ERGONOMIC ANALYSIS ON THE ASSEMBLY LINE BY THE RULA METHOD

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Abstract

The main topic of the article is an ergonomic analysis by the RULA method on the assembly line in the company Schaeffler Skalica s.r.o. It is very important to know the very process of assembly in the workplace, which leads to knowledge of the shortcomings that appear in the performance of work. The analytical part also includes the maximum weight limits allowed for working with loads. Using the ergonomic RULA method, we analyze the working positions that were evaluated as the most critical and find out the results.

Keywords: RULA, ergonomics, analysis

1. INTRODUCTION

We chose the RULA method because of its focus on the load and not the very suitable working positions of the upper limbs. The RULA method was performed in our case on working positions, which we evaluated as the most critical. In the presented article, we will focus on only one action of the employee, as the overall study of the workplace is more extensive in content. We also came to this conclusion about performing positions that are not very suitable from an ergonomic point of view on the basis of the methods that are part of the analysis. First of all, we carefully observed the work that operators do, i.e. we monitored their movements, also with what loads they work with, and we also noticed the comfort of the workplace. **Table 1** contains the methods that were used to thoroughly evaluate the current state of the assembly line and the work performed by the employees [1,3].

Table 1 Selected methods

Method	Resources	Method of analysis used
Workplace observation	Participation in the workplace	Gaining knowledge and information about the workplace
Documentation	Video document	Use of obtained resources for further processing for individual analyzes

2. UNLOADING FLANGE UNITS FROM A PALLET

At the beginning of the assembly process, the flange is unloaded from the pallet at station number one. At the beginning of the work, the pallet is full of flanges, which are placed in a cardboard box 80 cm high. The box contains a total of 138 pieces of flanges. In the Catia program, we simulated the working positions of the operator and then performed an analysis using the RULA method. In this case, we evaluated several movements, as the worker is no longer in an ergonomically very comfortable working position at the beginning of her activity, and the gradual removal of components from the box must reach lower and lower. However,

she does not perform very suitable positions during this time, so we have simulated several possibilities of job positions in which this operator finds herself during the performance of work [9].

2.1. First position when unloading from the pallet

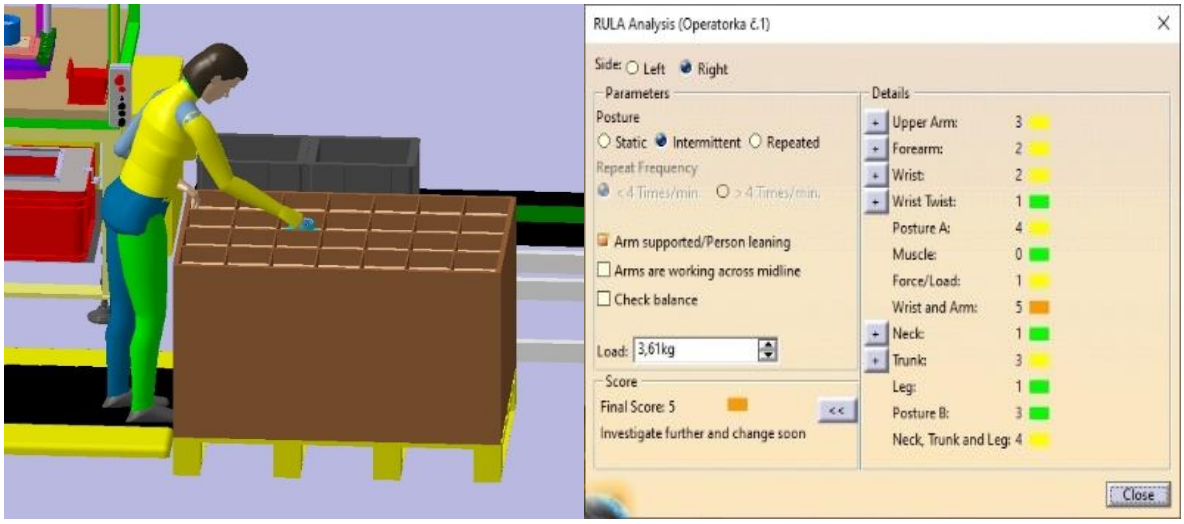

Figure 1 RULA analysis - position no. 1

In **Figure 1**, after applying the analysis in the first position of the worker, where we entered the individual settings, the table shows the resulting values (**Figure 1**). The criterion specified in the program was that the employee was in a tilted position. The individually colored parts of the body give us a visual idea of the load on these areas, which greatly facilitates the assessment of working position. Based on these results, we also see a slight load on the torso. According to the resulting score in the table, we can see that the most stressed part are the arms and wrists.

