EVALUATING DIFFERENCES IN THE LEVEL OF WORKING CONDITIONS BETWEEN THE EUROPEAN UNION MEMBER STATES USING TOPSIS AND K-MEANS METHODS

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Original scientific paper

Abstract: *Work, which is a conscious activity of man, plays an immensely important role in their life and is the basis for the development of civilization. The work process is closely related to the conditions in which work is performed. These conditions include a number of social, technical, environmental as well as economic and organizational factors necessary to perform work safely in accordance with the applicable legal conditions. The role and importance of working conditions is appreciated by all organizations, countries and their groups taking action to improve them, including formal order. Given the importance and topicality of this issue, research has been carried out, the main goal of which was to assess the level of working conditions in the European Union (EU) countries according to the adopted criteria. The research was based on data from the European Foundation for the Improvement of Living and Working Conditions (EUROFOUND). Accordingly, eight main criteria were adopted, which were characterized by 64 sub-indicators. Such a broad approach to describing individual areas related to working conditions made it possible to analyze many factors influencing them. The research covered the 27 EU member states by determining indicators for working conditions criteria and an indicator for general (overall) working conditions. On this basis, their ranking and the level of working conditions in these countries were specified. The TOPSIS method was applied to this part of the research. With the use of partial levels of working conditions evaluation criteria and the k-means method, the authors identified countries similar in terms of the level of studied working conditions criteria. Based on the Spearman's rho and Kendall's Tau correlation coefficients, relationships were examined between the working conditions and the level of economic development and indicators characterizing the area of health and safety at work in the countries under study, which is very important from the point of view of working conditions. The results showed significant differences in working conditions between the EU-27. They were found to be definitely worse in the economically less developed countries (mainly the so-*

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called "new" EU) than in the economically stronger states (the so-called "old" EU countries). The assessment and groups of similar countries in terms of working conditions should be used to develop strategies to improve these conditions in the EU-27. This is particularly significant in the context of dynamic technological, social and geopolitical changes across Europe, which have a significant impact on the labor market.

Key words: *working conditions, work-life balance, sustainability, labor market, EU-27, health and safety at work, MCDM method.*

1. Introduction

One of the most important factors that determines the quality of human life in the modern world is gainful employment (Clark, 2001; Haller & Hadler, 2006). It is the basis of existence, providing the means of subsistence, and thus determines the quality and sense of life as well as provides a clear time structure, a sense of identity, social status and integration and opportunities for personal development (Grote & Guest, 2017; Mosadeghrad et al., 2011; Taylor-Gooby, 2008). Therefore, it can be assumed that the necessity of work in a social and individual sense is fundamental for human existence. It is also obvious that performing work, especially paid work, occupies a significant part of a person's life. On average, a worker in the EU-27 works 1513 hours per year. The lowest workload is reported in Germany (1332 hours), Denmark (1336), the Netherlands (1399) and Austria (1400), while the highest in Malta (1827), Croatia (1834), Romania (1795), and Poland (1766) (OECD Stat, 2022).

Given the role and importance of work for individual and social development and the amount of time spent on it, it is reasonable to address the issue of conditions in which work is performed. It is mainly about providing employees with safety against loss of life and health and favorable circumstances for carrying out the work process. More often than not, work conditions are defined as a set of factors present in the work environment, resulting from the realized process and factors related to work performance, which affect the mental and physical well-being of employees (Feldman et al., 2002; Matthews et al., 2010; Tutak et al., 2020). Important factors affecting the quality of work are also the elements related to working time (working hours, rest, etc.) and remuneration (Davidescu et al., 2020). It is obvious that providing favorable working conditions has a positive effect on the quality and efficiency of work performed, both from the point of view of the employer and the employee. However, performing work in unfavorable conditions has a negative impact on the work process and may translate into unsatisfactory results. The risk of physical and mental fatigue resulting from the high quantitative and qualitative demands to which employees may be exposed can cause a threat to their health and disturb their work-life balance. In the long run, this situation can have very negative economic and social consequences for the workers themselves, the employer and society. Therefore, working conditions and professional life associated with them have a significant impact on the physical and psychological state of the employee, including in particular motivation and commitment at work.

Published research results indicate that appropriate working conditions and work organization are crucial for the ability to perform work, health, well-being and skills of workers (Davidescu et al., 2020; Dorenbosch, 2014; de Wind et al., 2016). Safe and hygienic working conditions significantly affect the quality of both work and life outside work (Greubel et al., 2016; Lunau et al., 2014). The role and importance of proper working conditions, which are the responsibility of the employer, is

appreciated in many countries and regions of the world. This also applies to the European Union (EU), where ensuring safe and employee-friendly working conditions is one of the basic assumptions of the social and economic policy. This is confirmed by numerous pieces of legislation, as well as the European Parliament Resolution of 10 March 2022 on a new EU strategic framework for health and safety at work after 2020 (including better protection of workers from exposure to harmful substances, work stress and repetitive motion injuries).

According to Article 151 of the EU Treaty, member states should actively work to improve living and working conditions. At the same time, individual countries may set stricter standards than those laid down in EU directives. As a result, working conditions vary considerably across the EU member states. This is due to the wealth of countries, changes in demographics and employment structure resulting from the ongoing processes of digitalization, development of new technologies and increasing labor market flexibility and fragmentation of work. All these factors are increasingly affecting working conditions in the EU member states. Therefore, given the role and importance of working conditions for the economic development of the EU, as well as the dynamic changes taking place in the labor market in the recent period, it is fully justified to conduct research on the assessment of the level of working conditions in the EU-27 countries.

The main purpose of this research was to determine, according to the adopted criteria, the level of working conditions in the EU-27 countries, to compare this level and to find out whether this level is related to the economic development of these countries. An important objective of the research was also to check for similarities between these countries in the level of criteria for evaluating working conditions. The evaluation of the level of working conditions in the EU-27 countries was based on 8 criteria, including: physical environment, work intensity, working time, social environment, skills, discretion and other cognitive factors, prospects, job and company context, and working life perspectives. These criteria were characterized, in total, by 64 diagnostic variables (sub-indicators). For this part of the study, the TOPSIS approach, from the MCDM methods group, was used. Similarities between the studied countries were determined based on the k-means method. Non-parametric tests such as the Kendall's Tau and Spearman's rank correlation coefficients were used to examine the relationship between the level of working conditions and the economic development of individual countries and indicators describing the area of health and safety at work.

The research presented in this paper, conducted for the first time in such a scope, fills the existing research gap resulting from the lack of such analyses for the EU market and makes a new contribution to the existing literature in several aspects. For the first time, an assessment of the level of working conditions in the EU-27 was carried out using the TOPSIS method (from the MCDM group of methods), dedicated to this type of analysis. The application of this method made it possible to assess objectively the level of working conditions, considering eight evaluation criteria which cover the most important aspects of this issue. Their characteristics include as many as 64 sub-indicators, which proves its comprehensiveness and transparency. It also made it possible to determine similarities between the studied countries in terms of the level of particular criteria of this evaluation, which is also a new approach to studying working conditions in the EU-27. This is particularly important from the point of view of economic diversification of these countries and the assessment of the impact on working conditions in these countries. Another important and new element presented in this paper is the research on the relationship between the level of

working conditions in the EU-27 countries and their economic development and the values of indicators characterizing the area of health and safety at work, which is crucial from the point of view of occupational safety.

The novelty of the presented research as well as the importance and significance of the problem of working conditions for the economic development of the EU in the dynamically changing labor market and for the employees and employers themselves fully justifies the advisability of undertaking this research. The application of a new analytical approach to the study of this topic guarantees new knowledge regarding the characteristics of the EU-27 countries in terms of the level of working conditions in these countries.

2. Literature review

The presented literature review focuses on issues related to the influence of working conditions on productivity and effectiveness of work and workers' health condition (physical and mental). The number of publications related to this subject has been growing recently, which proves its importance and topicality.

Published research has most often concerned the effect of working conditions on employee satisfaction (Agbozo et al., 2017), the effect of presenteeism, working conditions and absenteeism on work performance (Strömberg et al., 2017), as well as the effect of personality on employee performance (Mustafa & Ali, 2019). Recently, an increasing number of studies have also examined motivation as a determinant of job performance (Yuen et al., 2018) and the effect of working conditions on employees' physical and psychological well-being (Arenas et al., 2015; Jeong et al., 2020; Schütte et al., 2014).

