UTILIZING ERGONOMIC METHODS AT PRODUCTION FACILITIES

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Abstract

Nowadays, manufacturing companies are trying to automate production as much as possible according to the Industry 4.0 trend, leading not only to job reduction, but usually also to a greater division of labor and routine for the remaining employees. However, repeated movements in handling materials or products as results of the job division lead to sooner physical and mental exhaustion, and sometimes even to occupational diseases. Businesses must then seek out new workers and, in addition, bear large, extra costs for the affected workers compensations. The authors therefore focused on the ergonomic analysis of a selected workplace in the manufacturing company XY with the aim of assessing the health risks of the related work performance and designing and evaluating possible solutions to difficult working conditions there. The methods “Rapid Upper Limb Assessment” and “Rapid Entire Body Assessment” were applied to measure work load.

Keywords: HRM, ergonomics, division of labor, automation

1. INTRODUCTION

Strong competition, high work demands and ever-growing requirements for the precision of products and technologies force companies to replace manual labor with automated work. This trend is one of the basic pillars of Industry 4.0. Nevertheless, as far as at least one person needs to be at a given a worksite, the company is and will be responsible for his/her work conditions and their impact on the worker’s health. This trend is also getting more and more important and that is why the term ergonomics forms an inseparable part of modern dictionaries of human resource management.

Mass production workers at production lines usually conduct routine, repeated work while handling, inspecting or collecting material or goods from the lines. These laborers must do the same job again and again. Therefore, after some time, the workers become bored, the work becomes monotonous. The workers lose their concentration and that is how work injuries often occur. Apart from that, continuously repeated moves keep straining the same group of muscles and bones, resulting in illnesses, repeated work interruptions needed for treatment and even the necessity to quit such demanding work, in some cases due to job-related illnesses [1].

As a result of the aforementioned situation, companies have to face more frequent absences of their employees at work as a result of their sick leaves and work injuries. They need to seek and train new workers. The most expensive element of this situation is then the obligation of such companies to pay compensation to employees who have been diagnosed with job-related illnesses caused by the work conditions at the given company, due to which the workers cannot conduct their original work. The company is then forced to pay the gap between the original salary and the new one. Employees are ever more protected by the law, which unfortunately leads to a situation, under which awarding the status of a job-related illness is abused more often than is required by their actual health since some of the workers attempt to gain financial advantages and to avoid demanding work.

That is the reason why companies strive to find ways to prevent such financially expensive situations. The scientific field of ergonomics is the main field that assists in limiting negative impacts of demanding work conditions on people and their health. The objective of ergonomics is not only to limit the impacts of work conditions on people, but also to increase work productivity.

The authors of this article have examined ergonomic conditions at a selected worksite of a production facility of company XY, which produces parts for the automotive industry, which the company develops and sells to a majority of the well-known automobile manufacturers. Because of the sensitive data and know-how of the company, the article cannot state the official name of the company and is referred to as company XY.

2. ERGONOMICS

Ergonomics is a term originally adopted from Greek: ergon - work, nomos - laws. [2]. Ergonomics is a multidisciplinary field that comprehensively looks into human activities within the frame of the work system, and into the relations between men and machines in work processes [3]. Ergonomics explores the protection of human health at work in the form of effects of forces and positions on the human movement apparatus, striving to eliminate threats to human health and safety. Ergonomics is the result of a collaboration of many disciplines, for example, physiology, psychology, sociology, biomechanics, industrial design and anthropometrics. When monitoring the given human factors, a scientific method for assessing and detecting human behaviour is used, with the goal to apply the gathered data on four primary objectives. It basically studies the process of proposing individual instruments and processes, striving to arrive to designs that accommodate the human body and its cognitive abilities as much as possible.

Also, globalization emphasis the significant role of ergonomics in work conditions from company levels. The formerly practically 'nationalized' collective bargaining (as well as other regulatory practices) that pushed to accomplish also better working conditions, has been transformed to strongly localized forms of negotiating wages and working conditions [4].

