ERGONOMICS AS A TOOL FOR REDUCING THE PHYSICAL LOAD AND COSTS OF THE COMPANY

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The article's subject is to indicate ergonomic tools, which create room for saving costs for the enterprise by targeting the management of the workforce through influencing the degree of risk of physical load. The ergonomic solutions take into account people as a priority. People spend a large part of their lives at work, and there is an increased emphasis on productivity, quality and efficiency. However, achieving good results over the long term requires healthy employees. Ergonomics aims to optimise the workspace and environment to minimise the risks of harm to health and make it easier for people to work. Employers should give priority to occupational health and safety. However, the company's financial burden should also be considered. These objectives can be met by applying ergonomic measures to reduce the risk of physical strain on employees. It is essential to recognise that, although work systems will become more automated and digitalised due to the introduction of Industry 4.0, human involvement will still be necessary. Industry 4.0 can be the answer to reducing the physical burden on employees. Several analytical methods were used to obtain the analytical basis, which served to identify employees in particular risk groups in terms of physical strain, to describe the state of the workforce in industrial enterprises, and to map the financial burden of industrial enterprises on employees classified in risk groups in terms of physical strain at work. Based on the example of the application of ergonomic tools to influence the degree of risk of the physical load of the enterprise's workforce, it will be possible to understand better the enterprise's management, where the scope for cost savings of industrial enterprises is created.

KEYWORDS

Employee, physical load, Industry 4.0, risk group, company costs

1 INTRODUCTION

The Fourth Industrial Revolution brought rapid technological growth and development in manufacturing industries. Technological developments enable efficient production processes and bring about changes in human work that can cause new threats to the well-being of employees and challenge their existing skills and knowledge. Human factors and ergonomics is a scientific discipline that aims to optimize overall system performance and human well-being in different work domains simultaneously [Dyadyura 2021, Reiman 2021]. In developed industries, effective incorporation of ergonomics into procedures and equipment has been shown to reduce expenses associated with sick leave, additional or overtime hours, health care, insurance premiums, or accident fines [Vinoth Kumar 2021]. In the era of Industry 4.0, striving for social sustainability also means synergistic collaboration between workers and robots. Robot behaviour affects workers' safety, health, and well-being. In this context, physical monitoring of the operator to reduce the risk of musculoskeletal disorders is an important topic to be reinforced [Bozek 2021, Ciccarelli 2022].

Heavy industry, construction and logistics are among the most physically demanding areas of activity. Human workers are also essential in these industries with the increase in automation, as some market segments specialise in low-volume products or have a wide variety of different products, which makes automation impossible. One solution is exoskeleton technology, which can improve the ergonomic condition of some workplaces [Rusu 2021]. Exoskeletons, as personal assistive technologies, act on the body mechanically. They are beneficial in mitigating the risk of supporting musculoskeletal system injuries due to physical work such as heavy lifting. Exoskeletons are advantageous when it is not possible to ergonomically design and arrange the workplace, particularly for temporary jobs [EU-OSHA 2023].

Physical load is primarily influenced by the extent to which individual muscle groups are activated. Muscle movement is divided into static and dynamic. At work, it is essential to minimise static loads on workers and to give preference to dynamic loads, which are less harmful in terms of affecting the health of the body. Static or dynamic loads affect individuals individually. Loads usually involve the volume of work and the weight of loads. The assessment of strain on the body is complex, and the methods used focus on the reactions and manifestations of the exposed organ systems and body parts. We can measure the strain on the body and confront it with the legislation, thus assessing the loads at work, which can effectively influence the physical strain on employees. The strain on the body depends on the individual's functional fitness, the load's intensity and the duration of the load itself [Markova 2021].

Risks that endanger the life and health of the employee or others at work increase the likelihood of an adverse outcome due to a combination of risk factors. Physiological and psychological reactions manifest the body's response to stress and can be quantified by measuring parameters of physiological functions [Mascenik 2020, Makovicka 2021].

Measuring the workload of upper and lower limb muscles, large or small muscle groups such as hand and forearm muscles can be used to assess physical strain at work. Based on the measurement and subsequent evaluation of the physical load, work categories for the material load factor are determined, and further procedures and measures are proposed to improve working conditions, decrease employee health problems, reduce workload, fatigue, occupational injuries and occupational diseases of the supporting musculoskeletal system (carpal tunnel syndrome, rotator cuff syndrome, epicondylitis, etc.) [probenefit 2022]. Physical strain assessment is a process by which measured values are compared with limit values set by law to classify work activities into work categories. Based on which measures are proposed to reduce the physical load, such as ergonomic, technical and organisational.