A number of research results indicate the importance of working conditions that enable employees to properly perform their duties and use their full potential. This mainly affects work performance and employee satisfaction (Masadeh et al., 2016).

Work performance is often taken up in studies, the results of which indicate its strict dependence on working conditions. The fewer factors limiting an employee, the more effectively the employee is able to perform his or her tasks (Guan & Frenkel, 2019; Marshall et al., 2015; Matsuo, 2019; Yozgat et al., 2013). On the other hand, inadequate working conditions disrupt the work process, often causing employees to increase their energy expenditure while performing assigned tasks (Jimenez et al., 2017). As shown by one study (Mustafa & Ali, 2019; Rossberg & Friss, 2004), poor working conditions are one of the main reasons for high employee turnover in companies and low satisfaction and productivity.

Currently, much research in the scientific literature also addresses the issue of working conditions and satisfaction with work-life balance (Gragnano et al., 2020; Isaacs, 2016; Rich et al., 2016).

The literature is also rich in articles on physical and ergonomic factors affecting working conditions for specific companies or occupational groups. This includes teachers (Amin, 2015), members of the Professional Guard (Nelson et al., 2015), as well as shearer loader assembly line workers (Saurin & Ferreira, 2009) and standing sewing machine operators (Nagaraj et al., 2019). In the latter case, the body parts where musculoskeletal symptoms are most common during such work (knee, foot, thigh, shin, and lower back) were identified. Similar studies have been conducted for workers who perform hand sewing of shoes (Dianat & Salimi, 2014). The results of these studies clearly indicate that work experience, daily working hours, working time

without breaks, feeling pressure to perform tasks, and posture during work have a significant impact on the health of workers.

The analysis of the literature also shows a lack of works on the formation of working conditions in different countries, including both developed and developing countries. This is because such a comprehensive approach provides an opportunity for a broader assessment of the processes related to working conditions in individual countries and regions. In this regard, it is possible to only mention studies on working conditions at the macro level, in different countries, including the EU countries, and relating to the issue of satisfaction with work-life balance (Greubel et al., 2016; Lunau et al., 2014; Wepfer et al, 2015).

However, the existing literature lacks studies on working conditions in different groups of countries, including the EU countries. This is important because nowadays, especially in Europe, major changes can be observed in the labor market related to the ongoing industrial revolution, coronavirus pandemic and geopolitical turmoil. These phenomena have a tremendous impact on the labor market, for which the conditions of work performance can be a serious asset in attracting new employees with appropriate competencies. Given the current state of the literature, it is reasonable to fill the arising research gap by carrying out comprehensive studies on the assessment of the level of working conditions in the EU-27 countries.

An approach based on MCDM methods will be used to evaluate working conditions. This methodology includes a set of methods, for multi-criteria decision support. Most often, the purpose of their application – through analysis and synthesis of discrete multi-criteria problems – is to evaluate a set of alternatives in terms of multiple, often conflicting, decision criteria that characterize a phenomenon or process (Zavadskas & Turskis, 2011; Zavadskas et al., 2014). Thus, having a set of alternatives (objects) and a number of evaluation criteria, the goal of applying the MCDM method/methods is to create a ranking of alternatives, e.g., from best to worst. A number of different methodologies for the application of MCDM methods have been presented in the literature, along with their characteristics, level of complexity and varied range of applications (Božanić et al., 2021; Kizielewicz et al., 2021; Opricovic & Tzeng, 2004; Peng et al., 2011; Stojčić et al., 2019; Yorulmaz et al., 2021).

Studies to date have used MCDM methods, for example, to evaluate the development of renewable energy sources (Kumar et al., 2017), energy security (Tutak & Brodny, 2022), sustainable development (Stanujkic et al., 2020), selection of materials in engineering applications (Emovon & Oghenenyerovwho, 2020), evaluation of public transportation (Kundu et al., 2014), and many other phenomena and processes. By contrast, for the evaluation of working conditions, these methods have not been used so far, which can undoubtedly be considered a research gap in this area. On the other hand, the multifaceted nature of the issues related to the labor market and its conditions fully predestines them for such application.

3. Material and methods

This section introduces the study area and the source from which the data were obtained, which are then discussed in section 3.2. Sections 3.3, 3.4 and 3.5 characterize the research methods used.

3.1. Area of Research

The European Union, the countries of which were enrolled in the study, has 27 member states (as of 2020) (Figure 1) and occupies a combined area of 4.4 million km^2 on the European continent. It is inhabited by approximately 437 million people.

The promotion of employment, better living and working conditions, adequate social protection, dialogue between management and employees, the development of personnel resources to ensure sustainable and high levels of employment and the prevention of social exclusion are the common objectives of the EU and the member states in the field of social and employment policy. These tasks, together with the free movement of workers, constitute one of the main pillars of the EU, listed in Article 151 Treaty on the Functioning of the European Union (Treaty on the Functioning of the European Union, 2012).

It should also be emphasized that the EU-27 is the only economic and political union of its kind in the world, bringing together as many as 27 countries with diverse energy structures, employment, economic levels and wealth of societies. The origins of the idea to create the EU go back to the period after World War II. The first stages of integration of European countries consisted of improving economic cooperation according to the principle that countries that trade with each other benefit from it, avoiding conflicts. The result of this premise was the creation of the European Economic Community (EEC) in 1958. Initially, economic cooperation involved six countries: Belgium, France, Germany, Italy, Luxembourg, and the Netherlands. Since then, 22 more members have joined the EU and a huge single and common market for the free movement of labor, capital and goods has been created, which is constantly developing its potential. It should also be noted that on January 31, 2020, the United Kingdom became the first country to withdraw from the EU.

Figure 1. The EU-27 countries area (own elaboration)

3.2. Data

Data from the European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) database were used for the study (EUROFOUND, 2022). EUROFOUND (2022) is a tripartite EU agency that conducts activities to improve living and working conditions. As part of its activities since 2005, it has been conducting "European Working Conditions Surveys" in 36 European countries, including 27 EU member states. From 2005 to 2015, the survey was conducted on a 5-year cycle basis. The next survey was conducted not in 2020, but in 2021, due to the ongoing pandemic of the SARS coronavirus CoV-2. The working conditions survey was conducted on a sample of over 44,000 respondents using the CATI method (computer-assisted telephone interview). Respondents were selected by random direct calls to cell phone numbers. Sample sizes ranged from 1000 to 4200 interviews per country. This sample size for each country enabled very robust estimates to be made at the European level and allowed information to be collected and analyses to be performed on working conditions in the surveyed countries and the EU as a whole. The working conditions survey covered a total of 8 evaluation criteria: physical environment, work intensity, working time, social environment, skills, discretion and cognitive factors, prospects, job and company context, and working life perspectives. A total of 64 indicators were used for the eight criteria for evaluating working conditions (Table 1).

