ORIGINAL ARTICLE

ERGONOMIC ENGINEERING INTERVENTION OF BATIK STAMPING WORK TO REDUCE LIFTING LOAD

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ABSTRACT

One of the common health problems for small and medium enterprise such as batik production is work-related musculoskeletal disorder (WMSD). This health problem may contribute to long-term medical effect on the production workers. For batik stamping workers, the load of the copper block that need to be used repetitively can reach up to 2kg. This study aims to reduce WMSD effect by reducing the lifting load of the cooper block handled by the batik stamping worker. The worker's working load is observed before the intervention process by using one of the ergonomic risk assessment tools, Rapid Upper Limb Asssessment (RULA). The ergonomic intervention designed in this study is from the engineering approach by modifying tools. It is found out that the intervention done were able to eliminate the lifting load handled by the worker to avoid discomfort or further health complication. This outcome are hoped to be able to improve workers' health and increase batik stamping work productivity that eventually increased company's revenue.

Keywords: *Ergonomic, comfort posture, engineering approach, WMSD, postural load*

INTRODUCTION

The term WMSD has come to be used to refer to work-related musculoskeletal disorders as suggested by Simoneau, St-Vincent & Chicoine[1] which means disorders that are associated with the movement of upper limbs, lower limbs and the back of the human body. As a result of an ergonomic factor that encompassed an awkward working posture, manoeuvrability of the static load and task invariability are some factor contributing to WMSD[2]. It is reported that 60.2% of batik operators surveyed in Kelantan suffer from musculoskeletal symptoms which accounts for 41.0% has pain over the shoulder, 34.4% for lower back pain and the rest is for ankle pain[3].

Ergonomic related disorders as mentioned by DOSH[4] reveals that there has been exponentially increasing trend of ergonomic related disorders by referring to Social Security Organization (SOCSO) 2015 in contrast with the awareness that has been spread among Malaysian employers regarding that issue. The main objective of Ergonomic risk assessment (ERA) is to identify risk factors that can harm workers in workplace and propose an appropriate measure which are the best solution in minimizing or eliminating the ergonomic risk[4]. Rapid Upper Limb Assessment (RULA) index is one of the most cited and commonly used tools for evaluating ergonomic risk of work-related MSDs[5,6]. RULA is a subjective observation method for posture analysis that focuses on the upper part of the body with particular attention to the neck, trunk and upper limbs[5,7,8].

To overcome this problem, this study had suggested the engineering approach. In general, an engineering approach consists of four general approach which are modifying tools, redesigning the workstation, utilization of powered equipment and applying automation with the goal to lower or eradicate WMSD effect and ergonomic risk for example stress and fatigue[9]. Modifying tool is one of the common approaches used to reduce the weight of the tool by utilizing a spring balancer equipped by hoist rail for reducing manual handling effort. The main objective of this study is to reduce or eliminate the load handled by the batik stamping workers through ergonomic engineering approach in terms of modifying tools.

METHODS

This study was done on Batik stamping workstation at one batik production company located at the east coast of Malaysia. This workstation was chosen due to their working procedures that include handling load in a repetitive working movement. The study process includes several stages: the background review, ergonomic risk assessment using RULA, ergonomic engineering approach and after intervention observation.

RULA is a subjective observation method on postures that focuses on the upper body, but includes the lower body. RULA was developed as a screening tool for exposure of adults to risk factors for work-related upper limb disorders, and takes into account the repetitive movements and force that may be required for a task[10]. The

postures will then be analysed by using the RULA assessment where the score will be calculated and the grand score will determine the requirements of action that should be taken based on it.

As for the engineering approach intervention, the machinery design process was constructed using Solid Work 2017 Software.

RESULT

Ergonomic Risk Assessment

From a simple observation and interview, it is shown that the subject clearly experiencing posture discomfort during work. The existing working posture involved awkward posture in repetitive motion while handling copper block with their hand. A RULA assessment was done on the current working posture to determine its working risk factors. The working posture assessed is shown in Figure 1.

Figure 1 - Current working posture for batik stamping

From the RULA assessment done it is found out that the posture had a final score of 7. This means that investigation and changes are required immediately[7].

Engineering Approach Intervention

One of the common methods used to reduce or eliminate WMSD among workers is through engineering approach. In this study, a simple crane and hoist system were designed to assist the batik stamping worker to handle the heavy copper block during stamping process. The hoist crane can move in x and y-axis while the small movement for z-axis required for dipping and splattering the molten wax is provided by spring balancer, which can provide a lifting, force up to 30N. Figure 2 shows the 3D design of the crane system.

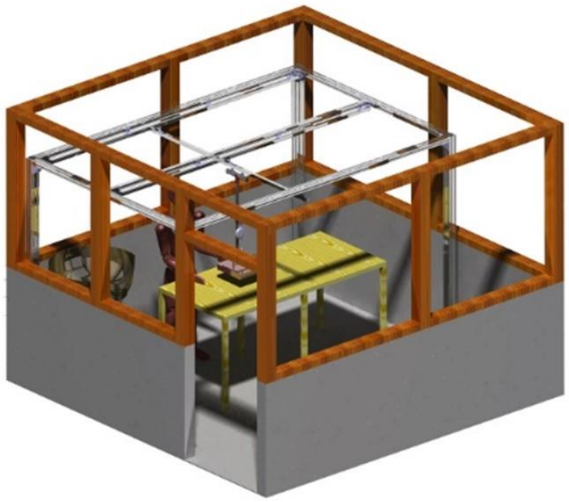

Figure 2 - 3D design of crane system for batik stamping

This crane system was designed and assembled inside the batik stamping workshop. A hoist device from the crane is able to move in all 3-axis direction inside the workshop. This hoist will be attached to the copper block handle with the help of hook and spring balancer to eliminate the load handled by the worker while stamping process was done. The usage of spring balancer is to provide an ease lifting force when the copper block is ready to be dipped into the hot molten wax pan. Figure 3 and 4 shows the batik stamping work after engineering approach intervention that had been done.

Figure 3 – Copper block handle attached to the crane system

Figure 4 - Batik stamping work after engineering approach

DISCUSSION

From the ergonomic risk assessment conducted on the existing stamping process posture, it is found that the results was score 7. Thus, improvement needs to be done for this posture in order to make sure that it is safe for the worker and also comfortable so that workers can perform better while working. Improvements must be done in order to prevent unwanted cases that can cost the health of the worker. From the RULA analysis, it shows that one of the postural problems was caused by the load handled by the worker. The load was from the copper block used in the stamping process that usually varies around 1kg to 3kg.

After the intervention was done through engineering approach, the working postural load was greatly improved. Eventhough the RULA posture improvement after intervention only score 6 but the objective of this study that is to reduce lifting load was achieved. The crane and hoist system able to reduce the copper block load handled by the worker around 50% reduction. This consequently improved the working conditions by eliminating the working risk that can avoid WMSD, increased higher productivity level and allowed for bigger copper block to be designed depending on the customer or designer requirement. For the bigger acting force by the spring balancer, bigger force specification is required for the spring balancer. However the result after the intervention at this stage was only reported through observation method. In future studies, a proper objective measurement method will be used to assess the results of the intervention that had been done.

CONCLUSION

In conclusion, this ergonomic intervention done through engineering approach was able to improve the batik stamping working condition. The working posture is crucial in designing the suitable working process for the batik stamping worker so that WMSD problems can be avoided. Other than that, proper posture might lead to better worker performance and they will be more satisfied in doing their job thus improve the productivity of the related industry.

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COMPETING INTERESTS

There is no conflict of interest.

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