

Analysis of manual material handling activity to increase work productivity (Case study: manufacturing company)

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Abstract. Manual material handling is one of work activities that have an effect on the physical aspect of workers in manufacturing industry, it is necessary to do the analysis of the risks from such activities. Analysis was performed on worker when performing manual lifting activity and when using two tools (Automatic Handlift and Manual Handlift). In addition to analyse in ergonomics aspect, time study analysis and productivity measurement were carried out to determine the effects of the equipment. Nordic Body Map (NBM) questionnaire on worker using Automatic Handlift showed declining level of musculoskeletal disorders by 22%. REBA method obtained score of 10 and was declined to 4 after using these tool. The results of MPL method showed declining of Fc value from 4756.37 N to 1346.56 N. The results of RWL method showed declining of LI value (Lifting Index) origin and destination from 1.84 and 1.18 to 1.12 and 0.89 respectively. As for worker using Manual Handlift, NBM questionnaire result shows declining level of musculoskeletal disorders by 57%. REBA method obtained scores of 8 and was reduced to 5. For MPL method result, the Fc value is 4906.99 N and reduced to 2047.88 N. RWL method results showed declining of LI value (Lifting Index) origin and destination from 1.02 and 0.67 to 0.74 and 0.58. The results of time study analysis showed declining of Standard Time when use the two tools and make the increasing productivity of 9% by worker using Automatic Handlift and 4% by worker using Manual Handlift.

1 Introduction

PT. XYZ is one of the manufacturing company engaged in the production of musical instruments named piano. In the manufacturing industry, human labor is still needed on the production floor to ensure the smoothness of the process by transferring materials (handling) from one machine to another machine or from one workstation to another. At PT. XYZ, manual handling material handling that often done by workers is the lifting activity.

MMH is the most common cause of fatigue, waist injury and spinal cord injury [1]. From some material handling manual activity, lifting activity proved to be one cause of the high level of injury [2], with the risks faced by workers when performing manual material handling activities, it needs an intervention or improvement of ergonomics aspect to minimize the risk of injury to workers. The improvements made by PT. XYZ is to provide lifting tools Handlift Manual and Automatic Handlift for workers. However, good ergonomics interventions those that can achieve two objectives: to reduce the risk and improve work productivity [3]. Therefore in this study will be discussed how far ergonomic improvements can reduce risks and increase work productivity.

2 Methodology

2.1 Sample

This study focused on workers in the woodworking department of PT. XYZ. Woodworking workers were chosen due to manual handling material handling were majority performed especially lifting activity. In addition, the lifting object is quite large because the woodworking department is one of the early stages of the piano production process. The workers observed were Double-sizer machine operator from Cutting Sizer section and Ban Saw machine operator from Machine Bridge section.

2.2 Research Scheme

The focus of this study is to compare the risk level and productivity of workers when performing manual lifting and lifting activities using lifting tools so that it can be seen how much effect the improvements made. Therefore, several methods such as Nordic Body Map, REBA, RWL, MPL, time study and productivity measurement are performed on both conditions (manual lifting and using lifting tools).

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2.3 Nordic Body Map

Nordic Body Map is subjective identification questionnaire that is used to identify discomfort or complaints from body parts when performing work activities [4]. Nordic Body Map is based on the 28 points of the body to judge it based on the level of complaints are divided into 4 levels of complaints [5].

2.4 REBA

REBA (Rapid Entire Body Assessment) is a method developed to investigate the risks experienced by workers based on posture while performing work activities by considering the load, coupling (grip) and posture changes [6]. In work posture evaluation using REBA, the body is divided into two groups were observed, namely Group A and Group B. Group A consists of the neck, back and legs while Group B consists of the upper arm, forearm and wrist. The results of REBA is the level of risk experienced by workers based on work posture. The score and the risk level of REBA method can be seen on the table 2.3 below.

