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ERGONOMIC SIMULATION OF THE ASSEMBLY LINE – CASE STUDY

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Abstract: While raising productivity and improving logistics processes must not be ignored the question of ergonomics, which plays an important role not only at the workplace level. Ergonomically arranged workplace can affect logistics support processes, such as pressure to use other packaging, etc. Ergonomic simulation is becoming an important element in process improvement. The presenting benefit to the specific example presents an experience in analyzing the workload and utilization of computer simulation in ergonomic studies. In the article is briefly introduced the project of ergonomic analysis of the assembly line. There are discussed doubtful places in the line and some corrective measures to improving the current state, it means to reduce the ergonomic heftiness. The project was elaborated with the support of the simulation program, Siemens Classical Jack.

1 INTRODUCTION

Methods for improving production processes (for example: VSM, 5S, SMED, visualization...), implementation of manufacturing cells and tension control systems (Kanban, CONWIP, POLKA) or Lean logistics techniques (Supermarket, Milkrun,...) have become standard for improving productivity and reduction of cost (of example: [6], [8]). The implementation of innovative manufacturing and logistics structures is equally important question of working environment and the impact of potential changes for workers.

Ergonomics is still the single most important evaluation criteria in the evaluation of proposed alternative solutions and has a significant influence for the final decisions.

Ergonomics plays an important role not only at the workplace level. Ergonomically arranged workplace can also affect supporting logistic processes, for example pressure to use other packages, racks etc. Ergonomic analysis are becoming increasingly important and must go hand in hand with the other process improvement techniques.

The above-mentioned issues will be outlined in the next chapter the example of an ergonomic analysis of assembly line.

2 CASE STUDY - ERGONOMIC SIMULATION OF THE ASSEMBLY LINE

This is an automated assembly line of double sockets machines. Two workers operate the assembly line.

An important step in the entire analysis was to find problem areas of the assembly line. It was based on the frequency of activity and established ergonomic criteria. Among the ergonomic criteria include distance from the base station, bending, weight boxes or use of the hand tools. Filtered point evaluation was nine setting locations, where it was possible ergonomic risk.

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After determining the risk points was created 3D model of the assembly line in the simulation software Jack Classical by Siemens (Figure 1). To evaluate the workload in the dangerous setting locations were chosen method OWAS and RULA.

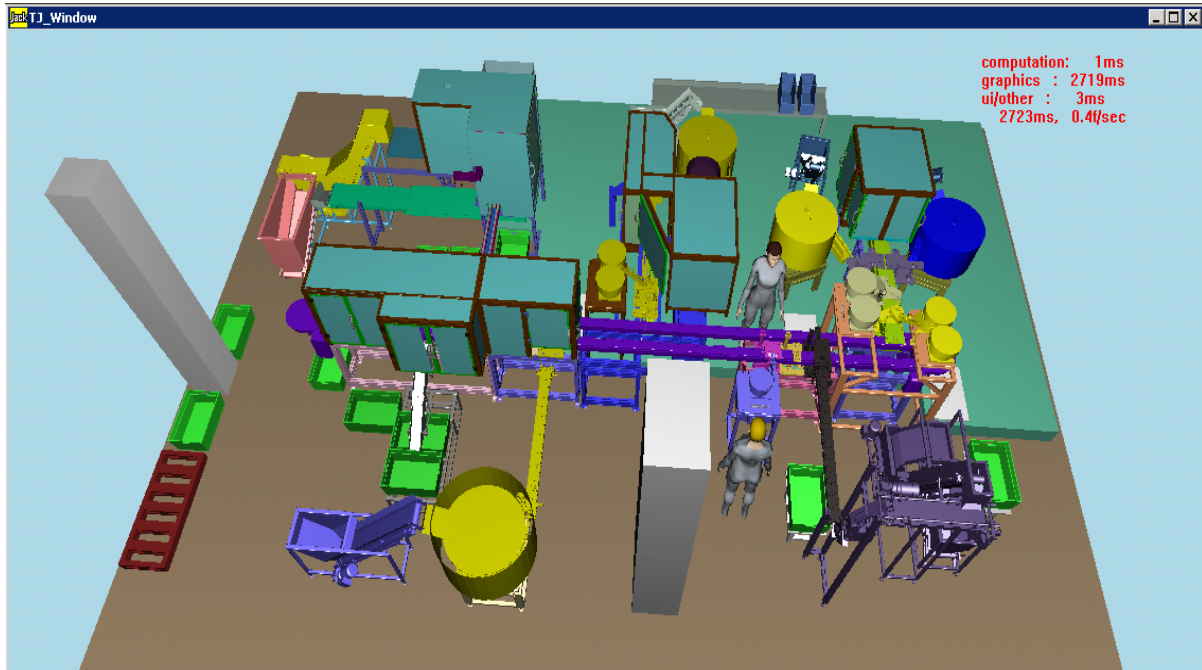


Figure 1: 3D model of the assembly line in Jack software [1]

The next section will briefly discuss the results of partial analysis of the location of complete double socket machine, when workers at work is the greatest manipulation.