Overload or physical strain and irregularity are related to people's work, which is often complicated and could be done more sensibly. Successful implementation of lean manufacturing involves more than process improvement; any change in work practices impacts workers, and their performance should be assessed. The effects of implementation include not only workers' willingness to comply with new procedures but also concern for their occupational

health and safety and their well-being. In line with this statement, many authors say that ergonomics can help enterprises' business strategies maintain their competitiveness in the market. The worker is at the centre of attention in the application of the lean production model because, in the implementation of a poor production strategy, it is necessary to study more deeply the impact of this strategy on the work demands, the health of workers and the expenditure of their energy, to identify better practices of human performance that is necessary to achieve and maintain productivity, work safety and quality [Carbalho Alves 2019]. During the application of lean manufacturing, the incorporation of ergonomics can achieve a significant increase in productivity while improving working conditions. Poor ergonomics can reduce lead time by eliminating waste from unproductive manual material handling movements such as stretching, bending, and reaching awkward positions, increasing efficiency, safety, and health [Vinoth Kumar 2021].

Improving the quality of people's work has received much research attention. Although there have been concerns about automation, the importance of humans as an integral part of the future socio-technical workforce has been confirmed through several studies. In particular, the digital transformation in human factors and ergonomics will empower the next generation of socio-technical workers. The rise of digital transformation in human factors and ergonomics improvement is an indication of the targeted focus on improving the quality of work for humans through wearable sensors, collaborative robots, and exoskeletons for real-time assessment of human ergonomics as the complexity of work increases [Tirupachuri 2021, Krenicky 2022].

Each workplace needs to be assessed in terms of the extent to which harmful factors at work and in the working environment affect the health of employees while at the same time ensuring the prevention of harm to the health of employees at work. The health risk assessment results in a categorisation of work in terms of health risk. The employer must keep a register of employees according to the categories of work in terms of health risks. The conditions for categorising work into categories in terms of health risk for individual factors of work and working environment are the subject of Act No. 355/2007 Coll., specified in the Decree of the Ministry of Health of the Slovak Republic No. 448/2007 Coll. According to the assessment of health risks, work is divided into four categories [MiBo 2023, Ondrejkova 2023]:

- **Categories 1 and 2** are so-called non-hazardous work,
- **Categories 3 and 4** are classified as risky.

Hazardous work is a type of work that is classified as third or fourth in terms of the difficulty of the work. This work may cause damage to health even though precautions are taken to reduce the risk.

Work activities in category 3 include those **with a high level of health risk** [MiBo 2023, Ondrejkova 2023]:

- the use of personal protective equipment and other specific protective measures is required, but the employee's exposure to the working environment is not reduced to the level of the limit laid down,
- exposure (e.g. vibration, noise) is reduced to the level of the established limit, but at the same time the interaction between the work and the working environment can be damaging health or health changes in workers,
- there are no set limits, but the body responds adversely to factors and the working environment, creating a risk of damage to health.

Work classified as Category 4 includes activities **with a very high health risk level**. Work may only be classified in this category for a limited period, at most one year. These are jobs in which [MiBo 2023, Ondrejkova 2023]:

- the exposure cannot be reduced to the level of the established limits by any measures,
- the work could be classified as category 3 according to the level of exposure, but due to a combination of several factors, the impairment is increased or changes are detected in workers, and therefore these activities are classified as category four.

The employer shall also be obliged to draw up, in cooperation with the occupational health service, an annual report on the results of the health risk assessment and the measures taken to reduce or eliminate them in workplaces where employees perform work classified in the third or fourth category, including the number of employees performing hazardous work and an assessment of the health status of the employees about their work, and to submit it to the competent public health authority. Another of the employer's obligations is to ensure the assessment of employees' fitness for work based on medical preventive examinations carried out about the work about all the harmful factors inherent in the performance of the work and about the working conditions under which the work is carried out to prevent the occurrence of occupational diseases or work-related diseases [MiBo 2023, Ondrejkova 2023].