2.2. Second position when unloading from the pallet

Figure 2 shows the worker at the shop window from the pallet in the second position, where, as we can see, there was a reduction in the number of components due to the assembly process. So a person in this position has to do more physical activity than before when the pallet was still full of flanges.

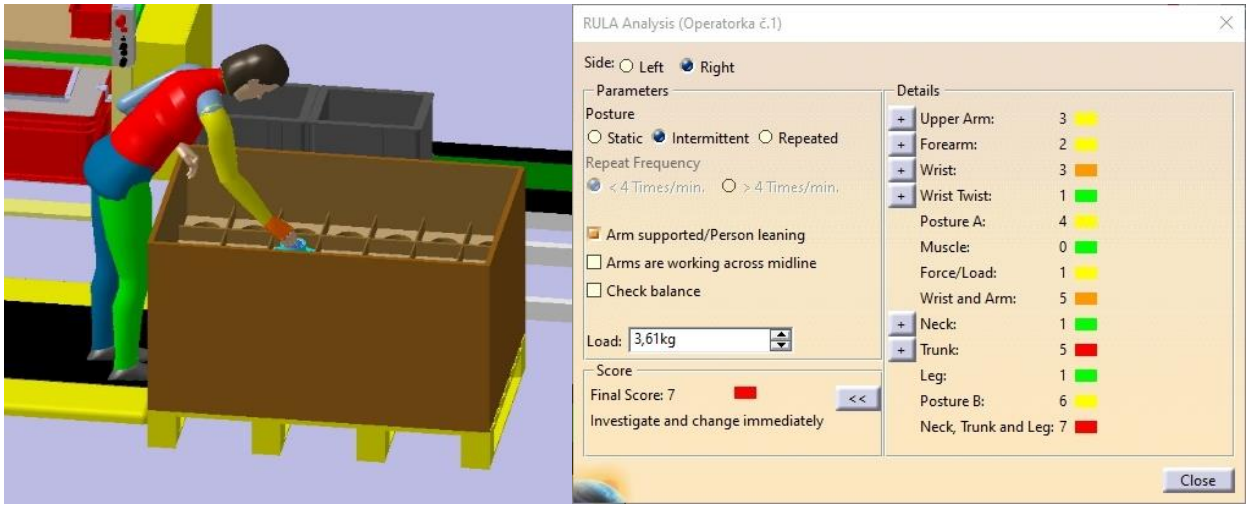

Figure 2 RULA analysis - position no. 2.

Based on the data found in the table as well as according to the color of the individual parts of the body, we can see that a slightly loaded wrist is present, similar to the previous position (**Figure 2**). However, the neck, torso and legs of the worker are in critical values and not very suitable for health. For this reason, we think it is appropriate to consider improving workplace comfort or optimizations [8].

2.3. Third position when unloading from the pallet

Based on our observations, we considered the number three position of the worker to be the most physically demanding. This statement was also confirmed to us by the analysis, as the worker has to make a considerable effort in unloading the flanges, which are located completely at the bottom of the pallet. Looking at **Figure 3**, we can see that the final score is 7. This means that the person who is in this position performs the work from an ergonomic point of view in the most inappropriate way and there is a risk of injury respectively health threats.