Results of the analysis initial state are shown in Figure 2. As expected already during the initial analysis, the risk activities is the manipulation with boxes.

To reduce the ergonomic load was recommended the following simple improvements:

- Spring-loaded pallette table - when workers put a full box on the table, table is reduced and the workers will put down boxes still to the same optima height.
- Another suggested improvement was the placing of gravity rack for empty boxes next pallette table (alternative may be for example an elevated storage platform for half the number of boxes).
- Increase the placement height of the boxes, which fall into complete products.

How could demonstrate the implementation of the first two improvements is shown in Figure 2. The chart shows that the values for optimized status are favourable than the values for original status of assembly line. The values for optimized status are favourable, because we were added three optimized features, namely table for pallett (Figure 2 – operation 3rd) and gravity flow rack (Figure 2 – operation 5th).

The proposed improvements, however, have an impact on logistics. Gravity flow rack is two-storied. In each floor can seat ten empty boxes, gravity flow rack can seat twenty empty boxes. The empty box can seat one hundred of complete double-socket machines. The assembly line cycle is one hundred complete two-outlet machines per five minutes. Which corresponds to the fact that gravity flow rack would have to fill 4 to 5 - times per shift. The table for pallette can seat a ten full boxes, the table for pallette would have to take off 8 to 10 - times per shift. Before implementing of optimized features were brought the empty pallettes and the empty boxes at the beginning of the shift, which were placed as assembly line operators want. After implementation of optimized features would have to change charging strategy and logistics.

Use palette table is reflected also in the manipulation technique. Before implementing changes took place of supply and transport full boxes with help of the hand pallet truck. After implementation of optimized features would be to need a low lifter.