Employees performing hazardous work are entitled to the following rights under the current legislation [MiBo 2023, Ondrejkova 2023]:

- entitlement to a convalescent stay,
- entitlement to additional leave,
- entitlement to wage compensation for difficulty in performing work,
- entitlement to reduced weekly working time,
- impossibility of ordering overtime,
- overtime pay,
- eligibility for supplementary pension insurance.

Employee entitlements under the legislation also increase the employer's costs for employees who perform work classified in the third or fourth category.

2 METHODOLOGY

Basic thought processes such as analysis, synthesis, abstraction, concretization, deduction, analogy, comparison, etc., were used to prepare the paper. The interpretation of the data was handled through descriptive and quantitative statistical methods. In the preparation of the article, we rely on the results of analyses of EU-OSHA, the Office of Public Health of the Slovak Republic, the Statistical Office of the Government of the Slovak Republic, the National Centre of Health Information of the Ministry of Health of the Slovak Republic, and the results of measurements of the physical load of employees in an industrial enterprise. The EMG method was used to determine the exposed employees' physical load and the work risk level. The EMG method is one of the most accurate methods for measuring local muscle load by integrated electromyography using an EMG Holter device. This method is based on monitoring electrophysiological potentials from the loaded muscles during a work shift and videotaping the assessed work activities of the evaluated workers. EMG allows for measuring local muscle loading of small muscle groups of the upper and lower limbs with many movements. The measurement uses two electrodes to determine the percentage of muscle force exerted out of the maximum force of a given muscle group and the number of movements per minute and per work shift. The measurements are then used to determine the percentage of maximal muscle force exerted by the muscle group (% Fmax)

and the number of movements per minute and per work shift. The hand and forearm muscles of both upper limbs are monitored. The results of the measurements are then processed after the measurements, and the result is a protocol with the obtained data in analogue and graphical form. The protocol also includes a comparison of the measured values with the limit values given by the legislation (Decree of the Ministry of Health of the Slovak Republic No. 542/2007 Coll.), classification of the work into categories and recommendations for the implementation of measures to reduce the physical load. An essential source for evaluating the outputs was also the research results of domestic and foreign authors in the subject area.

3 RESULTS

In 2022, based on the results of the Labour Force Sample Survey processed by the Statistical Office of the Slovak Republic, there were 2 603 900 persons registered as working in the territory of the Slovak Republic. Compared to 2021, the number of newly recognised occupational diseases increased by 24.1%, which in absolute terms represents an increase of 102 cases. In 2022, the rate of freshly recognised occupational diseases was 20.2 cases per 100,000 workers. Compared to 2021 (16.5 cases per 100,000 workers), the rate of newly recognised occupational diseases increased by 22.0%. The highest incidence of occupational diseases in the year under review by classification of economic activities (Figure 1) was in health and social assistance; namely 48.4% of all reported occupational diseases.

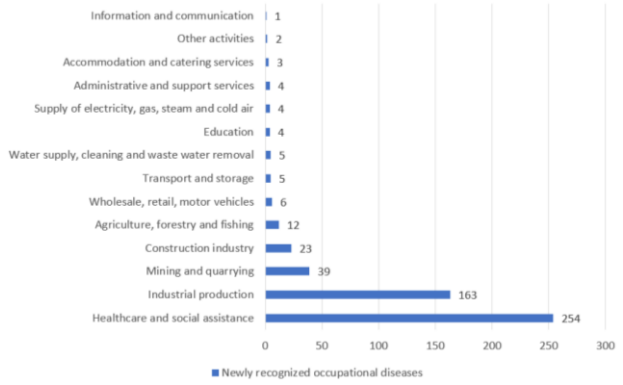

Figure 1. Economic activities with the highest number of newly recognised occupational diseases in 2022 [NCZI 2023]

Next was industrial production (163 newly recognised occupational diseases), the paper's subject, followed by mining, quarrying, and construction. A high level of physical strain at work characterises all of these sectors.