Table 1. List of criteria and indicators used to evaluate working conditions

Criteria to evaluate working conditions	Evaluation indicators
Physical environment (12)	Exposure to high temperature Exposure to low temperature Exposure to smoke, vapors, dust or particles Exposure to inhalation of vapors Exposure to chemical products or substances Exposure to tobacco smoke from other people Exposure to materials which may be infectious Work requires strenuous or painful positions Work requires lifting or carrying people Work requires carrying or moving heavy loads Work requires repetitive hand or arm movements Work requires wearing personal protective equipment
Work intensity (6)	Work at very high speed Work requires meeting tight deadlines Adequate time to perform one's duties Frequent interruptions that disrupt work rhythm Number of factors influencing the pace of work Work requires participating in situations that cause emotional discomfort
Working time (6)	Number of hours per week spent on main paid work Performing more than 10 hours of work per month Doing night work Doing weekend work Doing shift work

Criteria to evaluate working conditions	Evaluation indicators
	Doing work according to a set start and end time
Social environment (5)	Exposure to undesirable social behavior
	Support and assistance by co-workers
	Support and assistance by a manager/head
	Fair treatment at work
	Experience of discrimination at work in the past 12 months
Skills, discretion and other cognitive factors (15)	Work requires solving unforeseen problems independently
	Work requires performing complex tasks
	Work requires learning new things
	Work requires using computers, laptops, smartphones, etc.
	While performing work, it is possible to select tasks to be performed or to change the order of performing these tasks
	While performing work, it is possible to select or change the speed or pace of work
	While performing work, it is possible to choose or change the manner of work
	Possibility to have a say in selecting co-workers
	Possibility to participate in improving the work organization or work processes in a department or organization
	Possibility to influence decisions that are important to the job
	Participation in training paid for by an employer (or by oneself if self-employed) within the last 12 months
	Participation in on-the-job training in the past 12 months
	Work involves monotonous activities
	Possibility to take a break at any time
Prospects (3)	Job provides good prospects for further career development
	Workplace restructuring or reorganization that has had a significant impact on your job in the past three years
	Possibility to find a new job with similar pay after losing current job or leaving voluntarily
Job and company context (7)	Change in hours worked per week in the last 12 months
	Change in salary or income in the last 12 months
	Knowledge of health and safety risks associated with the job
	Exposure to health or safety risks because of the job
	Trade union/works council or similar organizations representing workers in the company
	Health and safety delegate or committee within an organization
	Regular meetings at which workers can express their views on the situation in a company
Working life perspectives (10)	Sense of work being well done
	Well done work gives a sense of well-done duty
	Sense of work being useful
	Feeling adequately rewarded for work
	Work makes a difference to health
	Feeling that current job or a similar job will be possible until age 60
	Number of hours per week spent doing paid and unpaid work

Criteria to evaluate working conditions	Evaluation indicators
	Worrying about work-related issues outside of work hours in the past 12 months
	Feeling tired after work, which prevents from doing housework that needed to be done (in the past 12 months)
	Devoting an inadequate amount of time to family because of work (in the past 12 months)

3.3. The TOPSIS methods

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was used for a multivariate analysis aimed at assessing the level of working conditions in the EU-27 countries. This method consists in comparing the vector of values of decision (evaluation) criteria for a given object (EU country) with vectors of ideal and anti-ideal solution. The vector of ideal solution is the vector of values selected as the best from the set of values available for each of the indicators in the whole set of considered objects. Similarly, the negatively ideal vector is the vector of the worst values. In order to assess a given object (EU country) and compare it with others, it is necessary to determine the distance in Euclidean space between the vector of values of a given object and vectors: ideal and anti-ideal. The best object is the one of the objects (EU countries), for which its value vector has simultaneously the smallest distance from the ideal vector and the largest from the negatively ideal vector.

The idea of TOPSIS method is to determine the distance of considered objects (EU countries) from ideal (pattern) and anti-ideal (anti-pattern) solution. The result of the analysis is a synthetic index that creates a ranking of the studied countries. The best country is considered to be the one with the smallest distance from the ideal solution and at the same time the largest distance from the anti-ideal solution (Chakraborty, 2022).

The algorithm of the research procedure using the TOPSIS method consists of the following steps:

– To construct a new decision matrix:

$$X = [x_{ij}]_{m \times n} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \tag{1}$$

where: where n is the number of alternatives and m is the number of criteria

– To calculate a normalized decision matrix:

$$x_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}; \quad \forall i,j \tag{2}$$

– To determine the ideal S^+ and anti-ideal S^- alternative:

$$S^+ = (x_1^+, x_2^+, x_3^+, \dots x_n^+) = \{(max_i x_{ij}|j \in B|),(min_i, x_{ij}|j \in C|)\} \tag{3}$$

$$S^- = (x_1^-, x_2^-, x_3^-, \dots x_n^-) = \{(min_i x_{ij}|j \in B|),(max_i, x_{ij}|j \in C|)\} \tag{4}$$

– To determine the Euclidean distance of a given alternative from the ideal alternative S^+ and anti-ideal alternative S^-:

$$d_i^+ = \sqrt{\sum_{j=1}^n (x_{ij} - x_j^+)^2} \qquad (5)$$

$$d_i^- = \sqrt{\sum_{j=1}^n (x_{ij} - x_j^-)^2} \qquad (6)$$

- To determine the coefficient of relative closeness of alternatives S_i to the ideal alternative S^+ (indicator of working conditions criteria):

$$P_i = \frac{d_i^-}{d_i^+ + d_i^-} \qquad (7)$$

The values of the indicator of relative closeness of objects to the ideal object in the TOPSIS method are within the range from 0 to 1, and the higher the value of the indicator, the higher position a country achieves in the ranking.

In the study of the evaluation of the level of working conditions, the TOPSIS index was determined for each of the eight evaluation criteria, i.e., physical environment, work intensity, working time, social environment, skills, discretion and cognitive factors, prospects, job and company context, and working life perspectives. On the other hand, the final value of the TOPSIS index is the sum of the indices determined for the eight evaluation criteria:

$$P_i^* = \sum_{j=8}^i P_{ij} \qquad (8)$$

Based on the determined values of the TOPSIS index (P_{ij})) for each criterion of working conditions evaluation and based on the final value of this index P_i^*, the levels for each criterion and the overall level of working conditions in the EU-27 countries were determined. A division was made into four classes of working conditions level and is as follows:

Class 1 – very high level

$$P_i^* \geq \overline{P_i^*} + s_{P_i^*} \quad \text{(overall evaluation)} \qquad (9)$$

$$P_{ij} \geq \overline{P_{ij}} + s_{P_{ij}} \quad \text{(criterion evaluation)} \qquad (10)$$

Class 2 –high level

$$\overline{P_i^*} + s_{P_i^*} > P_i^* \geq \overline{P_i^*} \quad \text{(overall evaluation)} \qquad (11)$$

$$\overline{P_{ij}} + s_{P_{ij}} > P_{ij} \geq \overline{P_{ij}} \quad \text{(criterion evaluation)} \qquad (12)$$

Class 3 – acceptable level

$$\overline{P_i} > P_i^* \geq \overline{P_i} - s_{P_i} \text{(overall evaluation)} \qquad (13)$$

$$\overline{P_{ij}} > P_{ij} \geq \overline{P_{ij}} - s_{P_{ij}} \text{(criterion evaluation)} \qquad (14)$$

Class 4– low level

$$P_i^* < \overline{P_i} - s_{P_i} \text{(overall evaluation)} \qquad (15)$$

$$P_{ij} < \overline{P_{ij}} - s_{P_{ij}} \text{(criterion evaluation)} \qquad (16)$$

where: P_i^* is the working conditions indicator of a given country; P_{ij} is indicator of working conditions criterion of a given country; $\overline{P_i^*}$ is the average value of the P_i^* indicator for the population of countries under study; $\overline{P_{ij}}$ is the average value of the P_{ij} indicator for the population of countries under study; s_{P_i} is the standard deviation of the mean value of the P_i^* indicator for the population of countries under study and $s_{P_{ij}}$ is the standard deviation from the mean value of the P_{ij} indicator the population of countries under study.

Based on the values of the criteria for evaluating working conditions P_{ij}, groups of similar countries were identified.

3.4. The k-menas methods

The k-means clustering method belongs to non-hierarchical clustering methods. The analysis is based on finding and separating groups of similar objects (clusters). According to the algorithm of this method, k (given a priori) different, possibly dissimilar clusters are created. In the next stage, the objects are moved from cluster to cluster until the intra-cluster variation becomes optimized. Clusters created in accordance with the algorithm are characterized by the greatest similarity between countries contained in them. Individual clusters, on the other hand, should differ from one another as much as possible. One of the most important stages of grouping countries by the k-means method is to determine cluster centers and the Euclidean distance, which determines the distance of the tested object (country) from the center of gravity of the cluster (17):

$$d(x,y) = \sqrt{\sum_{i=1}^{p}(x_i - y_i)^2} \tag{17}$$

where: $d(x,y)$ is Euclidean distance; p is number of objects (EU-27 countries).

On the basis of the determined Euclidean distances, the process of assigning the examined objects (EU-27 countries) to groups of similar countries/clusters was carried out.

3.5. Method for analyzing the relationship between the level of working conditions and economic development of individual countries

Two non-parametric tests in the form of the Kendall's Tau and Spearman's rank correlation coefficients were used to determine a relationship between the level of working conditions in the EU-27 countries and economic development and indicators characterizing health and safety at work.

