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Human-Centric Design: Improving Workplaces for People in Production and Logistics Systems

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Abstract: This study aims to determine the position of workers in the design of production and logistics systems. This article deals mainly with the role of humans in production systems. The introduction of this article is dedicated to the development of ergonomics in production and logistics systems. Furthermore, this article deals with the literary research of the subject matter to find out the analysis of the current state of the issue of the solution in the world. The very core of the study is the position of a person from an ergonomic point of view in production and assembly systems and, in particular, methods of relaxation of employees in production sectors.

Keywords: industrial engineering, ergonomics, design, production systems, logistics systems.

INTRODUCTION

Improving workplaces through ergonomics is not only related to investing money to improve the working conditions of workers, but it is the key through which productivity, efficiency, and overall success of each company is achieved. Workers are generally willing to perform when they are ready, satisfied, trained, and effectively using their physical or mental abilities. However, sometimes their performance can be negatively affected, and this is mainly because they are tired, injured, bored, unmotivated, or dissatisfied [1, 2].

For future workplaces to become more efficient, it is necessary to use new, timeless, and progressive options when designing new workplaces, which will often include the different needs and abilities of workers. It is, therefore, necessary to understand that the skills of workers change dynamically and that flexibility in business systems to support the individual needs of workers becomes a suitable time and financial investment for companies. It is precisely for these reasons that topics such as the position of humans in production systems, ergonomic design of workplaces, methods of relaxation within the work process, and the interaction of work activity and relaxation within work activity should increasingly come to the fore in the company, to achieve improvements in working conditions. conditions [3, 4].

1 DEVELOPMENT OF ERGONOMICS IN PRODUCTION AND LOGISTICS SYSTEMS

Ergonomics in design production and logistics systems gradually developed due to the need to improve the working environment and the processes themselves so that they are acceptable, safe, and efficient for people. The origins of ergonomics date back to the first half of the 20th century, but the actual orientation towards production and logistics only began after *World War II*, when care was taken to improve work procedures, tools, and working environments to ensure higher productivity of employees and increase their comfort and well-being

at work. In the 1950s and 1960s, ergonomics began to become more specialized in specific areas, one of the areas being, for example, manufacturing and logistics. During this period, the seating of employees, the height of worktables, and the design of individual tools were examined. In the 1970s and 1980s, awareness of occupational accidents and safety at work began to increase, so scientists began to investigate the risks of repetitive movements and incorrect body positions in production and assembly systems when working with individual machines and tools. [5, 6] From the 80s of the 20th century until the present day, ergonomics gradually began to become part of individual improvement tools. The demand for ergonomics in logistics has been more intense with increasing attention to the effective management of supply chains and warehouse operations. After the expansion of automation and robotics in production and assembly systems, ergonomics gradually began to be devoted to and is devoted to cooperation between humans and robots on production and assembly lines [7, 8].

In general, the position of workers in production and logistics systems was first focused on the physical aspects of work, and later social and psychological factors also began to develop. The connection between the area of production and logistics and the position of individual workers in individual systems is essential, as more and more attention is paid to the needs and abilities of people to achieve the highest possible safety, satisfaction, and efficiency of employees in production and logistics systems.

2 LITERATURE REVIEW OF THE ISSUE

In the study by *Joshi & Deshpande* (2023) [8], the authors delineate the human factors and their significant role in improving health within production systems or factories. They describe that in the past 20 years, experts have increasingly emphasized the transformation of workplaces and factories to eliminate diseases arising from occupational activities. As part of this study, a project was undertaken in an automobile repair workshop to assess ergonomic risks associated with manual grinding. It was found that all 18 examined workers at this workstation suffered from various work-related illnesses. Subsequently, half of the workers underwent further examination using *CATIA-V*5 software, including ergonomic assessment, redesign of the existing workstation, and ergonomic evaluation of the new workstation. Methods such as *RULA*, anthropometry, etc., were employed for both existing and proposed workstations. The study concluded that improving workstations through ergonomic analysis contributes to reducing discrepancies between humans and machines, making the production system and processes more comfortable for human work, thereby not only reducing cumulative traumatic difficulties but also enhancing employee comfort.