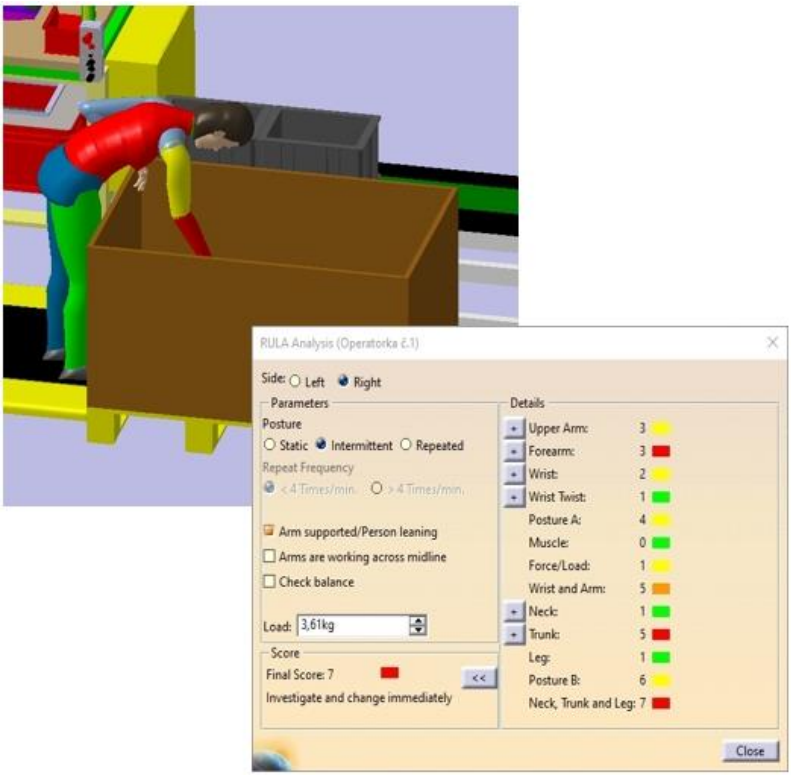

Figure 3 RULA analysis - position no. 3

Based on the simulated position, we see that the torso, neck and forearms are considered to be the most endangered. In these parts of the body, various health problems can occur due to overload, such as problems with intervertebral discs, carpal tunnel syndrome, etc. [2,4].

3. OPTIMIZATION PROPOSAL

At the entrance to the process, we suggested the use of a tilting pallet truck when unloading components from a pallet. This type of handling technique is considered to be very efficient and flexible in performing daily work activities in production or operation. Its main advantage is working in suitable ergonomic conditions, where robust construction, long life and also low weight are its advantages.

Our main goal of its use in the workplace was to eliminate the bending of the hull by more than 60 ° when unloading the flange unit. The function of tilting the truck to the right or left by 20 ° makes a significant contribution to this improvement, thus simplifying the unloading or loading of components.

Another change that took place at the workplace is the rotation of the pallet at the entrance and exit by 90 °. We applied a different pallet location at the workplace due to the better availability of the worker to the components at the entrance and also to a better way of packaging the products at the exit of the work process.

If we take the original size of the box, where the flange units are located, then from an ergonomic point of view, in addition to changing the position of the plate, the change of packaging also plays an important role. The original dimensions of the package with components are 1200 x 800 x 800 mm, where our proposal is to change this dimension to 1200 x 800 x 600 mm. This change would lead to a better approach to component selection, even if a tilting truck is used.

3.1. First position when pasting into the palette after optimization

After adjusting the workplace, we performed a re-analysis, where we also mentioned the use of a tilting truck. In the picture we can see that the pallet was raised using the truck and the operator does not perform any forward bend. I also have better access to select components in the palette. We can also see the improvement based on the final score, which is shown in **Figure 4**. The current score was 5 and the adjusted workplace is 2, which means that the person performs work in a very suitable position, which is without health risk.