The Kendall's Tau correlation coefficient provides a measure of the monotonic relationship between two random variables (X, Y). The Kendall's tau correlation coefficient takes values between -1 and +1 inclusive. This coefficient shows both the direction and the strength of a given relationship. It is determined from the following equation:

$$\tau(X,Y) = 2P[(X_1 - X_2)(Y_1 - Y_2) > 0] - 1 \tag{18}$$

The second test used in this study was the Spearman's rho coefficient. It is also one of the non-parametric measures of monotonic statistical relationship between random variables (X, Y). It is used to analyze the interdependence of objects in terms of a two-dimensional feature (X, Y). The correlation coefficient is used in analyses of the interdependence of objects with respect to two-dimensional feature (X, Y). The Spearman's rho correlation coefficient can take values from -1 to +1 inclusive and is calculated from the following equation:

$$\rho_s(X,Y) = 3\big[P_r[(X - X_1) \cdot (Y - Y_2) > 0] - P_r[(X - X_1) \cdot (Y - Y_2) < 0]\big] \tag{19}$$

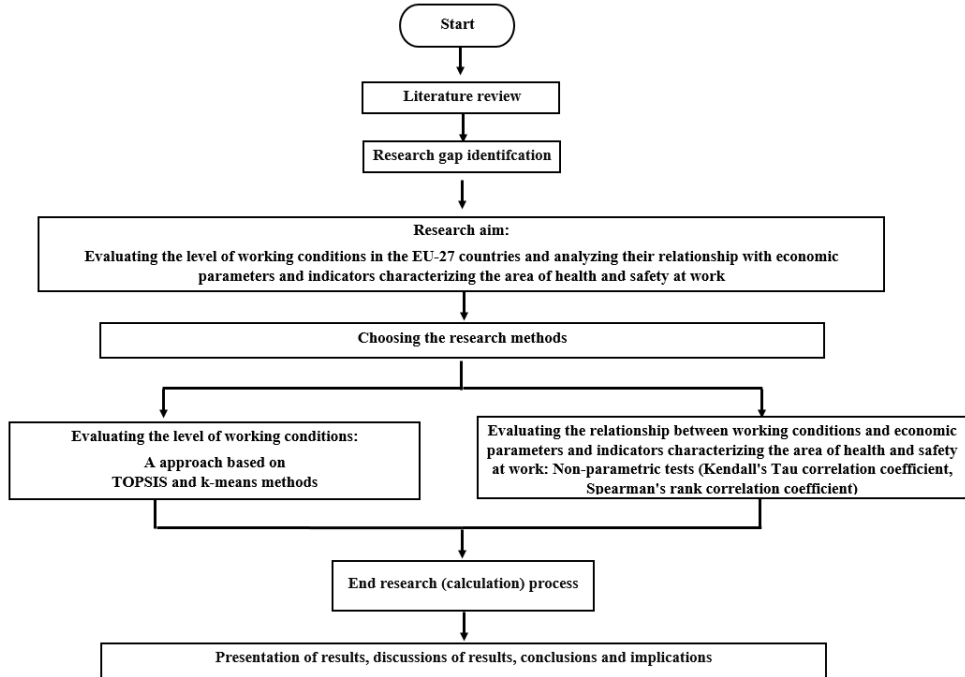A diagram showing the research procedure is shown in Figure 2.

Figure 2. Diagram of the research procedure

4. Results

Based on the data obtained from the EUROFOUND (2022) database and the methods discussed, research methodology was developed, and the study was conducted, the results of which are presented in this section. According to the adopted methodology, these results were divided into preliminary and fundamental. The preliminary research (statistical analysis of data) involved determining values for selected indicators characterizing working conditions in the EU-27 countries. The fundamental research involved evaluating the level of working conditions in particular countries and determining their relation to economic development of these countries and the area of health and safety at work, as well as determining similarities between the examined countries.

4.1. Preliminary statistical analysis

The indicators (diagnostic variables) characterizing the working conditions used in the study were subjected to preliminary processing and their basic statistical parameters were determined. The results for the selected group of indicators are presented in Table 2.

Table 2. Basic descriptive statistics for selected indicators related to working conditions

Indicators		Mean	Median	Min	Max	Standard deviation	Coefficient of variation	Skewness	Kurtosis
Exposure to chemical products or substances	more than 1/4 of the work time	15.84	16.00	8.90	22.00	3.33	20.99	-0.04	-0.54
	less than 1/4 of the work time	84.16	84.00	78.00	91.10	3.33	3.95	0.04	-0.54
Exposure to materials that may be infectious	more than 1/4 of the work time	12.41	12.20	6.70	20.30	3.18	25.60	0.39	0.16
	less than 1/4 of the work time	87.59	87.80	79.70	93.30	3.18	3.63	-0.39	0.16
Work requires wearing personal protective equipment	No	59.68	59.50	44.90	75.40	8.05	13.49	0.02	-0.45
	Yes	40.32	36.90	21.80	51.30	7.37	20.08	0.10	0.04
Work requires doing tasks at high speed	more than 1/4 of the work time	60.93	60.90	34.20	89.60	13.18	21.64	0.08	0.19
	Never	39.07	39.10	10.50	65.80	13.18	33.73	-0.08	0.19
Work requires meeting tight deadlines	more than 1/4 of the work time	62.53	62.20	49.80	80.50	7.68	12.28	0.44	-0.02
	Never	37.47	37.80	19.50	50.20	7.68	20.48	-0.44	-0.02
Number of factors influencing the pace of work	0-2	66.61	68.10	49.00	78.00	6.90	10.36	-0.90	0.83
	3 do 5	33.38	31.90	22.00	51.10	6.91	20.70	0.90	0.83
Number of hours per week spent on main paid work	Up to 40 hours	75.28	77.60	56.90	85.40	7.31	9.72	-0.92	0.36
	Over 40 hours	24.71	22.30	14.60	43.10	7.31	29.57	0.92	0.37
Doing night work	Never	80.28	81.60	73.70	87.00	3.75	4.67	-0.34	-1.07
	At least once	19.72	18.40	13.00	26.30	3.75	19.02	0.34	-1.07
Exposure to undesirable social behavior	Yes	75.28	77.60	56.90	85.40	7.31	9.72	-0.92	0.36
	No	24.71	22.30	14.60	43.10	7.31	29.57	0.92	0.37
Experience of discrimination at work in the past 12 months	Yes	21.19	21.00	10.40	40.20	6.39	30.18	0.84	1.88
	No	78.81	79.00	59.80	89.60	6.39	8.11	-0.84	1.88
Work requires performing complex tasks	Yes	62.36	65.80	38.80	80.00	11.16	17.89	-0.53	-0.38
	No	37.64	34.20	20.00	61.20	11.16	29.64	0.53	-0.38
Participation in training paid for by the employer (or by oneself if self-employed) within the last 12 months	Yes	36.47	37.90	8.60	53.90	12.13	33.27	-0.55	-0.51
	No	63.53	62.10	46.10	91.40	12.13	19.10	0.55	-0.51
Job provides good prospects for further career development	Yes	40.00	41.60	26.70	52.80	6.78	16.96	-0.30	-0.64
	No	36.40	37.10	24.20	46.70	6.10	16.75	-0.08	-0.81

Indicators		Mean	Median	Min	Max	Standard deviation	Coefficient of variation	Skewness	Kurtosis
Knowledge of the health and safety risks associated with the job	Very good	90.33	91.60	78.90	96.40	4.88	5.40	-0.85	0.14
	Not the best	9.67	8.40	3.60	21.10	4.88	50.42	0.85	0.14
Exposure to health or safety risks because of the job	Yes	25.34	25.30	13.10	46.80	7.70	30.38	0.70	0.99
	No	74.66	74.70	53.20	86.90	7.70	10.31	-0.70	0.99
Feeling adequately rewarded for work	Yes	50.46	48.20	32.20	66.90	9.07	17.97	0.10	-0.71
	No	49.54	51.80	33.10	67.80	9.07	18.31	-0.10	-0.71
Worrying about work-related issues outside of work hours in the past 12 months	Always, often	14.75	13.40	4.70	26.10	5.89	39.94	0.38	-0.90
	Sometimes, never	85.25	86.60	73.90	95.30	5.89	6.91	-0.38	-0.90