The practical utilization of the current knowledge in the field of ergonomics in particular situations and its implementation in today's world can be seen especially in the following areas [5]:

- Methodology of the analyses of work conditions using systematic sets of questions for orientation purposes and of the most important aspects of individual work environments.
- Specification of the main modification principles from the perspective of the requirements for the information and motoric activities of people in the work processes.
- Specification of the main sources for modifying physical factors of work environments,
- Specification of the main sources for the design of machines and tools and their functional expediency.
- Specification of the main principles for modifying work procedures and overall work modes from the perspective of performance abilities of people.

Ergonomics can also have an economic benefit. Most experts unconditionally recognize that ergonomics can be utilized not only for social objectives but also for economic goals [1], even though its economic benefits are still subject to discussion and evaluation.

Work ergonomics has a rich tradition in the Czech Republic and, in comparison with the rest of the world, many of its aspects are on a very high level. A very significant fact is that many ergonomic parameters are defined by the Czech legislature, including the limits that define optimal work conditions. Furthermore, Czech manufacturing companies have been involved in improving the ERGO designs of their workplaces during the last five years much more than in the past. Many companies have gradually comprehended the benefits of suitable work conditions not only for the purpose of protecting the health of their employees, but also for improving the quality and efficiency of their work and production processes [6].

There are currently many methods that can be used for evaluating work conditions and their impact on humans. Worksite analyses in the Czech Republic usually utilize tensometrics, questionnaire or visual methods, integrated electromyographic or biomechanical evaluation methods.

3. RESEARCH METHODOLOGY

The examined workplace was a production line at XY, formed by two production devices. Both devices are automated to a high degree. Despite that, to ensure the full and fluent operation of the entire production facility, they require a total of 14 operators. The problematic location in our study was the point where two semi-finished products are assembled into a single product, i.e. the location where the two production devices meet. It is here where the demands on the operators are the greatest due the need of a fast and accurate product completion procedure. At the same time, this station is narrow, and the production cycle of the entire production line depends on it. The problem at the workplace is related to the operation that involves connecting a connector to a counterpart from line “A”. This workplace and the work activities conducted there were subjected to ergonomic analyses because of the frequent fluctuation of the employees and occurrence of work-related illnesses, particularly carpal tunnel syndrome.

The RULA and REBA methods were used for the analysis. These methods represent a tool for postural analyses. The RULA method is used for a complex and immediate evaluation of risks related to human muscles, particularly muscles of the upper limbs. However, the method also focuses on evaluating positions and their risks when it comes to neck, torso and legs. It is used for assessing possible illnesses that can be related to the given work and workspace. The REBA method (“Rapid Entire Body Assessment”) is a complex method that is used for assessing the human musculoskeletal system. The method is based on the RULA methodology and, additionally, utilizes evaluations of ergonomic risks that can occur while working with display units. One group of factors assesses the neck, torso and legs. The final score also incorporates the process of handling loads (this is included in the strength and load score). The second category includes assessments of forearms, arms, wrists and upper limbs as well as given gripping techniques.

The first step included an analysis of the placement of upper limbs pursuant to the given check list using the RULA method. Next, the authors of the study focused on assessing the position of the wrists and the process of their turning.

4. RESEARCH RESULTS

Workplace analysis using the RULA method

Based on the analysis of the placement of the upper limbs pursuant to the given checklist using the RULA method, score A was 5 points. Using the obtained score A, score C was calculated next. After including the muscle load for the right hand, which was over 6 kg, the resulting score was 6. Neck, torso position and position of the legs pursuant to the check list were evaluated next. This operation resulted in 2 points. All the obtained corresponding results were entered in Table B. The final score was 2 points. Upon obtaining score B, score D was calculated. The muscle score for the legs, which was +1 in our case due to carrying the given load more than 4 times every minute, is added to score B. The resulting score D was thus 3 points. Next, the total score of the RULA ergonomic method was finally calculated. This score is the sum of score C and score D decreased by the score from table C. The final score is 5, which suggests that some standing positions are not acceptable from the ergonomic point of view. The analysis determined which of the positions need to be modified.

Workplace analysis using the REBA method

The analysis focused on the positions identified as uncomfortable and also complex positions that require the use of force. Using the given check list, positions of the torso, neck, legs and upper limbs were assessed, focusing on the impact of the given forces on the wrists and fingers.

