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INVESTIGATION OF THE EMPLOYEES' WELL-BEING UNDER INDUSTRY 4.0 DEVELOPMENT

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Abstract. The article is devoted to the global factors affecting the workers' well-being in the context of the work prosses transformation under the Industry 4.0. The study is aimed at examination the problem of the negative impact of economy globalization and digitalization on the socio-psychological employees' well-being. As a research method, a sociological survey conducted by the authors was used, in which 800 people living in six regions of the Russian Federation participated. The index method was used for a correct comparison of the obtained quantitative

indicators. A subjective respondent's assessment of different aspects of professional activities is took as an indicator for calculating the employee's socio-psychological well-being index. The survey results were processed using cluster analysis as an effective method of working with fuzzy information. It has been established workers groups at risk, who demonstrate low rates of socio-psychological well-being and a high level of concern about global socio-economic risks.

Keywords: Industry 4.0; employees' socio-psychological well-being; global economic risks; global social risks; labour sphere.

JEL codes: J28; I31.

Introduction

The study of the phenomenon of employees' socio-psychological well-being becomes relevant in connection with the existing and probable transformations in the work under the influence of global changes conjugated with the rapid development of digital technologies and the globalization of the labour market within the fourth industrial revolution. Industry 4.0, on the one hand, opens up new opportunities for all spheres of human life, including professional ones, and on the other hand, carries global risks for the working population. Most researchers associate the main risks of Industry 4.0 for the labour sphere with the digital divide, technological unemployment, polarization and precarization of employment, forced labour migration of the population from low-tech regions and the emergence of social tension in society [1; 2]. Automation and robotization of work operations has led to a change in the labour system and contributed to the emergence of new high-tech jobs and professions, as well as non-standard employment forms. Cloud employment and online platforms for a new type of interaction between employees and employers are rapidly developing, leading to significant changes in the labour market. In the context of high-tech digital manufacturing, work functions consist of small tasks and operations that are performed through the interaction of a person and "smart machines", therefore, there are opportunities for new combinations of mental, physical and mechanical work. At the same time, there is a growing need for highly qualified human capital capable of working effectively in the new working conditions [3]. Work 4.0 radically changes the requirements for the labour organization [4]. Guaranteed labour relations based on open-ended employment contracts are gradually disappearing, and the role of career self-management is increasing. An Industry 4.0 employee must timely adapt to new working conditions and be able to manage career risks throughout their working life [5; 6]. Modern workers must quickly learn new competencies in order not to face technological unemployment and lower wages. In this regard, issues related to the socio-psychological well-being of working population in the context of the Industry 4.0 development are becoming relevant [7].

Despite the potential positive impact of the latest technologies on the economic growth of the Russian Federation, it is important to consider the possible negative impact of global economic and social risks on the well-being of the labour force in the short and long term. Maintaining a high level of social and psychological well-being of workers is an urgent task for the economy and psychology of labour in the conditions of the current global transformations of society. The socio-psychological employees' well-being is considered by the authors as an indicator of global economic and social transformations. The main objective of the study is to scientifically substantiate the search for managerial decisions at the state and organizational level to ensure a high level of socio-psychological well-being of the most vulnerable categories of workers under the Industry 4.0 development.

1. Global factors of the Industry 4.0 affecting the employees' well-being

In modern science, there is no unity in understanding the content boundaries of the phenomenon of working man well-being, the opinions of scientists differ regarding indicators and parameters for studying socio-psychological well-being. Often, these ideas are conjectural in nature and are based on the theoretical and methodological provisions of any one scientific discipline. The solution to this problem requires the triangulation of empirical data obtained in various scientific disciplines and industries, as well as the integration of existing methodological approaches to the study of the phenomenon. The concept of "socio-psychological well-being of an employee" is associated with objective and subjective aspects, therefore, can be defined both in economic and sociological terms, and in psychological characteristics. The interdisciplinary nature of the presented research at the intersection of psychology, economics and human resource management makes it possible to take into account the features characteristic of workers who are representatives of different age, gender, educational, professional groups. J. Gordon was one of the first to conduct a factor analysis of the needs of workers that affect their well-being [8]. To date, a large number of studies on the problem of workers well-being are devoted to the issues of increasing labour productivity and job satisfaction, a sense of happiness and satisfaction with various aspects of life [9]. Of interest are theories that link employee well-being to managing employee engagement through the creation of a high-performing work system [10]. Particular attention is paid to the search for tools that contribute to improving the employees' well-being through involvement in the work process [11]. Another area of research on well-being at work is related to the study of the impact of organizational support or perceived organizational support [12]. New scientific research on the well-being of a working man is related to the investigation of the impact of social pollution, work digitalization and non-standard employment. However, there is still an under-representation in

the academic literature that addresses worker well-being in conditions of the Industry 4.0 and the associated changes in labour relations.