In the article by *Pereira et al.* (2023) [9], the authors describe the massive transformation of the global industrial environment due to the emergence of Industry 4.0 and its revolutionary technologies. Specifically, this case study focuses on augmented reality in assessing ergonomic risks in logistic processes. The authors present the results of a project aimed at improving working conditions for operators involved in material handling and movement processes. To achieve this goal, a methodology called *Risk Assessment for Ergonomics and Safety in Logistics* (*RAES-Log*) was developed to analyze and define the requirements for implementing augmented reality to mitigate existing risks and improve ergonomic conditions in logistic processes. The authors aimed to employ a human-centric approach consistent with Lean thinking and *Industry* 5.0, aiming to reduce human effort in task fulfillment and enhance the thinking, abilities, and senses of workers. Finally, the opinions of workers and the acceptance of proposed augmented reality solutions derived from the *RAES-Log* methodology were collected and analyzed. The overall evaluation and feedback from the case study were positive, anticipating a lower incidence of musculoskeletal work-related disorders, decreased severity of injuries, increased process efficiency, operator motivation, comfort, relaxation, and engagement in continuous process improvement.

The study by *Trstenjak et al.* (2023) [10] addresses the position of workers in manufacturing considering the ongoing changes in production systems in the context of *Industry* 4.0 and particularly *Industry* 5.0. The study describes *Industry* 5.0 as a concept of industrial development focused on humans to achieve a sustainable and resilient system. The European Union aims for *Industry* 5.0 to become a global leader in innovation and industry, surpassing the barriers of the established *Industry* 4.0. Furthermore, the study aimed to conduct research in 112 *Croatian* manufacturing companies concerning awareness levels of *Industry* 5.0, as well as the utilization of green and digital elements in logistic activities. The results indicated low awareness of digital concepts of *Industry* 4.0 and *Industry* 5.0, but companies were more open to implementing green and digital elements, acknowledging the potential for future development.

The outcome of the literature review on this issue emphasizes the necessity of considering the worker's position in manufacturing and logistics systems, as well as ensuring the well-being and humanization of work in these systems. Additionally, the literature review highlights that the integration of these two themes remains relevant and currently underexplored,

being the subject of ongoing research in Slovakia and worldwide.

2 POSITION OF WORKERS IN PRODUCTION AND LOGISTICS SYSTEMS

The position of workers in production and logistics systems in terms of ergonomics takes into account a variety of factors that affect the working environment and working conditions. Ergonomics in production and logistics systems aims to minimize the risks of occupational accidents, improve work efficiency and worker comfort, and contribute to the overall health and well-being of employees. For example, the position of workers in production and logistics systems is affected by:

- *Workplace design:* The ergonomic design of individual workplaces is important for the comfort and efficient operation of employees. The design of the workplace can include the appropriate selection and placement of work aids so that the burden on the employee's body is minimized and his position is improved by the work performed.

In Fig. 1, it is possible to see the appropriate and inappropriate placement of components in the workplace. From Fig. 1, it follows that the location of the workplace should not be above the height of the employee's heart, for that reason, because there may be a reduction in blood circulation, which results in a reduced performance of the employee.

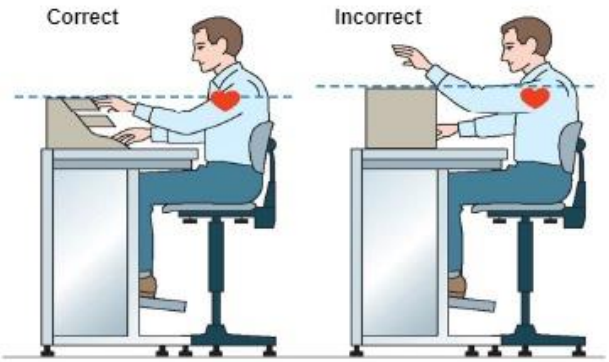

Fig. 1. Appropriate and inappropriate placement of components in the workplace depending on the level of the heart [10]

Production aids, trays, controls, tools, and implements should be stored in such a way as to allow the worker efficient work movements. There should not be any obstacles in the workplace that could make it difficult to carry out work movements or unnecessarily lengthen the path of movement. The layout of the workplace should allow a smooth and comfortable visual inspection of all resources and monitoring of the production process [11, 12].

- *Material handling:* Workplaces in production and logistics systems should be organized efficiently, due to material handling, to ensure the minimization of employee's physical effort. In logistics operations, it is important that the pallets are placed correctly, the design of storage areas, and the correct selection of handling equipment are ensured.