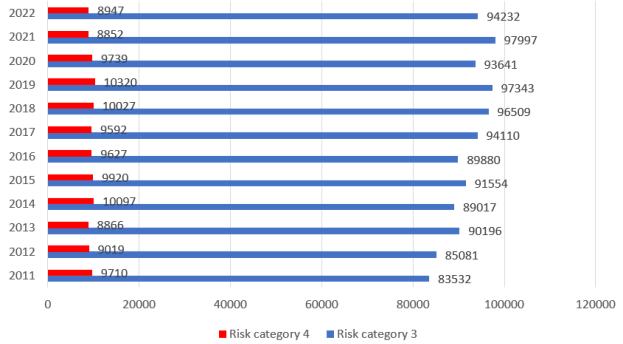

Figure 2. Number of employees performing hazardous work in the Slovak Republic in 2011-2022 (by work category) [UVZ SR 2023]

Employees performing hazardous work represent approximately 5% of all employees in the Slovak Republic. The most significant number of employees performing dangerous work worked in the industrial production sector (67 283 employees), in the health care and social assistance sector (14 079 employees) and the transport and storage sector (4 085 employees) [NCZI 2023]. In 2022, 103,179 employees performed hazardous work, a decrease of 3,670 employees compared to 2021. Of this number, 94,232 employees were classified in Category 3 and 8,947 in Category 4 (Figure 2). A closer examination of hazardous work by predominant economic activity continues to show the highest incidence of dangerous work in the industrial production sector (a slight decrease of 2 581 employees) and in the health and social work sector (a decrease of 121 employees).

In terms of statistics, industrial production ranks second in the incidence of newly diagnosed diseases, so we also focused on exploring the risk categorization of jobs that may be associated with an increased incidence of newly diagnosed diseases (see Fig. 3).

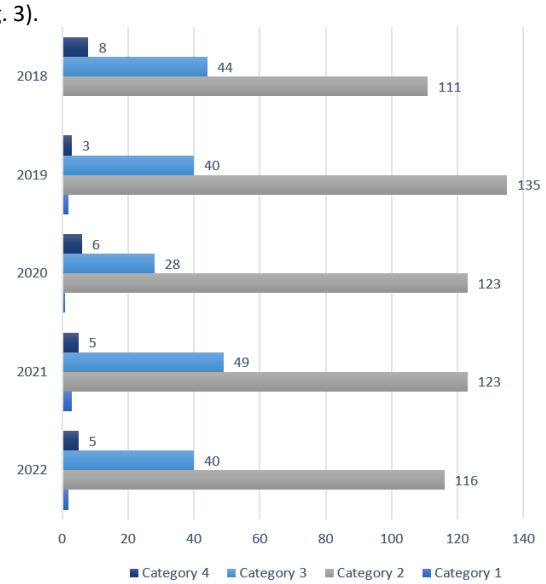

Figure 3. Number of newly diagnosed occupational diseases in industrial production by job category in 2018-2022 [NCZI 2023]

Europe's largest occupational health survey has identified pain reflected in the musculoskeletal system as the most common work-related health problem, namely back pain, affecting 46% of employees, and neck, shoulder and upper limb pain, affecting 43% of employees. An increase in musculoskeletal disorders among employees can be observed. Between 2007 and 2013, the percentage of workers reporting musculoskeletal disorders increased from 59% to 62%. Of course, work cannot be considered the only aspect of their occurrence, but prevention of musculoskeletal disorders can only be successful if work-related risks are reduced [Rusu 2021].

For work-related health problems, it is estimated that the number of days lost due to sickness is 1.6 to 2.2 times higher than the number of days of temporary disability caused by the injury. One tentative explanation is that these disorders develop gradually over time. Longer-term impairments and chronic diseases increase with age. Given demographic changes, especially in developed countries, the importance of topics such as occupational health and safety for labour market policy will increase significantly in the future [Rusu 2021].

An industrial company measured the local physical strain on employees to demonstrate the use of ergonomics tools to save a company's labour costs. The workplaces of the production line meet the prerequisites for classification to risk level 3 in terms of physical load according to the Decree of the Ministry of Health of the Slovak Republic 448/2007 Coll.

Measurements of local physical loads were carried out on an assembly line of air conditioning units for the automotive industry [Horny 2023]. The PSA line workplace is located in a

production and storage hall, the premises of which comply with the current legislation and are organizationally separated from other workplaces. It is divided into assembly line positions (designated as WS 10, WS 20, WS 40, WS 50, WS 60, WS 70, WS 80, WS 90, WS 100, WS 110 EOL test, WS 120) and sub-line positions (Air Intake Assembly, Heater Assembly, Balancer Assembly, Rear Distributor Cover Assembly, Fan Pressing + Fan Cover Assembly + Motor Sleeve Assembly). The PSA line consists of 11 workstations. Measurements were made based on each operator's work, according to the number of positions the operator performed. The line was designed so that one worker could achieve the entire HVAC air conditioner manufacturing process; however, due to the workers not mastering all positions, they perform either one or several positions. One of the reasons for the problem of workers not controlling all positions is that a high turnover rate plagues the company.