When looking at the results, on average, nearly 16% of workers in the EU-27 are exposed to chemical products or substances for more than a quarter of their working time, with the highest proportion in Hungary (22%) and the lowest in the Netherlands (8.9%). On average, nearly 40% of workers in the EU-27 are required to use personal protective equipment at their workplace, with the highest proportion in Slovenia (51.3%) and the lowest in Greece (21.8%). EU-27 workers who spend up to 40 hours a week on paid work account for just over 75%, with the highest proportion in the Netherlands (85.4%) and the lowest in Greece (56.9%). An average of 75% of workers in the EU-27 are exposed to undesirable social behavior at work, with the highest proportion in the Netherlands (85.5%) and the lowest in Greece (56.9%). Across the EU-27, on average, only just over 50% of workers feel adequately rewarded for their work. The best situation in this respect is found in Denmark, where 66.9% of workers feel that they are well paid for their work, and the worst situation is reported in Greece, where only just over 32% of workers confirm that they are well paid for their work. As regards upskilling, only 37% of the EU-27 workforce had participated in an employer-paid training course in the 12 months prior to the survey. The worst situation in this respect was reported in Greece, where less than 9% of employees had participated in training, and the best situation in Finland (more than 50% of employees).

4.2. Analysis and evaluation of working conditions

In the first stage of fundamental research, using the TOPSIS method, an index of working conditions criteria was determined for the EU countries and their rankings were made in terms of the value of these indices. The results are presented in Table 3.

Then, based on the values of the working conditions criteria indices Pi, the level of these conditions was assessed for each of the eight criteria: physical environment, work intensity, working time, social environment, skills, discretion and other cognitive factors, prospects, job and company context, and working life perspectives. To assess this level, a 4-point scale was adopted (according to equations 9-16), using the arithmetic mean and standard deviation calculated from the values of indices of

working conditions Pi (equation 7). The results of the assessment conducted are shown in Table 4.

Table 3. Indices and rankings of the EU countries for particular criteria of working conditions evaluation

	Physical environment		Work intensity		Working time		Social environment		Skills, discretion and other cognitive factors		Working life perspectives		Job and company context		Prospects	
	Pi	Rank	Pi	Rank	Pi	Rank	Pi	Rank	Pi	Rank	Pi	Rank	Pi	Rank	Pi	Rank
AT	0.71	10	0.58	14	0.79	10	0.67	6	0.67	12	0.38	11	0.56	10	0.91	1
BE	0.85	4	0.50	17	0.81	7	0.64	7	0.73	8	0.42	10	0.48	13	0.72	8
BG	0.79	7	0.94	2	0.80	9	0.68	5	0.20	26	0.19	18	0.46	15	0.81	5
CY	0.47	20	0.15	27	0.93	1	0.82	1	0.21	25	0.30	12	0.24	24	0.65	13
CZ	0.69	11	0.78	7	0.34	26	0.63	8	0.41	15	0.16	20	0.70	6	0.61	15
DE	0.84	5	0.56	15	0.86	3	0.58	14	0.51	13	0.25	16	0.74	3	0.90	2
DK	0.78	8	0.30	25	0.56	15	0.42	20	0.89	2	1.00	1	0.73	5	0.89	3
EE	0.65	13	0.81	6	0.52	17	0.26	25	0.83	4	0.71	7	0.62	7	0.67	12
EL	0.43	21	0.35	22	0.37	22	0.70	4	0.15	27	0.05	25	0.09	27	0.30	26
ES	0.41	23	0.40	20	0.72	12	0.52	15	0.45	14	0.16	19	0.22	25	0.43	24
FI	0.49	19	0.31	24	0.37	21	0.24	27	0.92	1	0.91	3	0.58	8	0.52	17
FR	0.36	25	0.40	21	0.59	14	0.43	17	0.68	9	0.56	9	0.42	18	0.44	21
HR	0.53	17	0.74	8	0.34	25	0.37	22	0.35	18	0.07	23	0.30	22	0.44	22
HU	0.42	22	0.69	10	0.72	11	0.62	10	0.29	20	0.15	21	0.43	17	0.43	23
IE	0.71	9	0.62	13	0.33	27	0.29	24	0.68	11	0.74	6	0.57	9	0.79	6
IT	0.84	6	0.82	4	0.86	4	0.74	3	0.29	20	0.04	27	0.20	26	0.68	9
LT	0.34	26	0.68	11	0.84	5	0.61	11	0.31	19	0.11	22	0.41	19	0.48	19
LU	0.86	3	0.55	16	0.84	6	0.59	13	0.86	3	0.64	8	0.56	11	0.63	14
LV	0.53	18	0.95	1	0.81	8	0.63	9	0.21	24	0.28	14	0.44	16	0.45	20
MT	0.63	14	0.27	26	0.53	16	0.42	19	0.81	6	0.90	4	0.46	14	0.67	10
NL	0.86	2	0.65	12	0.67	13	0.49	16	0.82	5	0.75	5	0.53	12	0.89	3
PL	0.38	24	0.81	5	0.50	18	0.43	18	0.38	16	0.27	15	0.41	20	0.32	25
PT	0.92	1	0.88	3	0.91	2	0.81	2	0.25	23	0.07	24	0.27	23	0.77	7
RO	0.025	27	0.45	19	0.44	19	0.60	12	0.29	22	0.29	13	0.78	2	0.51	18
SE	0.60	15	0.31	23	0.36	23	0.25	26	0.80	7	0.91	2	0.85	1	0.59	16
SI	0.66	12	0.48	18	0.36	24	0.33	23	0.68	9	0.23	17	0.36	21	0.67	10
SK	0.55	16	0.69	9	0.38	20	0.38	21	0.36	17	0.04	26	0.74	4	0.30	27

Table 4. Levels of evaluating working conditions in individual EU-27 countries for the adopted criteria (according to equations 9-16)

Countries	Criterion (dimension)							
	Physical environment	Work intensity	Working time	Social environment	Skills, discretion and other cognitive factors, prospects	Working life perspectives	Job and company context	Prospects
AT	high	acceptable	high	high	high	acceptable	high	very high
BE	very high	acceptable	high	high	high	high	acceptable	high
BG	high	very high	high	high	low	acceptable	acceptable	very high
CY	acceptable	low	very high	very high	low	acceptable	low	high
CZ	high	high	low	high	acceptable	acceptable	very high	high
DE	very high	acceptable	very high	high	acceptable	acceptable	very high	very high
DK	high	low	acceptable	acceptable	very high	very high	very high	very high
EE	high	very high	acceptable	low	very high	very high	high	high
EL	acceptable	low	low	very high	low	low	low	low
ES	acceptable	acceptable	high	acceptable	acceptable	acceptable	low	acceptable
FI	acceptable	low	low	low	very high	very high	high	acceptable
FR	low	acceptable	acceptable	acceptable	high	high	acceptable	acceptable
HR	acceptable	high	low	acceptable	acceptable	low	acceptable	acceptable
HU	acceptable	high	high	high	acceptable	acceptable	acceptable	acceptable
IE	high	high	low	low	high	very high	high	high
IT	very high	very high	very high	very high	acceptable	negative	low	high
LT	low	high	very high	high	acceptable	acceptable	acceptable	acceptable
LU	very high	acceptable	very high	high	very high	high	high	high
LV	acceptable	very high	high	high	low	acceptable	acceptable	acceptable
MT	high	low	acceptable	acceptable	very high	very high	acceptable	high
NL	very high	high	high	acceptable	very high	very high	high	very high
PL	low	very high	acceptable	acceptable	acceptable	acceptable	acceptable	low
PT	very high	very high	very high	very high	low	low	low	high
RO	low	acceptable	acceptable	high	acceptable	acceptable	very high	acceptable
SE	acceptable	low	low	low	very high	very high	very high	acceptable
SI	high	acceptable	low	low	high	high	acceptable	high
SK	acceptable	high	low	acceptable	acceptable	low	very high	low