2.5 Maximum Permissible Limit

One method in biomechanics that can be used as an analytical tool for lifting activity is Maximum permissible limit (MPL) [7]. MPL is used to determine the value of the Force Compression (Fc) at the L5/S1. MPL is a limit of the amount of compressive force on the segment L5/S1 standardized by NIOSH (National Institute of Occupational Safety and Health) in 1981. According to NIOSH, maximum limit of compressive force on L5/S1 is 6400 N, while limit for normal force (Action Limit) is 3400 N on the L5/S1. Therefore the limit for lifting activity according to NIOSH based on the MPL, Navy and Air Force Compression (Fc) is as follows:

- LC = Load Constant = 23 kg
- HM = Horizontal multiplier = 25/H
- FM = Frequency multiplier
- CM = Coupling multiplier

Based on the principles set by NIOSH, if the LI value more than 1, it can be said lifting activity has a high risk of the occurrence of low back pain. So the good lifting activity is if it has LI value of 1 or less than 1 [8].

2.6 Time Study (Stopwatch)

Stopwatch method is a direct measurement of working time commonly applied for the jobs of short duration and repetitive [9]. In this study, stopwatch readout method used is Repetitive Timings. For this method, stopwatch read simultaneously and the numbers on the stopwatch is returned to zero after each work element is completed.

2.7 Productivity

Productivity is a value that indicates the ratio between output and input, increase productivity value can be seen when comparing the numbers getting bigger [10]. While other opinion explains that productivity is a comparison

between the results achieved with the participation of labor per unit time [11].

3 Result

3.1 Nordic Body Map

The identification results of musculoskeletal complaints using Nordic Body Map questionnaire shows a decrease in the level of complaints in Double Sizer worker at 22% and Ban Saw worker by 57% as shown in Figure 1.

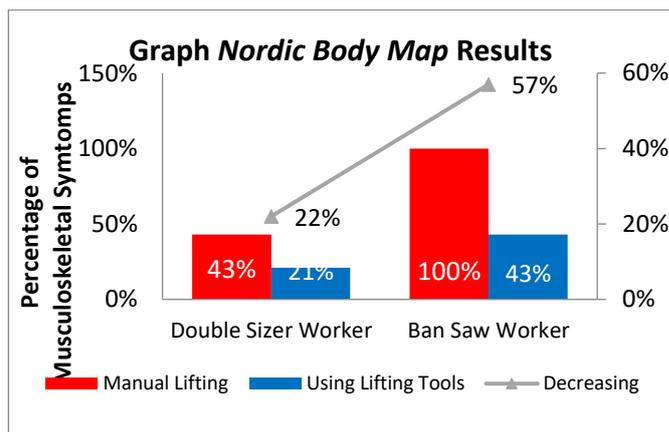


Fig 1. Graph nordic body map results

3.2 REBA

Work posture analysis using the REBA method gives the result that after the use of both lifting apparatus, the work posture score of Double Sizer worker and Ban Saw worker has decreased, which means the risk of injury also decreases. Decreasing score that occurs can be seen in Figure 2 below.

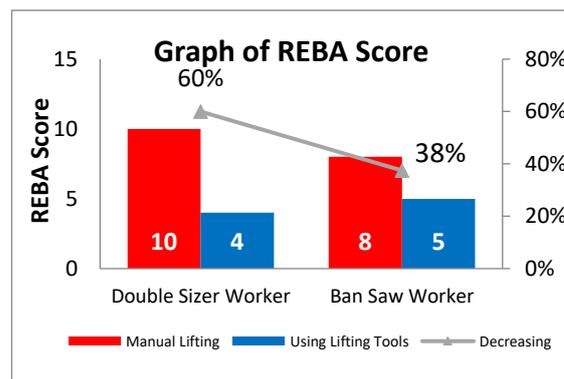


Fig 2. Graph of REBA score

3.4 Maximum Permissible Limit (MPL)

On the results of the MPL method, the value of Fc (Compression Force) of the two worker also declined after using the lifting tools as shown in Figure 3.