The measurement of local muscle strain was carried out by the occupational health service, as required by Slovak legislation. Instruments such as EMG Holter and EMG modules, a digital video camera and a laptop were used for the measurements. At the time of measurement, eight employees were working on the line: five employees were classified as production operators, and one was classified as a line supervisor working on the sublines performing manual assembly and operation of machines and inspection and packing of HVAC air conditioners. The measurement considered the laterality of the employees (right- or left-handed), with primarily women working on the line. The measurement was carried out during the morning and afternoon shifts. The average shift rate of the HVAC product on the PSA line is 450 units/shift. Both men and women work on the site in a three-shift operation with standard 8-hour work shifts with three breaks (two 10-minute and one 20-minute break). The networking time is 7 hours 20 minutes (440 minutes). This is a dynamic standing and walking job. In the position analysed, the production operators in each job do not have a work rotation; they perform the same activities throughout the work shift. Employees are entitled to a preventive medical examination of their job in terms of their job description every 12 months. Employees can use the employer's services in the form of purpose-built regeneration of the workforce on the company's premises. The loads handled by the operators during their work represent a complete HVAC product, weighing 6.6 kg (the weights of the parts that are assembled in each position range from a few grams (screws, small plates) to parts of higher weight (semi-finished products).

The measurement of the exerted muscular forces was carried out on two workers of the same profession. The changes in electromyographic potentials of flexors (flexors of the wrist, fingers and hand) and extensors (extensors of the fingers and hand) of the forearm muscles of both upper limbs were evaluated using EMG Holter. At the beginning of the measurements, the maximum muscle force (Fmax) of the muscle groups under study was recorded, which, when further processed, represented a reference value for the calculation of the percentage of muscle force exerted (% Fmax) during the work activity. In parallel with the measurement, a detailed time-lapse assessment of the temporal characteristics of the work and a video recording were processed. The videotape was used to count the workers' movements in each position accurately.

The measurements were evaluated using an EMG program and subtracted from the number of movements from the video recordings. The production on the measurement day determined the types of products produced and the nature of the activity. Before measurement, somatometry was performed on the PSA line and PSA subline workers, measuring the height, weight and hand grip strength (in N) of all participating workers' right upper limb and left upper limb. The measured values are shown in Table 1 and Table 2.

Table 1. Measuring somatometry on the PSA line [by Horny 2023]

S.n.	Gender	Laterality	Age [years]	Exposure [years]	Height [cm]	Weight [kg]	Strength of the handshake [N]	
							RUL	LUL
Emp1	Woman	Right-handed	41	1,5	155	70	270	310
Emp 2	Woman	Right-handed	40	1,5	160	53	269	318
Emp 3	Man	Right-handed	26	6	165	70	488	438
Emp 4	Man	Right-handed	21	2	190	66	537	437
Emp 5	Woman	Right-handed	38	3	152	47	290	269
Emp 6	Man	Right-handed	33	11	180	75	695	625
Emp 7	Woman	Right-handed	20	1	158	56	285	292
Emp 8	Woman	Right-handed	36	0,1	174	62	366	268
Average			**31,9**	**3,3**	**166,8**	**62,4**	**400**	**369,6**

Table 2. Measurement of somatometry on a PSA subline [by Horny 2023]

S.n.	Gender	Laterality	Age [years]	Exposure [years]	Height [cm]	Weight [kg]	Strength of the handshake [N]	
							RUL	LUL
Emp 1	Woman	Left-handed	18	1	160	50	290	333
Emp 2	Woman	Left-handed	36	3,5	158	60	298	271
Emp 3	Woman	Right-handed	42	8	165	73	266	296
Emp 4	Woman	Right-handed	41	2	155	70	308	329
Emp 5	Woman	Right-handed	49	4	174	86	315	296
Emp 6	Woman	Right-handed	49	6,5	185	80	435	282
Average			**39,2**	**4,2**	**166,2**	**69,8**	**318,7**	**301,2**

Based on the measurements, an assessment of the local muscular load was carried out in terms of the categorization of work for the classification of work in terms of health risks according to Decree No. 542/2007 Coll. The workstations WS 10, WS 50/WS 60, WS 80/WS 90, WS 100/WS 110 and the workstation Installation of air supply were included in the category of work with risk level 3 based on the assessment results. Category 4, regarding physical loads, is not represented in the positions assessed.