The analysis showed that for the criterion of 'physical environment', taking into account the indicators characterizing this criterion in the study, a very good result was obtained by Denmark, Belgium, Portugal, the Netherlands, Luxembourg, and Italy. All these countries belong to the developed EU countries (the so-called "old" EU countries). On the other hand, a low score for this criterion was obtained by Romania, Poland, Lithuania, and France. Among these countries as many as 3 belong to developing countries, i.e., the countries of the so-called "new" EU. In the case of assessing the criterion "work intensity", the highest scores were reported for Estonia, Italy, Latvia, Poland and Portugal, and the lowest scores for Denmark, Finland, Sweden, as well as Cyprus, Greece, and Malta. A very important criterion, which is now of increasing importance to society, is the balance between work and private life, which is contained in the criterion 'working life perspectives.' Very high scores for this criterion were obtained by Denmark, Estonia, Finland, Ireland, Malta, the Netherlands, and Sweden. Such a high rating for this criterion for the Scandinavian countries is due to the fact that employees from these countries report high satisfaction with their working time and work-life balance. This is consistent with the social welfare system of these countries, where a great deal of attention is paid to the problem of reconciling work and private life. The lowest scores for this criterion were obtained by Greece, Croatia, Portugal, and Slovakia. This is due to the fact that in these countries little action is taken to facilitate work-life balance (Matilla-Santander et al., 2019).

All in all, when analyzing the results presented in Tables 3 and 4, it can be seen that within the assessed criteria, the EU-27 countries are characterized by considerable diversity. This makes it relatively difficult to distinguish groups of similar countries.

Therefore, in order to identify countries similar in terms of the level of sub-criteria for assessing working conditions, they were grouped using the *k*-means method. On this basis, the EU countries were divided into four clusters. The compositions of the formed clusters and distances from their centers (cluster centers) are presented in Table 5. The greater the distance of the EU country from the center of the cluster in which it is located, the greater its differentiation from countries whose distance from the center of the cluster is smaller.

Table 5. Elements of clusters with distances form centers

Cluster 1	Distances from center of cluster 1	Cluster 2	Distances from center of cluster 2	Cluster 3	Distances from center of cluster 3	Cluster 4	Distances from center of cluster 4
AT	0.074	CY	0.253	BG	0.071	DK	0.148
BE	0.059	CZ	0.178	IT	0.072	EE	0.143
DE	0.134	EL	0.192	LV	0.137	FI	0.103
LU	0.099	ES	0.118	PT	0.084	FR	0.175
NL	0.123	HR	0.128			IE	0.116
		HU	0.086			MT	0.091
		LT	0.124			SE	0.112
		PL	0.119				
		RO	0.210				
		SI	0.192				
		SK	0.167				

The results indicate that cluster 2 contains the largest number of countries (11 countries), and cluster 3 – the lowest number of countries (4 countries). No homogeneity of any of the clusters was found. Countries from cluster 1 show the greatest similarity in terms of physical environment, work intensity, working time, social environment and prospects. As many as 11 countries from cluster 2 show the highest similarity in terms of social environment, prospects and skills, discretion and other cognitive factors. Cluster 3 consists of countries that are similar in terms of physical environment, work intensity, working time, social environment, job and company context, prospects and skills, discretion and other cognitive factors. Countries in cluster 4 are characterized by the highest similarity in terms of working life perspectives, working time, skills, discretion and other cognitive factors, social environment.

For the clusters formed by very different countries, it is reasonable to use the mean value to determine the average rating of the individual criteria used to assess working conditions. A summary of the mean values of the working conditions evaluation criteria for each cluster is presented in Figure 3.
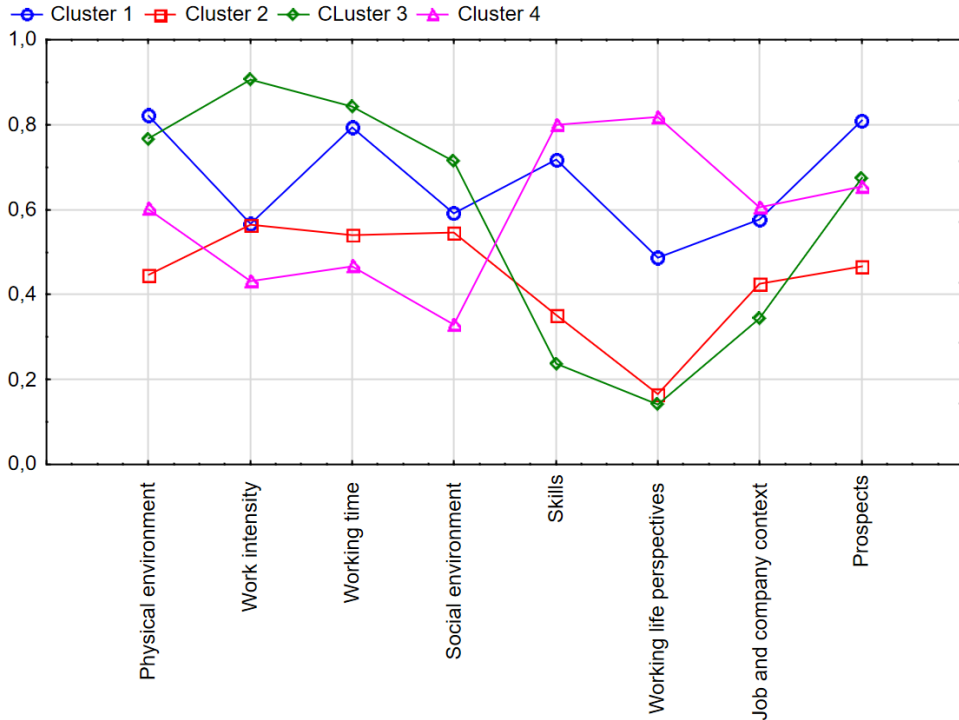
Figure 3. Average values of working conditions evaluation criteria for
particular clusters of similar EU-27 countries

When analyzing the results, it can be seen that countries in cluster 1 are characterized by the highest average score for the criteria physical environment and prospects. At the same time, for the criteria work intensity, working time, social environment, skills, discretion and other cognitive factors, the scores are slightly lower than for the countries in cluster 3, and for the criteria job and company context and working life perspectives, the scores are lower than for the countries in cluster 2.

Countries in cluster 2 were reported the worst in terms of the average evaluation of partial criteria for working conditions. Countries from this cluster perform poorly in comparison with other countries in terms of physical environment and prospects, and also quite poorly in terms of work intensity, working time and social environment (only countries from cluster 4 have worse scores for these criteria) as well as job and company context, working life perspectives and skills, discretion and other cognitive factors (only countries from cluster 3 have worse scores).

In the next stage of the research on the evaluation of working conditions, a total value of index of working conditions (equation 11) was determined for each EU-27 country, taking into account partial evaluation results for individual evaluation criteria (Table 3) and the level of working conditions (Figure 4).

Based on the analyses, the final levels of working conditions in the EU-27 countries were determined. This breakdown for different levels is as follows (Figure 5):
-   very high level of working conditions: Denmark, Germany, the Netherlands, Luxembourg, Austria
-   high level of working conditions: Belgium, Estonia, Bulgaria, Finland, Ireland, Malta, Portugal, Sweden, Italy

Evaluating differences in the level of working conditions between the European Union…

- acceptable level of working conditions: Czech Republic, Latvia, France, Slovenia, Lithuania, Cyprus, Hungary and Poland
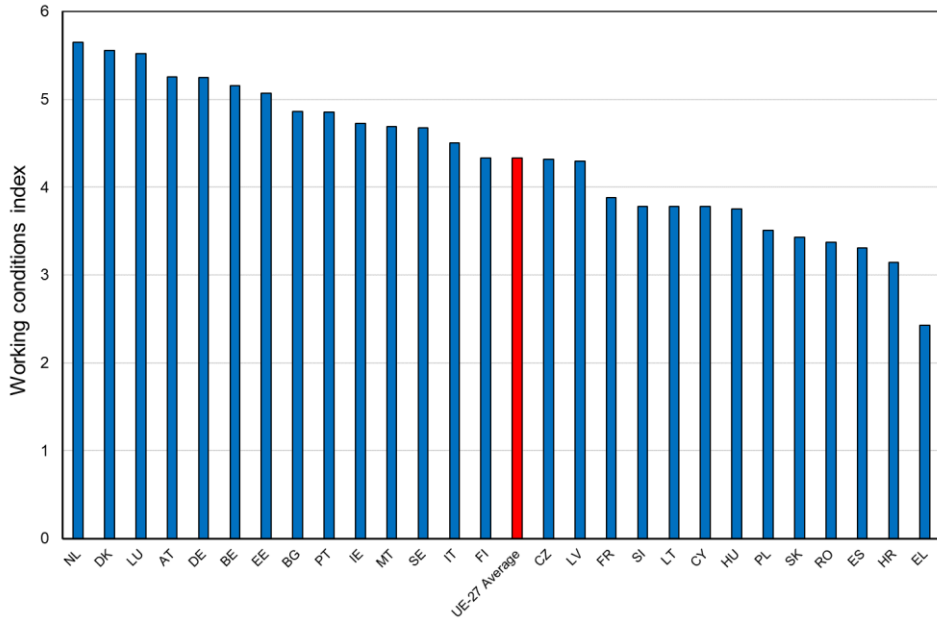- low level of working conditions: Greece, Croatia, Spain, Romania, Slovakia.