The overall neck score was 2. The assessment of the legs clearly determined that no one-sided loads or unstable positions occur. That is why this operation was assigned one point. The load and force assessment of the legs did not find any fast initial force or loads applied to the legs, which could have an impact on the human body when conducting the given work. As a result, no additional points were added from this

assessment. The score for group A was 3. Yet another part subjected to the evaluation were arms and wrists. The total REBA score was 6.

Comparison of the results obtained using the REBA and RULA methods

The workplace ergonomic analysis using the RULA and REBA methods demonstrated that the workplace is designed almost correctly ad no unnatural body positions occur when working there. To the contrary, the workplace allows for changing the body load. An exception to this is the area of wrists and fingers, in which case the position of the knuckles is unsuitable. The strength needed for connecting two semi-finished products using fingers exceeds the given average. The work operation is thus demanding and involves a great risk of developing a work-related illness, particularly carpal tunnel syndrome.

Both methods arrived at the conclusion that it is necessary to adopt corrective measures in the area of the wrists. This has been confirmed by the repeated occurrence of carpal tunnel syndrome illnesses (already five cases at the given position by the time the research was completed).

Proposed solutions

The company is interested in reducing the loads to which the wrists of its employees at the given job are exposed. Three possible solutions were thus offered to the company. One of the possible scenarios for solving the problem of the given workplace seems to be an acquisition of a robotic glove, which the given employee would put on his/her hand, which would not limit him/her in his/her movement and which would make the given work task, i.e. clicking the connector to the counterpart, easier. However, the robotic gloves, currently available on the market, are not suitable for the task in question and their modification would, from the financial point of view, significantly exceed the cost of the current production manner, including the expenses related to the corresponding job-related illnesses.

Another option for solving the problem at the affected location is the acquisition and implementation of the Yumi® robot made by ABB. The company can choose from two options for using the Yumi® robot. The first option is the cooperation of the robot with a worker. The other option is to replace the given worker with the Yumi® robot. The Yumi robots cost approximately CZK 1 million, which is also an expensive, however not unrealistic, solution.

The last proposal came from the workers themselves. It would require a technology adjustment. It would require the internal production of a pressing device for replacing the work task in question. The advantage of such a pressing device is clearly its acquisition price, which is around CZK 5000.

5. CONCLUSION

The application of the REBA and RULA ergonomic methods at the workplace in question demonstrated that working at the given position under the current conditions for a long time results in an excessive load on the employees' wrists, which can subsequently lead to job-related illnesses. The management thus scientifically and objectively verified the complaints of the employees and conclusions of the related medical reports, which determined the given work to be the cause of the carpal tunnel syndrome. The authors demonstrated that examining and improving the conditions at the workplace pursuant to the given ergonomic principles and methods can not only prevent the fluctuation and illnesses of the workers, but it can make their work easier, thus making it more productive.

Despite the fact than many Czech companies are already monitoring their work conditions with the objective of protecting the health of their employees, this trend is not prevailing. The main obstacle of a better application of ergonomic innovations in real practices in Czech companies is often an outdated approach by the top management, not understanding the benefits of the ergonomic principles and a lack of time capacities and ergonomics experts inside the companies.

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REFERENCES

[1] SAQIB, Shaikh. *Division of Labour: Meaning Forms and Advantages Economics* [online]. [viewed 2019-10-30]. Available from: http://www.economicsdiscussion.net/labour/division-of-labour/division-of-labour-meaning-forms-and-advantages-economics/13757.

[2] MALÝ, Stanislav, Miroslav KRÁL a Eva HANÁKOVÁ. ABC ergonomie. Praha: Professional Publishing, 2010.

[3] MAREK, Jakub a Petr SKŘEHOT. Základy aplikované ergonomie. Praha: VÚBP, 2009. Bezpečný podnik.

[4] SUCHÁČEK, Jan. *(2011): Globalization and Glocalization*. In The Scale of Globalization. Think Globally, Act Locally, Change Individually in the 21st Century, Ostrava: University of Ostrava, pp. 319-324.

[5] GLIVICKÝ, Vladimír. Ergonomie na pracovištích. Praha: MPSV ČR, 2004.

[6] ŠOLTYS, Lukáš. *Firmy postupně chápou význam ergonomických inovací* [online]. [viewed 2019-11-04]. Available from: https://www.happyend.cz/blog/mudr-lukas-soltys-firmy-postupne-chapou-vyznam-ergonomickych-inovaci.