Table 3. Average values obtained from the measurement of the medical health service at each position [by Horny 2023]

Position	RUL - % Fmax		Number of movements per shift - RUL	LUL – v % Fmax		Number of movements per shift - LUL
	Extensors	Flexors		Extensors	Flexors	
WS 10	10.87	6.77	18 900	10.02	9.13	17 325
WS 50/WS 60	10.22	10.34	26 325	11,02	8.00	24 075
WS 80/WS 90	8.99	8.55	25 875	9.86	8.81	21 375
WS 100/WS 110	11.38	2.66	18 000	12.28	2.74	18 450
Installation of the air inlet	11,15	7.13	22 500	8.27	7.83	16 650

The workplaces, classified as category 3 in terms of physical load, were subjected to measurement of local muscle load in individual employees with limit values specified in the Decree of the Ministry of Health of the Slovak Republic No. 542/2007 Coll. The measured values for both workers were averaged and compared with the limit values. The results of the measurements are presented in Table 3.

According to the data from measurements and Decree of the Ministry of Health of the Slovak Republic, No. 542/2007 Coll., five workstations are unsatisfactory in terms of a more significant number of movements within the muscle forces exerted by the extensors and flexors of the forearm (Figs. 4 and 5). The higher number of movements may be due to high employee turnover and inadequate training of employees who have been in their position for a shorter period, as experienced employees have been found to comply with the limit values for forces exerted and the number of movements.

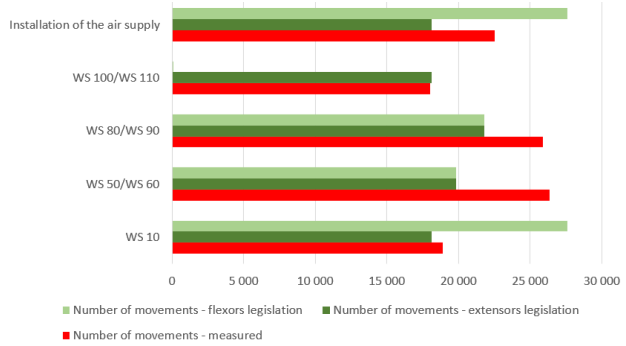

Figure 4. Right upper limb - Assessment of number of movements per shift [by Horny 2023]

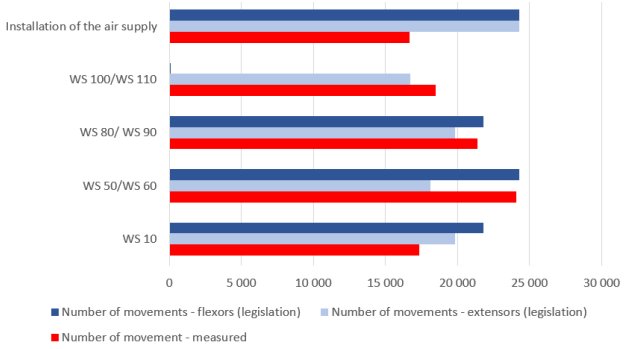

Figure 5. Left upper limb - Assessment of number of movements per shift [by Horny 2023]