The fourth industrial revolution is destined to significantly improve the lives of millions of people around the world and increase their well-being through qualitative changes in the economy, manufacturing, healthcare, education, science and culture. However, any global changes, as a rule, are accompanied by certain risks that require competent and conscious management. Academic research on Industry 4.0 is covered by representatives of various scientific disciplines and is often interdisciplinary and multidisciplinary in nature. The general direction of scientific publications in the social sciences on the issues of the fourth industrial revolution is mainly associated with the identification of the role of Industry 4.0 in the sustainable development of society and the economy. As P. Schneider rightly notes in his literature review, most researchers are focused on the study of individual technologies in specific areas of application and ignore the serious management problems underlying the new type of industry. As a result, he identified six interconnected clusters of Industry 4.0 management challenges: strategy and analysis, planning and implementation, collaboration and networks, business models, human resources, change and leadership [13]. The opportunities of the fourth industrial revolution for the labour sphere are associated primarily with the flexible organization of work in time and space. Scientists believe that the fourth industrial revolution will allow organizing the employment of the economically active population, taking into account demographic changes and social factors. Intelligent systems can free workers from routine tasks and enable them to focus on value-added creative activities. In view of the expected shortage of skilled employees, this will allow older workers to extend their working life and remain productive for a long time [14]. It is considered that the distance employment will help level the existing gender inequality in the labour market. Teleworking obviously provides women with great opportunities to create a balance between work and personal life, allowing them to devote more time to family and, in particular, parental responsibilities by reducing time and financial costs, as well as flexible working time planning [15]. Digital employment and the introduction of robot assistants open up new perspectives for people with disabilities. Robotization and automation of production frees a human from performing monotonous, heavy and life-threatening work.

Experts associate the significant economic and social threats of the fourth industrial revolution to the employees' well-being with the increase in the polarization of jobs and income inequality of workers, in connection with which social inequality and technological unemployment will increase. In particular, according to Russian researchers, the release of a large number of jobs is one of the key social risks of the fourth industrial revolution. The risks are increased by the

predominance of raw materials industries in the regional economy and the lack of training of specialists with demanded competencies [16].

The experts' fears related to the fact that a number of employees of modernizing enterprises without the availability of appropriate state and organizational support will not be able to adapt to technological changes in a timely are quite justified. This situation will increase the digital divide between employees; labour polarization will mean that mid-level jobs are in danger of being cut [17]. Hard physical work will be in demand as it is often cost effective for organizations to continue to use cheap labour rather than costly robotics. The rapid development of new technologies in the Russian Federation will lead to a redistribution of work force in the labour market, to an increase in demand for specialists in the field of engineering and information technology. The question of the degree of influence of the global risks of Industry 4.0 on the socio-psychological employees' well-being of different categories remains unresolved, since the opinions of researchers on this matter differ.

2. Method

To determine the sample population using the quota sampling method, the authors identified three essential features: place of residence, education, and gender. When calculating the sample, the factor of respondents living in regions with different levels of elaboration and use of advanced technologies, as well as with different level s of unemployment, was taken into account for a more detailed analysis of the dynamics of the impact of Industry 4.0 on the socio-psychological well-being of workers. As a result, six regions of the Russian Federation were selected for the study, differing in the level of introduction of advanced technologies and unemployment: Sverdlovsk region, St. Petersburg, Nizhegorod region, the Republic of Adygea, Saratov region, Novosibirsk region. The sample was calculated in accordance with the size and structure of the labour force in the selected regions.

The study, implemented in 2021, involved 800 people: 412 men (51.50%) and 388 (48.50%) women aged 18 to 69 years. Of these, 327 people (40.88%) have secondary vocational education, 473 people (59.12%) have higher education. The basis for the development of a sociological questionnaire was a constructed project of parameters of the socio-psychological employee well-being: economic, material, social, professional, psychological well-being. Using the method of group expert assessments, the validity of the project parameters and indicators was verified [17]. The first part of the questionnaire is aimed at assessing the main parameters of the employee's socio-psychological well-being: when answering questions, respondents were asked to make a choice within a standard balanced scale consisting of two negative and two positive judgments of

equal weight and one neutral judgment. The second part of the questionnaire is aimed at studying the attitude of employees to the global social and economic risks of Industry 4.0. The third part of the questionnaire is designed to collect socio-demographic information about the respondents.