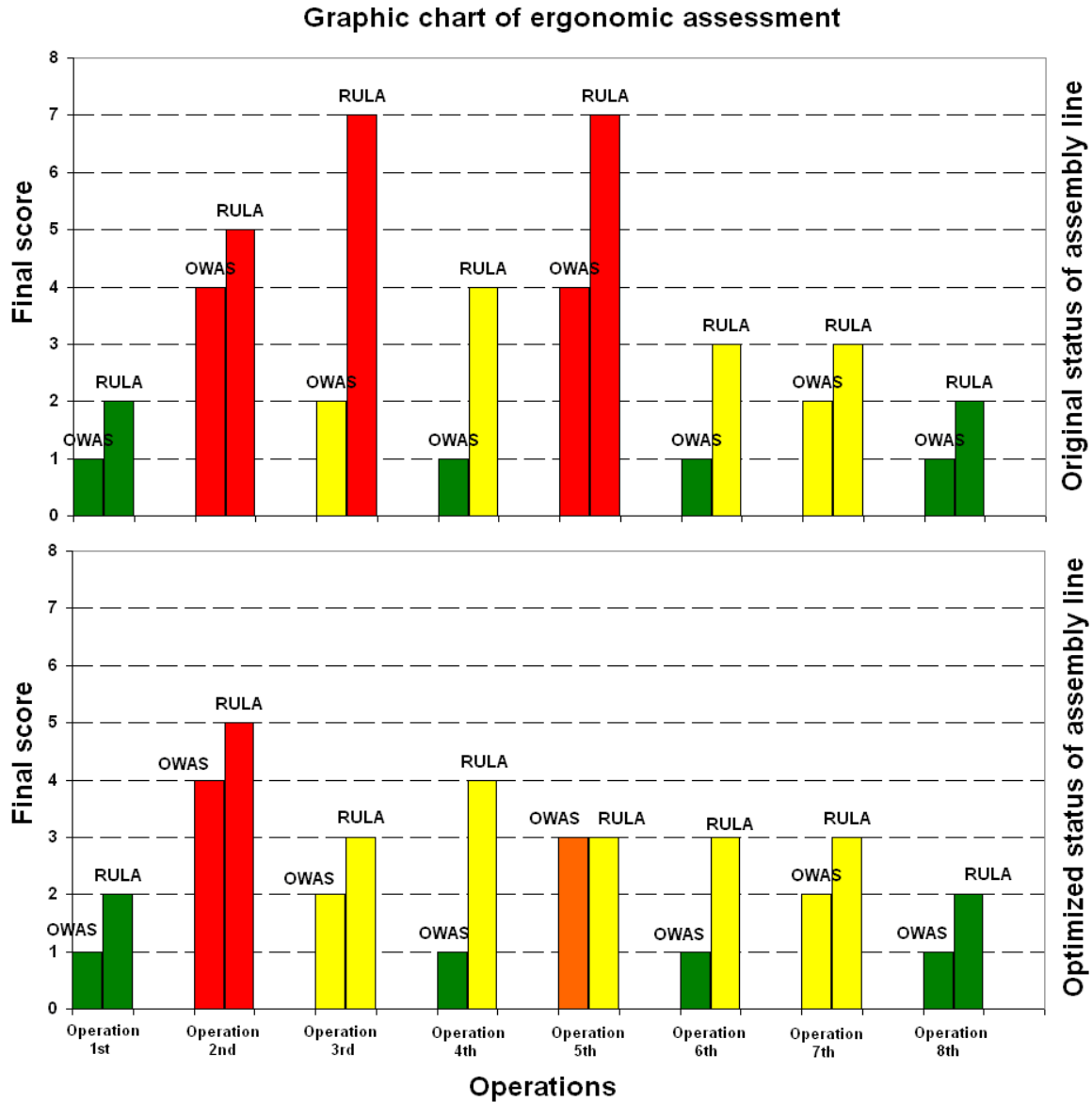


Figure 2: Graphic chart of ergonomic assessment

The presented designs of course are not final. It is necessary to think about different options. An alternative to the gravity flow rack in for example using of elevated storage space for half the number of boxes. The advantage of this variant solutions are mainly due to lower demands for space and lower implementation costs, on the other hand, it again shows the requirement to address higher frequency loading.

The ergonomic study was carried out with analysis of the entire assembly line. In the Figure 3 are presented some of the other proposed improvements on the assembly line. It is a simple, low-cost, yet quickly realizable measures to facilitate the work while significantly reducing ergonomic risks in the workplace, reducing the possibility of risks leading to long-term illness.

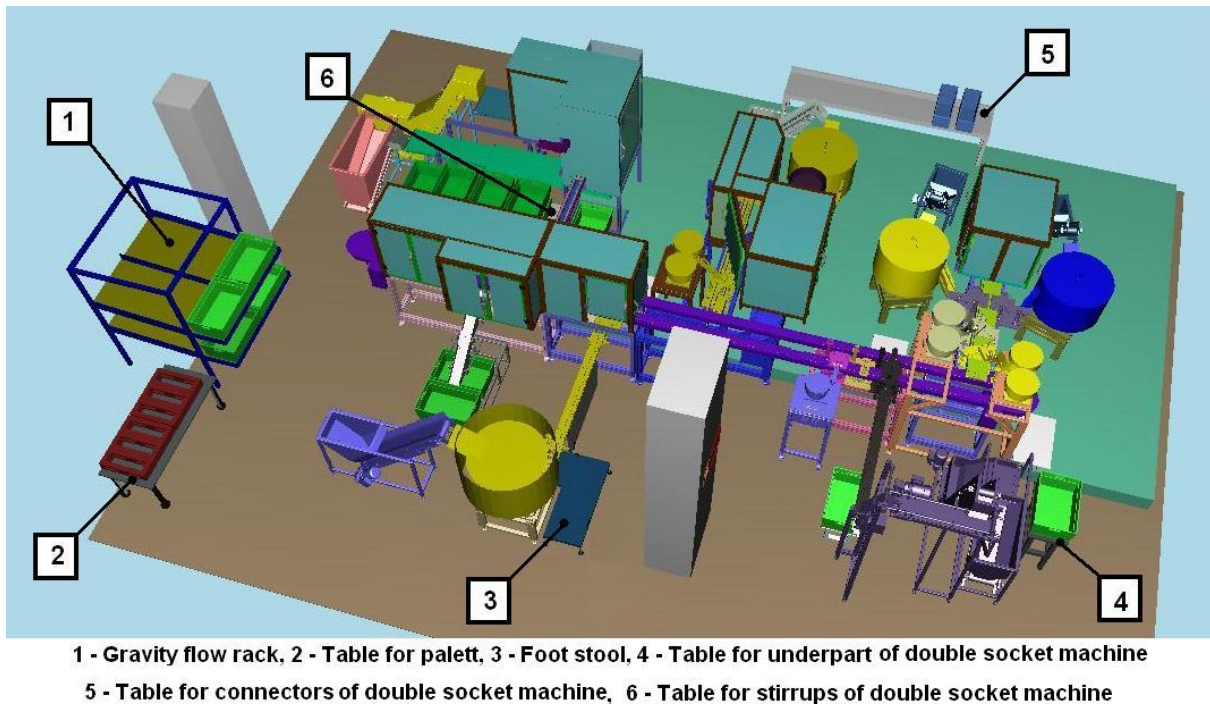


Figure 3: Optimized assembly line

3 CONCLUSION

Presented case study shows, even using simple improvements can significantly improve the working environment and reduce the likelihood of risks leading to long-term illness, which can be positively reflected in the company management.

In conclusion it may be said:

- Ergonomics has played, plays and will continue to play an important role in improving processes and not only at the workplace level.
- The ergonomic redesign of assembly lines may have an impact for the change charging strategy and logistics in large scale (for example: in the way of supply lines, in the manipulation technique, etc.)
- Process (holistics, logistics) thinking, comprehensive approach to solving and cooperation between experts from different fields are essential for efficient processing of innovative projects in the area of improving business processes.

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