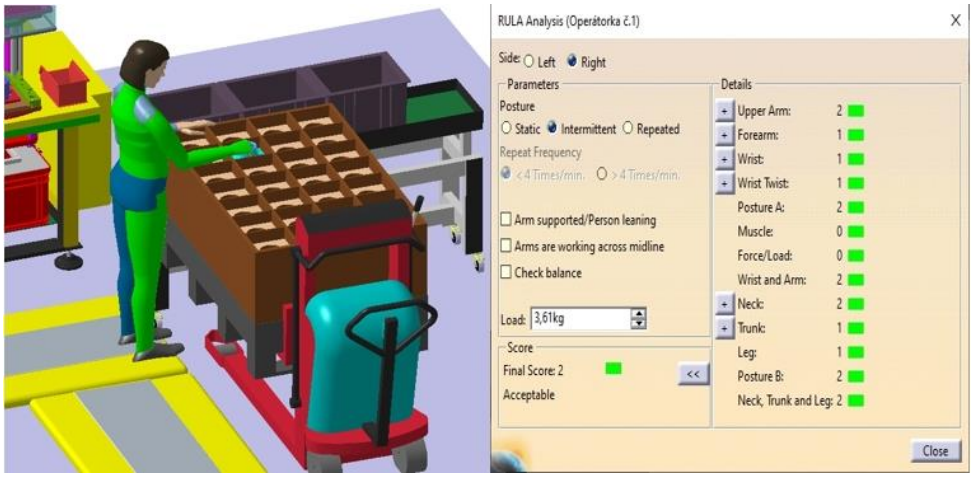

Figure 4 Pallet insertion after workplace optimization - first position

3.2. Second position when pasting into the palette after optimization

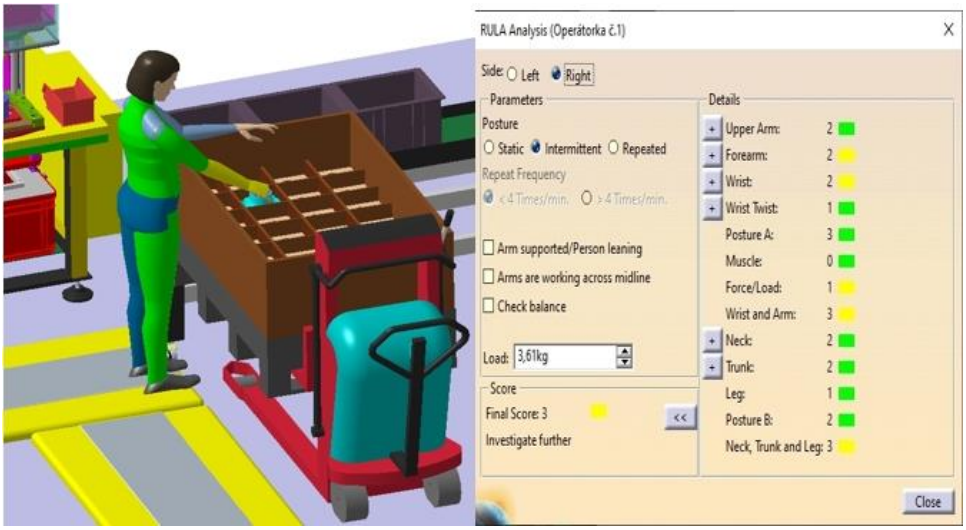

Figure 5 Pallet insertion after workplace optimization - second position

After the analysis of the optimized workplace, it is clear from **Figure 5** that the application of the tilting trolley in this variant contributed to the improvement of the working position of the operator, since the pallet is placed higher in this case. This position will improve the position of the worker's torso, where the resulting score of this body segment was previously in critical values, i.e. 5 and the value after adjustment of the workplace is 2.

3.3. Third position when pasting into the palette after optimization

The third position, where the worker has to lean to the bottom of the pallet after the components in their original state, had an adverse effect on the long-term performance in this position. The function of tilting the truck to the right or left by 20 ° significantly helps to improve, which simplifies the unloading of components (**Figure 8**) [5,6].

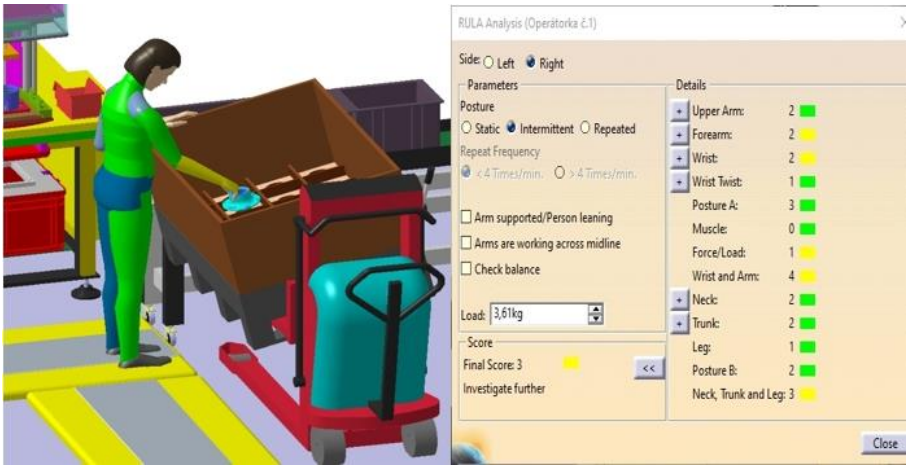

Figure 2 Pallet insertion after workplace optimization - third position

4. CONCLUSION

Ergonomic improvements in the workplace also bring improvements that intervene in the company's indirect costs, such as reducing the risk of accidents at work or reducing the number of occupational diseases. The aim of the proposed variant was to improve the working position of the operators at the entrance and exit of the assembly process, where they performed a very unnatural movement when loading and unloading the product, which leads to permanent health problems [7]. We also dealt with occupational health and safety, where our proposal was to install protective covers as well as to facilitate the start-up of the process. One of the advantages of this project is that the original area of the workplace has been preserved and another benefit is the addition of an ergonomic mat at the entrance to the assembly process, where it provides comfort and improved working conditions for the operator.

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