.
3	Investment and formation of personnel by the organization	3.1 Search for and attract talent on the external and internal labor market. 3.2 Conclude labor relations and additional agreements. 3.3 Teach and develop the personnel. 3.4 Create favorable working conditions. 3.5 Develop a corporate culture to support the process of HR risk management. 3.6 Develop the employer's brand
4	Personnel use	4.1 Assess human capital and talents (potential and results). 4.2 Develop and introduce an incentive system.
5	Personnel accumulation	5.1 Plan the careers and success of the organization's workers. 5.2 Retain talent through incentives, increased involvement, loyalty, and job satisfaction
6	Personnel reproduction	6.1 Succession planning. 6.2 Work with the personnel reserve. 6.3 Transfer experience through mentoring.
7	Result assessment and continuous improvement	7.1 Evaluate the efficiency of HR risk management and profitability. 7.2 Audit the personnel and HR risks. 7.3 Continuously improve the system.

Source: developed by the authors.

6. Conclusions

This study demonstrates that HR risk management calls for comprehensive work in the HR sphere. HR risks depend on the specifics of the organization, the sector in which it operates, its size, maturity, and strategy, and the degree of uncertainty of the internal and external environment. By developing stages and measures for eliminating the security threat to the organization, one can assess the effect of risk and form an effective management mechanism to support the stability and harmonious development of the organization. An important scientific contribution of the authors' work is the developed conceptual model of HR risk management and the algorithm of its implementation in the context of subsystems (elements) of personnel management. Thus, based on the original research and the compilation of various approaches to personnel management and HR risk management, the authors developed a conceptual system for monitoring HR risks in an organization in order to minimize them and prevent negative effects.

The authors of this study conducted a sociological survey of employees, including HR specialists, which allowed for the identification of high-risk areas of personnel management and the requirements that should be met by the HR risk management system. The uniqueness of this research lies in the results of the survey, clustering groups of respondents and identifying typical responses. On this basis, the author's methodology of personnel risk management was made, which takes into account the opinion of respondents, who are the professionals of different organizations.

A limitation of this study is the relatively small number of respondents, representing only one country. In the future, it is recommended to continue this research by expanding the number of respondents and attracting respondents from different regions and countries. This will highlight the regional and national peculiarities of HR risks and offer specific recommendations for their minimization.

Author Contributions: Conceptualization, I.B. and V.P.; methodology, I.I.; software, I.I.; validation, V.P., I.B., and G.M.; formal analysis, V.P.; investigation, G.M.; resources, Y.V.; data curation, I.B.; writing—original draft preparation, I.I.; writing—review and editing, I.B.; visualization, Y.V.; supervision, I.B.; project administration, I.B. All authors have read and agreed to the published version of the manuscript.

Funding: The research was partially funded by the Ministry of Science and Higher Education of the Russian Federation under the strategic academic leadership program ‘Priority 2030’ (agreement 075-15-2021-1333, dated 30 September 2021).

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The questionnaire on problems of HR risks and personnel discrimination.

Dear colleagues! We invite you to take part in the study concerning HR risks in the organization. All the results will be used in a generalized form and can help to develop a methodology for managing HR risks. If you are interested in learning about the research results, you can provide your e-mail account at the end.

1. Your gender
 - (a) male
 - (b) female
2. Your age
 - (a) under 25
 - (b) 26–35
 - (c) 36–45
 - (d) 46–60
 - (e) over 60
3. What sector does your organization operate in?
 - (a) industrial production
 - (b) trade
 - (c) construction
 - (d) health care
 - (e) education
 - (f) financial services
 - (g) consulting services
 - (h) IT
 - (i) agriculture
 - (j) public service
 - (k) other _____
4. The headcount of your organization is
 - (a) less than 50 people
 - (b) 51–100
 - (c) 101–500
 - (d) 501–1000
 - (e) from 1000 to 5000
 - (f) over 5000
5. Your work experience in this organization is
 - (a) less than 6 months
 - (b) from 6 months to 1 year
 - (c) 1–3 years
 - (d) 3–5 years
 - (e) 5–10 years