By observing work activities, it was found that employees have to use a certain amount of force to pull the tool attached to the balancer. The solution can be implemented in terms of technical and organisational measures. Given that women predominantly work the line and the subline, this force is too high and should be reduced by repositioning the balancer, which is also a technical measure that is not costly. The forces required to manipulate the balancer should be measured and reduced. The purpose of organisational measures is to design adjustments to the working arrangements of employees and the organisation of work to prevent adverse effects of work and the working environment on employees' health. Due to the exceeding of the limit values of movements under the action of forces of flexors and extensors according to the Decree of the Ministry of Health of the Slovak Republic No. 542/2007 Coll., the appropriate solution is to introduce a rotation of work by 1/2 shift on the non-compliant positions of the PSA line and PSA subline, which should solve the shortcomings. Work rotation activates the muscle groups of the workers and also leads to changes in the workers' attention. The change in attention is necessary because when one job is performed continuously, there is monotony, which causes a decrease in efficiency and an increase in mistakes. Another positive aspect is that by an appropriate combination of rotation between workstations with similar workload, it is possible to influence the classification of workstations into physical load category three according to Decree No 542/2007 Coll. of the Ministry of Health of the Slovak Republic and to reclassify them into risk category 2, which is associated with lower costs for employees. Staff rotation is not costly, but it is time-consuming due to the training of staff in several positions. If rotation is not used as a tool to reduce local muscle strain in the positions in question, a suitable alternative to achieve the goal of reclassifying the workplace to risk category two would be to add one employee to each of these positions. While this proposal would increase the company's wage costs, it would also solve the problems created at the risky workstations. It could theoretically increase productivity if there is no downtime due to waiting for semi-finished products at the upcoming workstations.

4 DISCUSSION

The physical load solution aimed to propose measures to prevent work-related diseases in PSA line and subline employees. The solution of physical load should help to avoid excessive load of workers health problems and save the company the costs associated with the classification of the workplace in the 3rd category of physical load according to the Decree of the Ministry of Health of the Slovak Republic No. 542/2007 Coll. and the recommendations of the occupational health service, specifically for work in the 3rd category of physical load, namely for work in the 3rd category of physical load. The employees' entitlements cover the category of health risks under the current legislation (entitlement to supplementary pension insurance, overtime pay, wage compensation for hindered work performance, additional leave, recovery, and reduced weekly working hours). At the same time, the employer shall not be able to order overtime work without the employee's consent.

For a comprehensive assessment of the impact of work and work environment factors on humans, it is necessary to focus on identifying the impact of workload on the worker. The assessment of the physical load on workers should be carried out not only on the muscles under load but also comprehensively in terms of the working positions and the way of handling during the work activity and the influence of work environment factors [Luptakova 2021].

The survey found excessive loading of the flexors and extensors of the employees' hands combined with a disproportionate number of movements of the exposed limbs per work shift. These are the first indicators for the onset and development of occupational disease problems. Ergonomics aims to ensure employees' long-term, stable work performance without adverse effects on their health, which implies the need to pay increased attention to the physical load on employees.

Over the years, the ergonomics-focused approach has changed. We still talk about identifying - analysing - eliminating risks in the workplace. However, the differences are in the possibilities of modern ergonomics the movement of science and technical possibilities. The opportunities are using mobile applications, the Internet of Things, real-time data collection and evaluation and sharing. The research results are innovative and advanced ergonomic tools based on the Industry 4.0 concept. Electronic tools supported by software solutions and mobile applications represent a new direction in ergonomics to create healthy working conditions for employees [Gasova 2017].

The last decade has witnessed significant research and development efforts in improving robotic systems to be deployed alongside human collaboration, particularly emphasizing human safety and security in the solution [Tirupachuri 2021]. The researchers' work is to develop a methodology to monitor the physiological state of workers with active and passive exoskeletons in real time, then interpret and utilize the collected data needed to create a hybrid

human/exoskeleton digital model [Rusu 2021].
Digitalization of employee physical load solutions using exoskeletons will speed up the diagnosis of health risks, influence the degree of physical load on employees, enable more efficient workforce management, and create room for cost savings for industrial enterprises.

5 CONCLUSION

As Industry 4.0 becomes more mainstream, workplaces will be affected by the pressure of rapid technological change. The global trend of an ageing population and a shrinking workforce cannot be ignored. Given the challenges and constraints that come with this, it is necessary to ensure that we do not wear out and devalue the workforce, hence the need for ergonomics in the workplace to take on greater importance. Ergonomists could help manage workplace risks more effectively by promoting awareness of the need for change, improved guidance from OSH regulators, research into issues related to the management of musculoskeletal disorders in the workplace, and professional development programmes for ergonomists and other OSH professionals [MacDonald 2022].
By targeted application of ergonomic tools, it is possible to correct the degree of risk of physical strain on the workforce, to reduce the costs of industrial enterprises on the workforce and ultimately to create a financial reserve for the implementation of progressive technologies, tools and Industry 4.0 solutions in industrial practice.

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