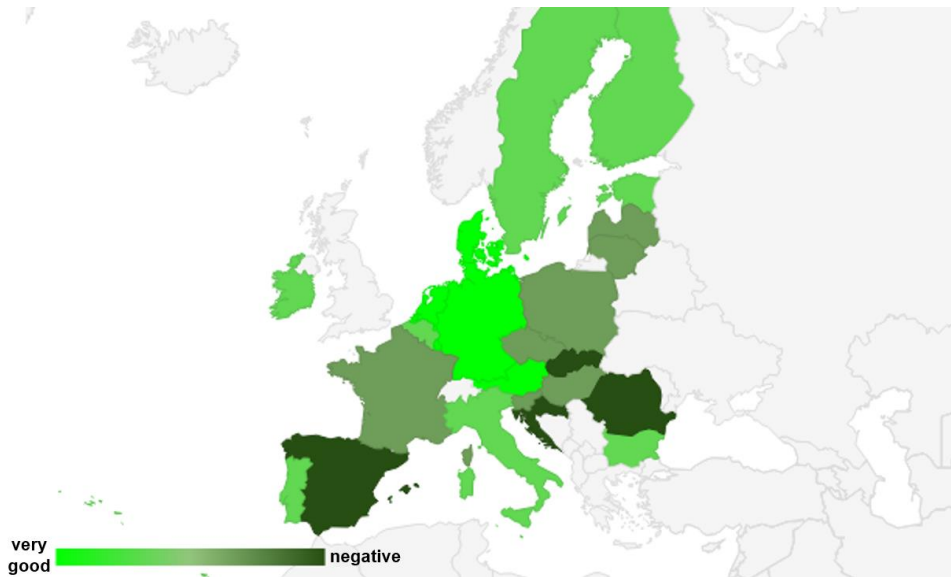**Figure 4.** Summary values of the working conditions index in the EU-27

Figure 5. Levels of working conditions in the EU countries

On the basis of the conducted research, it can be concluded that definitely better working conditions can be found in the developed countries than in the developing countries of the EU. The exceptions in this regard are Greece and Spain (countries of the "old" EU), where the level of working conditions was reported to be low. The overall assessment of working conditions shows that in as many as eleven (out of fourteen) countries of the so-called "old" EU, the level of working conditions is either very high or high; in one of them, it is acceptable (France), and in two of them – low (Spain and Greece).

Among the countries of the so-called "new" EU, i.e., developing countries, a high level of working conditions can be found only in Malta, Estonia and Bulgaria, and acceptable conditions in Cyprus, Hungary, Lithuania, Latvia, Poland, Slovenia and the Czech Republic. In two countries (Romania and Croatia), a low level of working conditions was found. Unfortunately, the results show that in developed countries ("old" EU), there are much better working conditions than in the countries of the so-called "new" EU.

The next stage of the research was to check if and what relations exist between the working conditions index P_i^* (determined using the TOPSIS method) and the level of economic development and indicators characterizing the area of health and safety at work in the EU-27 countries. For this purpose, the Spearman's rho and Kendall's Tau correlation coefficients were adopted. The level of economic development of the EU countries was characterized by the values of GDP, GDP per capita, as well as gross domestic expenditure on R&D (% of GDP). The indicators describing the area of health and safety at work were: accidents at work (as percentage of persons employed), persons reporting exposure to risk factors that can adversely affect mental well-being (as percentage of total employment) and persons reporting a work-related health problem (as percentage of persons employed). The results of the calculations are summarized in Table 6.

Table 6. The Spearman's rank correlation coefficient and the Kendall's Tau correlation coefficient between the value of the work conditions index P_i^* and the economic development and health and safety at work in the EU-27 countries

Tested parameters	Kendall's Tau Correlation Coefficient		Spearman rho	
	work conditions index	p	work conditions index	p
GDP, million euro	0.111	0.416	0.190	0.341
GDP per capita, million euro	0.521	0.000	0.673	0.000
Gross domestic expenditure on R&D, % of GDP	0.308	0.024	0.451	0.018
Accidents at work, percentage of persons employed	0.136	0.320	0.243	0.223
Persons reporting exposure to risk factors that can adversely affect mental well-being, Percentage of total employment	0.094	0.491	0.133	0.508
Persons reporting a work-related health problem, Percentage of persons employed	0.275	0.044	0.389	0.045
Note: Statistically significant values are marked in bold				

Based on the results, it can be concluded that statistically significant positive relationships exist between the working conditions index and GDP per capita and

Gross domestic expenditure on R&D and between the working conditions index and persons reporting a work-related health problem, but in this case, the strength of the correlation is relatively weak. The strength of the relationship between the examined parameters and the working conditions index is higher for the Spearman's rho correlation coefficients than for the Kendall's Tau Correlation Coefficient. No relationship was found between the GDP of a country and the working conditions index, nor between the index and occupational accidents and persons reporting exposure to risk factors that can adversely affect mental well-being.

That is why the results obtained can be taken as statistical evidence that a relatively high economic level measured by GDP per capita is also associated with better working conditions in the EU-27. It is also very important to emphasize that business enterprise expenditure on R&D is statistically significant for the level of working conditions (i.e., has a positive impact on these conditions). This means that developed countries are characterized by significantly better working conditions than developing countries.

5. Discussion

Free movement of workers and their access to work under the same conditions as nationals is one of the fundamental principles of the EU. This principle plays an important role in achieving the Sustainable Development Goals and the 2030 Sustainable Europe Strategy for economic growth and reducing social disparities. Since many of the EU's policy priorities include increasing the level of employment, prolonging labor market participation and raising labor productivity, the issue of creating better working conditions appears to be an absolute necessity and even of fundamental importance for the success of the EU's economic and social strategies. Since work is the basis for the development of the EU-27, which currently employs some 195.7 million people (Eurostat, 2022), the problem of ensuring appropriate working conditions becomes extremely important and up to date. Also, changes in the structure of employment associated with the digitalization of the economy, the aging of the European population and the ongoing processes of immigration, as well as the recent geopolitical turmoil, make the issue of access and working conditions of key importance for individual countries and the EU as a whole (Cirillo et al., 2021; Cristea et al., 2020; Frennert, 2019; Nica, 2015).

Of particular importance are the working conditions, which, in addition to economic aspects, are a very important social factor determining the efficiency and success of an enterprise (organization) and the sustainable development of the economy and society (Davidescu et al., 2020; Matilla-Santander et al., 2019). Working conditions affect the commitment and willingness to improve skills by employees, their satisfaction and productivity. They also have a major impact on work-life balance. Therefore, it is important to assess these conditions, both at the level of an individual company and at the national and regional levels. A broader approach to assessing these conditions provides opportunities to compare them, identify similarities and differences, and identify shortcomings that can be improved through good practice or cooperation between groups of countries. In the case of the EU, which is building and promoting a common social policy and an open labor market, solutions to this issue are of particular importance.