- (f) more than 10 years
6. Do you hold a managerial position in your organization?
- (a) yes
(b) no
7. What statement do you associate HR risk?
- (a) loss or shortfall in the organization's income
(b) probability of deviation from the planned result
(c) security threat to the organization
(d) decreased labor efficiency
8. In your opinion, which stage of work process causes the highest probability of HR risks?
- (a) selection and assessment of candidates
(b) hiring (concluding labor relations)
(c) direct work of the personnel in the organization
(d) dismissal or resignation of an employee
9. In your opinion, which sphere is mostly damaged by HR risks in the organization? (choose no more than 3 answers)
- (a) financial
(b) informational
(c) material-technical
(d) moral
(e) professional competence
(f) personnel
10. In your opinion, which kinds of HR risks are most threatening to effective operation of the organization? (choose from 1 to 3 answers)
- (a) imbalance of the personnel age groups
(b) no monitoring of threats to vital interests of the organization
(c) no measures are taken to reveal and prevent unwanted actions of personnel
(d) selection of personnel that is not competent enough
(e) insufficiency of measures aimed at forming motivation and loyalty of employees working in the organization
(f) conflicts of interests between employees and the employer
(g) dismissal or resignation of key employees
11. In your opinion, in which of the functional personnel management subsystems do HR risks prevail? (choose no more than 3 answers)
- (a) personnel planning
(b) labor relations management
(c) provision of decent working conditions
(d) formation of organizational structure
(e) corporate culture development
(f) legal support of personnel management
(g) organization's social development management
(h) personnel development management
(i) personnel motivation management
(j) personnel assessment
12. In which form do HR risks manifest in your organization? (choose any number of answers)
- (a) violation of labor discipline and ethic code
(b) destructive conflicts and stress in the organizational environment
(c) the organizational structure is not effective or optimal
(d) insufficient professional competence of employees

- (e) high staff turnover
 - (f) fraud, financial losses
 - (g) threats to information security
 - (h) resistance of personnel to innovations
 - (i) our organization does not have any substantial HR risks
13. Have you ever encountered with employees' mistakes your professional activity that entailed serious negative effects for the organization (legal costs, financial and/or material losses, expired deadlines and broken agreements, etc.)
- (a) never
 - (b) very rarely
 - (c) rarely
 - (d) sometimes
 - (e) often
 - (f) very often
14. In your opinion, what caused these mistakes?
- (a) poor qualification
 - (b) lack of loyalty on the part of personnel
 - (c) interpersonal conflicts
 - (d) fraud
 - (e) sabotage and other forms of deviant behavior
 - (f) other _____
 - (g) I find it difficult to answer
15. Have you ever encountered in your professional experience with a situation when a dismissal or resignation of a key employee brought your organization substantial losses?
- (a) never
 - (b) very rarely
 - (c) rarely
 - (d) sometimes
 - (e) often
 - (f) very often
16. In your opinion, what causes violations of labor discipline (choose no more than 3 answers)
- (a) lack of clear understanding of the goals of the organization by employees
 - (b) barriers in communications between front-line employees and/or management team
 - (c) unstable work rates
 - (d) abuse of authority by the heads of departments, inconsistency of their requirements, etc.
 - (e) unjustified disciplinary rules and restrictions
17. In your opinion, what causes conflict situations among workforce (choose no more than 3 answers)
- (a) breach of promises between departments and employees
 - (b) constraints of any type of resources
 - (c) imperfect remuneration system
 - (d) presence of informal leadership and counterculture
 - (e) resistance to change
18. In your opinion, staff turnover is caused by: (choose no more than 3 answers)
- (a) low pay grade
 - (b) lack of respectful business relationships with the management team
 - (c) unsatisfactory labor conditions

- (d) unfavorable socio-psychological climate in the team
 - (e) high intensity of work
19. Which properties should the HR risk management methodology of the organization have (any number of answers can be chosen):
- (a) comprehensibility for the management team and employees
 - (b) low labor costs of the implementation
 - (c) flexibility for adapting the methodology to meet the changes in the organization;
 - (d) ability to continuously monitor the HR situation
 - (e) ability to get integrated into the corporate general security system
 - (f) meeting the requirements of international standards
20. In your opinion, which actions should be taken to minimize the risks of negative situations in the work with the personnel (any number of answers can be chosen)
- (a) training (professional development) of employees
 - (b) stricter control over the activities of the personnel
 - (c) informing employees about their liability
 - (d) forming a signaling system (informing about the negative situation in the organization)
 - (e) “exemplary dismissals”
 - (f) other _____

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