The activity as support for the design of productive system layout

Mayara Ramos [1], Fernanda Gomes Faust [2], Leila Amaral Gontijo[3], Marcelo Gitirana Gomes Ferreira [4]

Universidade Federal de Santa Catarina - Campus Reitor João David Ferreira Lima, s/n, Trindade, Florianópolis, Santa Catarina, Brazil, 88040-900

[1] mayara.ramos@gail.com, [2] fernandagfaust@gmail.com, [3] leila.gontijo@ufsc.br, [4] marcelo.gitirana@gmail.com

Keywords: ergonomic work analysis, productivity. layout

1 Context

The first purpose of the ergonomic action is work transformation, such transformation should be made to contribute to the creation of work situations that don't interfere with the worker's health and achieve the company's objective (GUÉRIN et al., 2001). On industrial workstation projects, the principal concern is the improvement of the equipment performance, little concern is given to matching the worker abilities to the task requirement. As consequence, the industrial workstations are poorly designed (DAS; SENGUPTA, 1996). By not observing the process ergonomics, working conditions result in loss of worker productivity and affects workers health (DAS; SENGUPTA, 1996; FIEDLER et al., 2009). A way to minimize these problems is the design of an adequate layout for the job (FIEDLER et al., 2009; SHINDE; JADHAV, 2012).

Worker efficiency is an important factor to the improvement of productivity in manufacturing industries. The worker productivity depends on the ergonomic workstation design (SHINDE; JADHAV, 2012). Ergonomics is not limited to the prevention and elimination of work injuries, it can also be used to help on productivity increase. Fatigue workers are more prone to injuries and tend to slow the work pace (RESNICK; ZANOTTI, 1997). An ergonomic approach to industrial workstation design tries to achieve a balance between the worker's capabilities and the work requirements to optimize the worker productivity, and the system as a whole, as well as provide the worker physical and mental well-being, work safety and satisfaction (DAS; SENGUPTA, 1996).

Many studies of Ergonomic Work Analysis focus on problems that are consequence of repetitive efforts, inadequate work postures, and furniture, in this article we seek to evaluate through an ergonomic work analysis the dislocations/movements made in the

assembly department of a factory, with the purpose of proposing improvements in the department organization and layout minimizing the dislocations and maximizing work activities. The work analysis generated the hypothesis that the dislocations made by the workers were exaggerated, causing overload in the lower limbs and a feeling of unproductiveness. The objective of this study is to develop the dislocations analysis for the assembly sector of the company evaluating the influence of the layout on the sector productivity.

2 Method

This paper originated of an Ergonomic Work Analysis made in the assembly department of a Pilates equipment factory. The analysis demand studied the improvement of the dislocations on the assembly department. In the department work two assemblers and a supervisor, the department job activity is the final assembly and packing of the Pilates equipments and accessories.

For task analysis data were collected through direct and indirect (videos) observation, work environment and furniture measurements, and workers interviews. With the video observation, it was analyzed the assembly time (time spent with dislocations and assembly operations) of the main products - Ladder Barrel, Cadilac, Reformer, and Step Chair. The work environment was modeled in 3D and then simulated the dislocations made during the task and measured the distances traveled. On the department improvement proposal, unnecessary dislocations were removed, for that, it was proposed a new layout for the department aiming the task improvement and minimizing the dislocations. The dislocations of the new layout were also simulated digitally.

3 Results

The current state analysis showed that during the assembly of one of the analyzed products the worker may walk up to 767.5 m, on average the distance traveled is 445m. The dislocation time is correspondent to an average of 35.3%, in one of the products it was 50% of the total assembly time. The dislocations made during the process involve carrying parts that weight 2 to 10Kg, this may intensify the fatigue.

The layout proposal for optimizing the assembly process established that the workers go to the stock only once, and with the support of a cart, store the necessary parts. The simulation for the process on the proposed layout showed an average reduction of 75.25% of the dislocations.

4 Conclusions

Ergonomics should be applied from the initial phases of a machine, system, environment or workstation; and they should always include the human being as one of the components. The man-machine system, environment, work organization and the improvement of working conditions are related to the changes proposed by the

assembly department of the analyzed company because the changes suggested on the layout and the assembly process may lead to a better work organization and work conditions for the staff.

The layout changes have an influence on productive and organizational matters in one hand and personal and staff motivation in the other. The results showed the impact of the layout over the work process, and consequently on worker productivity. The hypothesis that the current layout and work organization were generating excessive dislocations and causing overload on workers lower limbs and an unproductive sensation can be considered partially correct. Beside the dislocations, the overload may be caused also by other factors such as the execution of all activities in a standing position, and the lack of a support chair in the department.

5 References

1. DAS, B.; SENGUPTA, A. K. Industrial workstation design: A systematic ergonomics approach. **Applied Ergonomics**, v. 27, n. 3, p. 157–163, 1996.
2. FIEDLER, N. C. et al. Otimização do Layout de marcenarias no sul do Espírito Santo baseado em parâmetros ergonômicos e de produtividade. **Revista Árvore**, v. 33, n. 1, p. 161–170, 2009.
3. GUÉRIN, F. et al. **Compreender o trabalho para transformá-lo**: a prática da ergonomia. São Paulo: Edgard Blucher, 2001.
4. RESNICK, M. L.; ZANOTTI, A. Using Ergonomics To Target Productivity Improvements. **Computers ind. Engng**, v. 33, n. 12, p. 185–188, 1997.
5. SHINDE, G. V.; JADHAV, V. S. 'Ergonomic analysis of an assembly workstation to identify time consuming and fatigue causing factors using application of motion study'. **International Journal of Engineering and Technology**, v. 4, n. 4, p. 220–227, 2012.

6 Acknowledgments

The authors would like to thank the Federal University of Santa Catarina (UFSC), CNPq and CAPES for the financial support that made this research possible.