For a correct comparison and study of the quantitative indicators obtained in the study, the index method was used as the most relevant for assessing the multidimensional category of well-being. The idea of using indices to assess well-being is actively used in international studies. However, most of the available indices assess the well-being of the population at the global level and simultaneously relate to all spheres of human life, which makes it difficult to use them to correctly compare the well-being of various socio-demographic population groups. The scientific novelty of the author's approach lies in the development of an index of the employee's socio-psychological well-being, which includes five integral indicators of well-being. The indicator for calculating the index of employee's socio-psychological well-being is a person's subjective assessment of various aspects of his life conjugated with professional activity. To calculate the conditional average, all indicators of the employee's socio-psychological well-being were converted into points on a scale from "−1" (low level of the well-being parameter) to "1" (high level of the well-being parameter).

The calculation of the employee's well-being indices according to the weighted average formula was carried out by summing the value of each initial indicator multiplied by the weight. The weight of the indicator was determined in the process of expert evaluation. The sum was divided by the sum of the weights. For example, to calculate the index of the economic well-being of an employee, the following indicators were used (with weights): employee satisfaction with their income (4.71), the possibility of increasing income (2.0), the possibility of obtaining a loan/mortgage from a bank (2.0). To calculate the index of the material well-being of an employee, the following indicators were selected: the availability of real estate (4.43), the degree of satisfaction of material needs (1.57), the ability not to use borrowed funds for current expenses (1.57), and the ability to purchase quality food (1.57). As initial indicators of the employee's social well-being index, the following were taken: satisfaction with communication with colleagues (4.71), frequency of using messengers in communication (2.0), degree of foreign language proficiency (2.0). The initial indicators for calculating the index of professional well-being of an employee are: the perceived possibility of employment in the event of a job loss (3.86), satisfaction with professional status (4.29), the ability to freely express one's opinion when solving professional issues in a team (3.14). As initial indicators for calculating the index of the psychological well-being of an employee, the following were taken: assessment of the emotional atmosphere in the

workplace (4.43), assessment of the management's response to professional mistakes of employees (4.71), assessment of the safety of working conditions (4.29).

The calculation of the global social risk index and the global economic risk index was carried out using the simple average formula. The resulting result is measured in the range from "−1" (high level of global risks) to "1" (no risk). As initial indicators for calculating the index of global economic risks, respondents' assessments of such global threats as rising real estate prices, unemployment, economic crisis and default, reduction in the number of jobs due to robotization of production, and loss of income were used. The initial indicators for calculating the index of global social risks were: environmental problems in the place of residence, forced labour migration, the growth of social tension in society, the massive spread of infectious diseases. The use of the index method made it possible to calculate the overall index of employee's socio-psychological well-being (ESPWI), which combines all the indicators taken into account in the study.

3. Results

It was found that 71.75% of respondents have an index of economic well-being above zero, the average index was 0.22, and the median value was 0.344. The majority of working respondents (84.0%) assess their material well-being positively. The average score is 0.42 with a median of 0.545. The following fact is interesting: the employee's material well-being index gradually increases with age (Pearson's R correlation coefficient is 0.117, significance is 0.001), and the employee's economic well-being index gradually decreases with age (Pearson's R correlation coefficient is -0.160, significance is 0.000). In this regard, the correlation between the indices is not very high (Pearson's correlation coefficient R is -0.390, significance 0.000). Thus, with age, the satisfaction of workers from the volume of accumulated material goods increases, but the satisfaction from economic opportunities decreases. The calculation of the employee's social well-being index showed that the majority of respondents are also concentrated in the positive part of the scale (87.88%), however, there are relatively few respondents with the highest social well-being index ("1") (1.88%): the average score is 0.371 with a median 0.385. The resulting index of the employee's professional well-being shows that 83.5% of respondents assessed their professional well-being as positive (average 0.339, median 0.361). At the same time, only a small part of the respondents rated their professional well-being highly at once in all three indicators (2.38%). The index of psychological well-being of an employee shows that 80.5% of respondents rated their psychological well-being positively (mean 0.375, median 0.484). At the same time, 5.5% of respondents highly rated their psychological well-being in all three indicators. The results reflect that there are more respondents who highly assessed global social risks (62.5%): the average value

of the index is -0.159 with a median of -0.125. Also, 73% of respondents see themselves as a threat of global economic risks: the average value was -0.254 with a median of -0.300.