Therefore, for the first time, such a wide range of research has been conducted on the evaluation of working conditions in the EU-27. The results made it possible to

achieve the main objective of the paper, which was the overall evaluation of the level of working conditions in the EU-27 and a partial evaluation of the criteria influencing these conditions as a whole. The relationships between working conditions and the economic development of individual countries were also determined, as well as indicators characterizing an extremely important area, from the point of view of working conditions, i.e., safety and health at work.

The research carried out and its results show that the EU-27 countries are characterized by great diversity in the level of working conditions. A comprehensive evaluation of working conditions, including eight evaluation criteria and as many as 64 diagnostic variables, showed that very good working conditions are found in Denmark, Germany, the Netherlands, Luxembourg, Austria, and good conditions in Belgium, Estonia, Bulgaria, Finland, Ireland, Malta, Portugal, Sweden, and Italy. This means that the most favorable working conditions occur mainly in developed countries, conventionally classified as countries of the "old" EU. Only in three developing countries (so-called "new" EU), namely Estonia, Bulgaria and Malta, a high level of working conditions was found. These results therefore indicate that in developing countries, which joined the EU after 2004, apart from Estonia, Bulgaria and Malta, working conditions were reported to be acceptable and for two countries – Croatia and Romania – negative. At the same time, only in two countries of the "old" EU (Spain and Greece), working conditions were reported to be at a low level. A number of factors contribute to these differences, but the main reasons include insufficiently active labor policies and lower macroeconomic indicators (GDP per capita), which are ultimately important for working conditions in the evaluated countries (Table 6).

Indeed, the results obtained showed that the level of working conditions is related to the economic development of a country, which is also in line with the results of Giordano and Kostova (2002). Their results reflect that in most post-socialist countries, working conditions are often much worse than in Western countries ("old" EU). This, in turn, indirectly affects the issues of migration in search for better working conditions to Western countries from post-communist countries, such as Poland (Cieslik, 2011). Apart from political and security aspects, the issues of working conditions related to economics have the greatest impact on migration decisions (Bygnes & Erdal, 2017).

An important factor that also affects working conditions is the level of technological development. Most of the countries belonging to the "old" EU are much more technologically developed (Brodny & Tutak, 2021). The processes of digitalization, automation and robotization related to the activities of enterprises make it possible, for example, to reduce the contact of the employee with aggressive environments, which significantly improves the comfort of work. This process, often associated with the need to increase competence by the employee, generally improves his/her well-being and results in greater commitment (Marenco & Seidl, 2021). In the case of developing countries (the "new" EU), these processes do not occur so dynamically, which makes working conditions less favorable (Grigorescu et al., 2021).

By and large, the assessment of working conditions should be approached much more broadly than just by looking at the hazards in the work environment and health and safety issues. Also, social factors including relations with co-workers and other work partners (subcontractors, customers or users) are also crucial. In this respect, very high and high levels of working conditions were found in Cyprus, Greece, Italy and Portugal, Austria, Belgium, Bulgaria, the Czech Republic, Germany, Hungary, Lithuania, Luxembourg, Latvia and Romania, i.e. in more than half of the EU member states. It is somewhat surprising to note that in countries such as Finland and Sweden,

employees rated these conditions negatively. This is due to, among other things, relatively poor ratings compared to other EU countries for exposure to undesirable social behavior, and issues of help and support from co-workers and from the manager/head.

Working conditions should also help to satisfy the need to develop professional activity. Employees need a feeling of recognition, a sense of meaningfulness in their work, improvement of skills and a sense of accomplishment and purpose. From the point of view of the working life perspectives criterion, a very high level of working conditions was found in Denmark, Finland, Sweden, Ireland, the Netherlands (EU-14), Malta, and Estonia (EU-13), which is due to the social policies of these countries.

In a general sense, favorable working conditions influence the perception of a country as a suitable place to work and live. From an enterprise perspective, the provision of the best possible working conditions improves productivity and is a strong determinant of its success. Inadequate working conditions, on the other hand, pose risks, cause economic losses and lead to negative social impacts. And adverse physical factors that have a harmful effect on the human body can promote the emergence of occupational diseases and deterioration of workers' health. Therefore, good and comfortable working conditions, both in the physical and psychosocial sense, increase the productivity of enterprises and increase their value contributing to the economic growth of a country.

The results indicate that working conditions need to be improved as soon as possible in four EU countries: Greece, Spain, Croatia, and Romania. Improvements are also needed in the Czech Republic, Latvia, France, Slovenia, Lithuania, Cyprus, Hungary, and Poland. The improvement of working conditions in these countries concerns practically each of the evaluation criteria.

The improvement of these criteria, and thus of working conditions in general, should be based on a well-prepared strategy at both national and company levels. A very important element of such a process should be responsible preparation and convincing employees to such changes. Cooperation with employees and their engagement in the process of improving working conditions can be a critical factor for success in this area. The conducted research also indicates groups of similar countries and leaders in terms of working conditions. It is fully justified to take advantage of experiences and good practices of the leading countries in this area and use them by countries with less success in this field.

It is clear that sustainable economic development of individual countries and the entire EU-27 must be linked to improvements in working conditions and, as far as possible, their equalization across the EU. The differences in this area shown in this paper result not only in external migration, but also internal migration, which adversely affects the sustainable development of the entire EU-27. Solidarity between countries and mutual assistance should result in improved working conditions throughout the EU and in building a highly attractive labor market.

The results should therefore provide valuable insights to support employment policy making and related improvements in working conditions in the EU-27.

6. Conclusions

The paper presents the results of the assessment of the level of working conditions in the EU-27. The TOPSIS method, which belongs to the MCDM group of methods, and the k-means method were used for the assessment. The evaluation of the level of

working conditions was carried out by means of a set of 8 criteria, which took into account a total of as many as 64 indicators (diagnostic variables) characterizing these criteria.

The evaluation of the level of working conditions was also supplemented by studies aimed at indicating whether they are related to the basic economic parameters of the economy and indicators of the area of health and safety at work in the countries studied.

The results of the research on the assessment of working conditions showed the following:

− Very good working conditions were found in Denmark, Germany, the Netherlands, Luxembourg, and Austria.
− Good working conditions were found in Belgium, Estonia, Bulgaria, Finland, Ireland, Malta, Portugal, Sweden, and Italy.
− Acceptable working conditions were found in the Czech Republic, Latvia, France, Slovenia, Lithuania, Cyprus, Hungary, and Poland.
− Negative working conditions were found in Greece, Croatia, Spain, Romania, and Slovakia.

Thus, on the basis of these results, it can be concluded that definitely better working conditions are found in developed countries, which are part of the so-called "old EU-14" than in developing countries (the group of countries of the so-called "new EU-13").

On the other hand, the second part of the study conducted using non-parametric tests, such as Spearman's rho and Kendall's Tau Correlation Coefficient showed that working conditions are associated with a country's economic development characterized by the value of GDP per capita and gross domestic expenditure on R&D and are also related to the parameter of persons reporting a work-related health problem. The results clearly indicate that working conditions are also significantly better in countries that are more prosperous and have higher levels of economic development, as well as higher expenditures on R&D.

Therefore, the findings provide new knowledge in assessing the level of working conditions found in the EU-27 countries and the factors that influence these conditions. It should also be emphasized that the developed and applied research methodology can also be successfully used to study working conditions at the regional level and in individual groups of enterprises. The results of such research would undoubtedly complement those presented in the paper.

7. Future directions and limitations

The developed methodology, conducted research and its results make it possible, as in the case of most of this type of analysis, to formulate their limitations and future research directions.

In terms of limitations that may have affected the findings, an issue that should first be mentioned is related to the data obtained from the EUROFOUND (2022) database. All data collected in this database concern subjective evaluation of particular issues (Table 1), which is done by respondents. In this context, the concept of working conditions and their assessment by respondents may be relative.

Another limitation, which at the same time indicates the direction of further research, is related to the fact that this study presents a general evaluation of working conditions in the EU-27. It would be reasonable to conduct such an analysis taking into account different economic sectors, as well as age groups, gender and education, and

the form of employment of workers and size of enterprises. Such research would provide an opportunity for a very broad analysis of working conditions, which could result in more targeted recommendations for their improvement or harmonization. Systematic monitoring of working conditions would also provide an opportunity to observe changes and indicate areas for improvement.

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