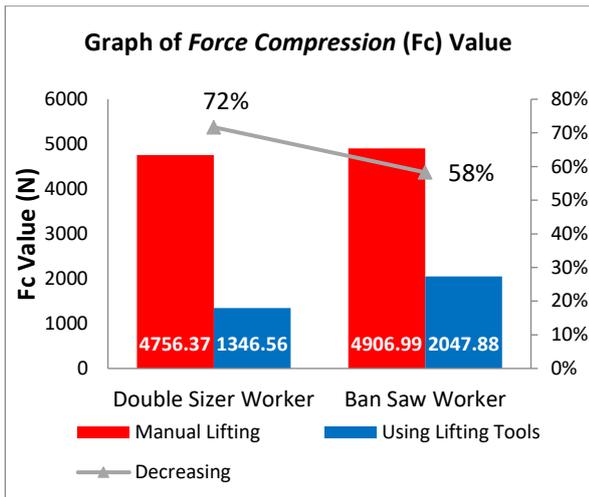


Fig 3. Graph of Force Compression (Fc) value

3.5 Recommended Weight Limit (RWL)

From the results of RWL method, the value of LI (Lifting Index) was obtained showed decline of two workers both origin and destination position as shown in Figure 4.

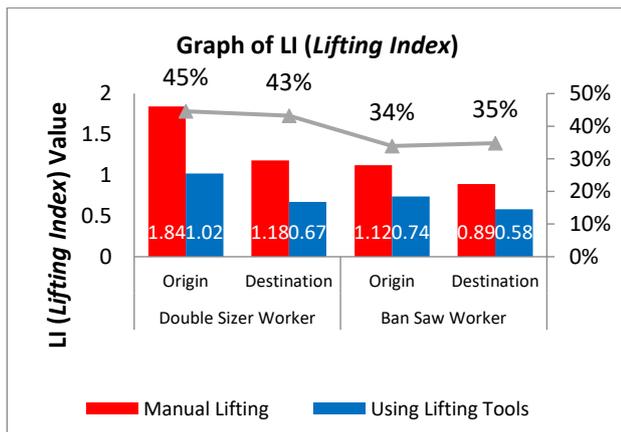


Fig 4. Graph of LI (Lifting Index)

3.6 Time Study (Stopwatch)

Time study analysis using the stopwatch method showed a decrease of standard time after the two workers use lifting tools as shown in Figure 5.

complaint rate to 21%. The decrease in complaints rate also occurred in Ban Saw worker who previously experienced a complaint rate of 100% and then dropped to 43%.