In Fig. 2 it is possible to see an example of the situation of using a roller conveyor. For example, in packaging plants in belt production, in which various products are removed and placed in boxes and on pallets, the height of the belt should be adapted to the body dimensions of workers working both sitting and standing, while of course the size of the product and the way it should be taken into account his grasp. It is advantageous to use support rack belts, where the height and use of sliding platforms can be changed. However, such solutions are rarely seen in Slovak companies due to the high cost. From the point of view of the worker's position in production systems, this is an important element that must be introduced in certain types of production to protect the health of employees [13, 14].

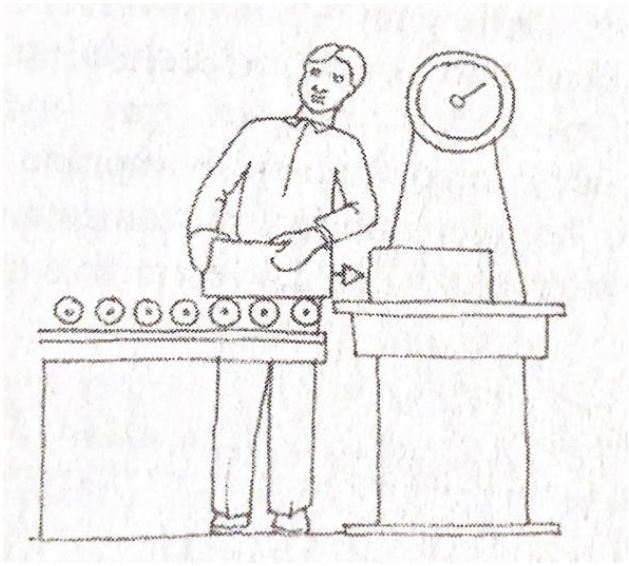

Fig. 2. The use of a roller conveyor in the production system [10]

- *Selection and control of technologies:* Ergonomically designed control panels, technological systems, and interfaces are essential for the efficient work of workers. Related to this is employee training on the correct use of technological tools and the necessary safety so that specific tools can be appropriately adapted to their needs.

From Fig. 3, you can see an example of setting the trays of the handling cart. Appropriately set work tools help to reduce stress and eliminate downtime, and also ensure an increase in productivity and performance. It is required that tools and components are placed at the correct height and distance, as well

as that a suitable chair and footrest position are selected for the worktable. A handling cart with material bins should also be placed within reach and at an angle to ensure improved access to parts [15-17].

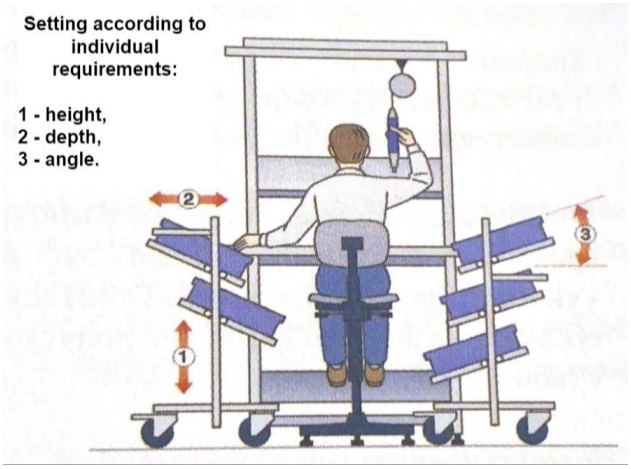

Fig. 3. Storage trolleys and their settings [10]

- *Psychosocial factors:* Within the framework of production systems at the workplace, it is also important to pay attention to psychosocial factors, which mainly include mutual relationships in the team, workload, stress, structure of rest during the working day, and others. These are factors that primarily affect the overall well-being and performance of employees.

In general, it can be said that production and logistics systems should ensure that workers can perform their tasks with minimum effort and risk and with maximum comfort and safety. A work environment adapted to people helps not only to improve the health of employees and the elimination of dangerous situations in the workplace but also to the more efficient functioning of the production and logistics operations themselves.

CONCLUSIONS

The main goal of the article was to describe the design of workplaces with the use of timeless and progressive possibilities, which will often consist of different abilities and needs of workers. It is clear from the article that, based on the literary research of the subject matter, the topic is current and unexplored and is constantly the subject of current research in the world and in Slovakia. It is therefore necessary to note that the very position of workers in production and logistics systems is important, which is influenced by various factors that contribute to the overall health and well-being of employees.

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