The global economic and social risk indices are closely positively correlated with each other (R = 0.534) and relatively weakly, but significantly and positively, with the five employee well-being indices. The exception is the correlation between the index of social well-being and the index of global social risks, its significance was 0.052, which is slightly more than the allowable 0.05. The index of social and psychological well-being of an employee is calculated using the formula of the weighted average of indicators from 1 to 16 and has an almost normal distribution with a mean value of 0.349 and a median of 0.381. The majority of respondents (88.75%) have ESPWI above zero.

Statistical data, especially for such abstract categories as quality of life, wealth, and well-being are not always accurate parameters, and therefore require special attention to the tools for processing empirical data. Since the data obtained in the course of surveys is often “fuzzy” data, it is advisable to analyse them using fuzzy information methods. In this case, to analyse the survey data, it is reasonable to use cluster analysis in order to identify the cluster structure and divide the sample of respondents into groups of similar objects. As a clustering algorithm, the authors used the k-means method (quick cluster analysis), since the indices are integral indicators and have a relatively normal distribution. Standardization in this case was not required, since all indices were measured in the range from "-1" to "1". The silhouette measure of connectivity and separation of clusters unambiguously indicates the optimal solution from two clusters (hereinafter, only less clear solutions). The characteristics of the clusters are presented in the table. Cluster 1, conventionally designated as "prosperous", includes 493 respondents (61.6%). This cluster has high indices for all parameters of the workers' socio-psychological well-being and relatively low values of global economic and social risks. Cluster 2, conventionally designated as "global risks", includes 307 respondents (38.4%). The cluster has low values for all parameters of well-being and elevated indices (negative values) of global social and global economic risks. Also in the cluster 2, the index of economic well-being has a negative value.

The subsequent construction of a classification tree according to the socio-demographic characteristics of the respondents made it possible to determine that the “prosperous” cluster most often consists of the following categories of employees: managers (73% of respondents, 86% from St. Petersburg); specialists (64% of respondents, 76% – youth); older specialists working under an indefinite employment contract (62%), mostly men (69%). The cluster "global risks" more often consists of the following categories of employees: manual workers (49%); specialists aged 30-49 (42%), especially in the absence of an open-ended contract (53%) or women (44%).

Table 1: Characteristics and end centres of clusters[1]

Characteristics and parameters	Cluster		In total
	1	2	
Silhouette measure of connectedness and separation of clusters [-1..+1]	-	-	0,385
Average distance between cluster centres	-	-	1,299
Cluster size, people	493	307	800
Average distance to centre	0,877	1,044	0,941
Minimum distance to centre	0,266	0,328	0,266
Maximum distance to centre	1,967	2,816	2,816
End centres of clusters:			
Index of economic well-being	0,450	-0,145	0,221
Index of material well-being	0,537	0,251	0,427
Index of social well-being	0,487	0,184	0,371
Index of professional well-being	0,515	0,058	0,340
Index of psychological well-being	0,595	0,022	0,375
Index of global social risks	-0,075	-0,294	-0,159
Index of global economic risks	-0,156	-0,411	-0,254
Index of socio-psychological well-being	0,524	0,070	0,350

The construction of a classification tree on substantive issues showed that belonging to a cluster strongly correlates with how management reacts to professional mistakes of employees (with a strict attitude, the proportion of those who are successful decreases to 36%, with a relatively loyal attitude, it grows to 79%). Satisfaction with income is important for those employees whose bosses react harshly to mistakes. With dissatisfaction with income, the share of the well-to-do falls to 8%, with relative satisfaction, it grows to 51%. For those employees whose management responds loyally to mistakes, working conditions are especially important. In safe working conditions, the share of prosperous workers increases to 92%, in hazardous conditions it drops to 57%. Further, the income factor begins to play an important role again.

4. Discussion

The results obtained on the Russian sample of respondents confirm the data of theoretical and empirical studies in a number of aspects. First of all, this concerns the socio-psychological well-being of such a category of employees as manual workers. Unfortunately, the pay for low-skilled labour in the realities of the fourth industrial revolution will decrease. A number of researchers predict strong labour market problems and note that widespread automation will lead to job losses and create fewer new jobs [18; 19]. Thus, the key issue is to achieve a long-term balance between

[1] Compiled by the authors

technology and new jobs, especially for manual workers. The main task of enterprises is to create conditions for adaptation of them to new technologies through timely training. However, according to experts, in the Russian Federation there is a risk of a discrepancy between the speed of both automation and employees retraining processes [20]. Upgrading qualifications, developing new competencies that are in demand will make it possible to level out wages between manual workers and other categories of employees; the temporary polarization of wages should gradually disappear. Information technology contributes to higher salaries among employees performing abstract tasks, representatives of managerial, intellectual and technical professions. The labour costs of managerial staff are reduced due to digitalization, but this effect is absent in professions that depend on intensive manual labour.