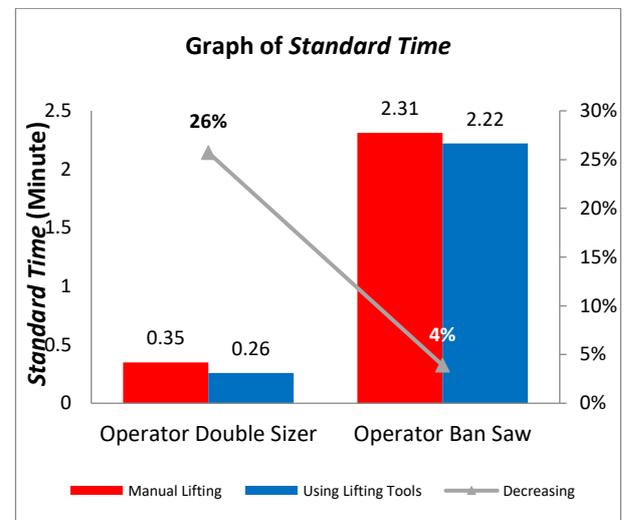


Fig 5. Graph of standard time

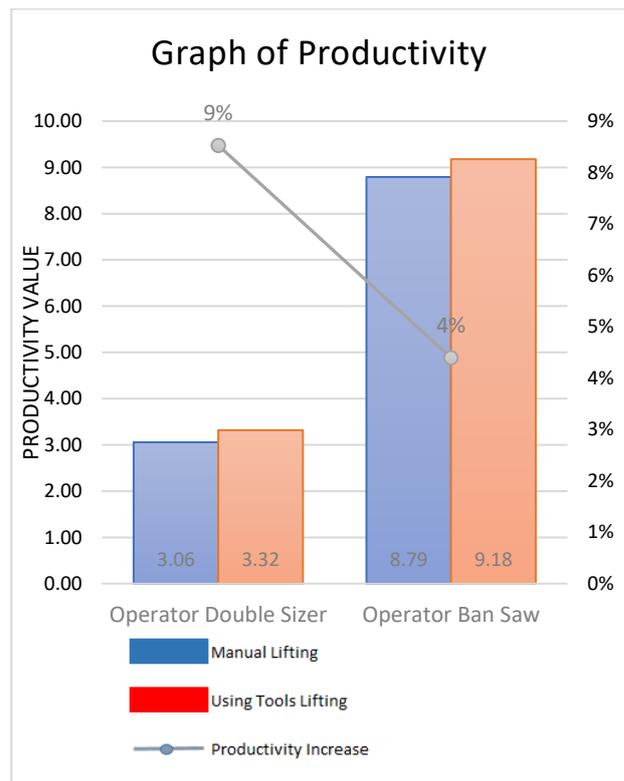


Fig 6. Graph of productivity

3.6 Productivity

And lastly from productivity measurement, both workers have increasing productivity after using the lifting tools as shown in Figure 6.

4 Analysis

Based on the results of NBM questionnaires that have been filled by the operator, there are subjective complaints experienced by Double Sizer worker by 43% of the total 28 points of the body. Then after using the Automatic Hand lift tool, there was a decrease in the

On the REBA score, REBA score of Double Sizer worker has decreased from 10 to 4, reducing the risk of injury. The amount of angles on the shoulders and elbows due to manual lifting movements is the cause of the high risk of injury [12]. In addition, the bending back position also causes the high risk of injury [13]. Decrising score of REBA also occur in Ban Saw worker after using Handlift Manual tool. Initial score of 8 down to 5 after using these tool. The high risk of injury of manual lifting activity is

caused by an extension of the neck that moves extension with the lifting distance around the elbow so that the use of muscle strength up to 50% which causes muscle strain on the back of the neck [14, 15].

MPL results showed decreasing of Fc value from Double Sizer worker after using Automatic Handlift. Meanwhile, Ban Saw worker also experienced a decrease in Fc value which caused a decrease in risk level after using Manual Handlift. The high value of Fc at the manual lifting of both workers is caused by the distance of initial lifting position is lower, causing the increase of force and force moment in the segment L5/S1 [16].

From the results of RWL method, it can be seen that declining Lifting Index (LI) value of both workers after using these two tools. Decrease in LI value occurs in the position of Origin and Destination. The high value of LI on manual lifting of both operators is caused by the distance of initial lifting position is too low and make the larger angle of waist and back inclination which causing dangerous bending posture [17]. However, the LI value of Ban Saw worker is smaller than Double Sizer worker. This is due to one other factor that is the lifting frequency (FM). Where the Double Sizer worker has higher lifting frequency causes higher muscle tension and injury [18]. While the analysis of Time Study using stopwatch method showed that a decline in Standard Time of two workers after using these tools. The decline can be seen when worker lift the materials to the machine. Both of these tools help the worker to lift the pile of the materials in desired height so that the lifting activity can be done more quickly.

In accordance with the decline of Standard Time, then the productivity measurement of both workers increased after using the lifting tools. This shows that the use of two tools was a positive impact for the productivity of both workers..

5 Conclusion

Based on the results of several methods and analysis has been presented it can be concluded that the improvement of the ergonomic aspects by using Manual Handlift and Automatic Handlift give the effect of decreasing the risk level of the injury suffered by both workers. In addition, the use of these two tools also proved to have positive impact on the performance aspects of the operator with the Standard Time reduction and productivity improvement

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