Well-being of workers of the older age category causes concerns. The results of the study carried out by the authors correlate with the analysis of vacancies conducted by I. Kulkova on the largest Russian job sites in the Sverdlovsk oblast. Content analysis has recorded a downward trend in the number and quality of job offers for people of pre-retirement and retirement age. This category of citizens, as a rule, can apply for low-paid and low-skilled work; the wages offered to them are lower than the average for Russia and the region [21]. The Sverdlovsk oblast is one of the leaders among the Russian regions in terms of the introduction of digital technologies in the industry. Thus, at this stage of the new industrial development, the opportunities for a decent working life for the elderly are not obvious.

A significant problem for society and the economy is the underrepresentation of women in STEM employment, which can also affect the socio-psychological well-being of working women. Today, women are not in sufficient demand in the segment of highly paid high technologies. At the same time, in the Russian Federation, women have greater access to STEM education than to STEM employment [22]. The tendency towards the spread of new employment forms and the reduction in the number of workers with open-ended labour contracts also causes reasonable concerns among researchers. The technological revolution is creating a demand for "flexible workers" who can work in a rapidly changing environment, in connection with which industrial enterprises are recording a decrease in the need for “standard workers". This trend is primarily due to the fact that it is often uneconomical for an employer to pay employees full time [23].

At the same time, it cannot be argued that the impact of Industry 4.0 on the employee's socio-psychological well-being is exclusively negative. On the contrary, the results of the field study indicate that there is a positive relationship between individual parameters of the socio-psychological well-being and the level of development and implementation of advanced technologies in the region of residence. In particular, the majority of managers living in St.

Petersburg were included in the “prosperous” cluster, which suggests that the high level of digital development of the region has a positive effect on the standard of living of highly qualified workers.

Conclusion

The theoretical and practical significance of the study carried out by the authors lies in the formation of a system of knowledge about changes in the parameters and indicators of the employee's socio-psychological well-being caused by the labour sphere transformation. The results of the study mediate the application of an integrated approach to the study of the phenomenon of employee's socio-psychological well-being. This approach allows us to consider the global economic and social risks associated with the fourth industrial revolution, in conjunction with psychological threats to the well-being at work.

The global economic and social risks of Industry 4.0 are associated with the economic crisis and rising inflation, as a result of falling household incomes, increasing employment polarization, digital unemployment, and an increase in forced labour migration from low-tech regions. Psychological risks are mediated by a decrease in perceived job security and uncertainty about the future, a heightened perception of interpersonal, social and economic threats. As a result, taking into account various factors and parameters of the workers' well-being allowed the authors to develop a methodology for assessing the impact of global economic and social risks of Industry 4.0 on this phenomenon. The results of the empirical study made it possible to identify the most vulnerable categories of workers, which makes it possible to develop targeted measures of state support. Currently at risk are working women, the elderly, as well as workers, especially those living in regions with a low level of development and implementation of advanced technologies.

The introduction of digital technologies and robotics into production is aimed at improving work processes by increasing productivity and labour efficiency. At the same time, automation and robotization of production leads to changes in the organization of personnel work, which requires the solution of social, technological, economic and psychological problems. To maintain the optimal level of the employees' socio-psychological well-being, the state and employers need to take care of training and advanced training of work force. This will require the organization to attract additional financial resources, including through state subsidies, both for the production re-equipment and for the personnel retraining. Also, representatives of those professional groups that will lose their jobs due to the automation of the production process require close attention. From a psychological point of view, it is necessary to create conditions to prevent possible negative scenarios of human-machine interaction by smoothly transforming the organizational culture and

improving labour safety, as well as timely informing employees about upcoming changes in the production process. The impact of global economic and social threats of Industry 4.0 on the well-being of a particular employee is associated with the implemented social policy of the enterprise, its organizational structure and other socio-economic characteristics. In particular, the size of the enterprise plays an important role, since large enterprises have better opportunities for retraining employees and creating new high-tech jobs. Thus, at the state level, it is necessary to provide support for the well-being of personnel working in small and medium-sized businesses, for example, to offer benefits for retraining employees.

Prospects for further research may be related to the study of the parameters of the well-being of employees of various professional groups and the development of specific organizational and managerial decisions to maintain the optimal level of the employee's socio-psychological well-being under the development of the fourth industrial revolution.

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