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The Proposed Improvement of Work Posture as An Attempt in Lowering the Risk of Musculoskeletal Disorder

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Abstract. *CV Valasindo is furniture industry that produces a wide range of wood product. The production process in CV. Valasindo is devided in two areas, preparation of materials area and production area. This research is focused on work posture of the production area's workers. The production area itself consists of work stationssuch as assembly, construction and finishing. The production area was chosen because on the production process in this area is still done manually by the operator. Additionally, on the production area is also still present a series of no ergonomic work posture, both on the work station construction, assembly and finishing. The purpose of this research is to identify a work posture on the production area and doing an improvement to lowers the risk of musculoskeletal injuries. Based on the results of the assessment work posture against 18 work stations at the production area, the seat assembly work station it is known that has the highest risk of musculoskeletal injuries with a score of QEC 67. 9%, REBA 9, OWAS 3 as well as score NBM 75. Based on work by posture assessment method of QEC, REBA, OWAS and reinforced with method NBM then the improvement will be focused on work station assembly seat. In this study, the improvements done by designing a working facility in the form of tables and chairs work. Based on the results of the design work facilities have been simulated and the result is the risk of musculoskeletal injuries that used to be high risk decrease to be low risk.*

Keywords: *musculoskeletal disorder, work posture, REBA, QEC, OWAS.*

I. INTRODUCTION

Musculoskeletal disorder system are a complaint on the parts of the skeletal muscle felt by a person, ranging from very mild to sick complaints (Tarwaka, 2011). Musculoskeletal injury is a major cause of occupational diseases in industrial sectors of developed and developing countries (Bongers, 2006). Based on data from the Health Office in 2008, musculoskeletal injuries were categorized as the top 10 disease in outpatients with a total of 175,132 visits, while for inpatients there were 26,897 patients. The results of the Health Agency's research in 2013 showed that the prevalence of musculoskeletal disorders against women was 27.5% while in men it was 21.8%.

Furniture industry is an industry where workers are exposed to many factors that are at risk of causing musculoskeletal injuries (Mirka, 2002; Sari, 2017). Research conducted by Nejad et al (2013) in 410 small-scale furniture workers in Iran obtained the highest prevalence of MSDs in knees (39%), lower back (35.6%), and wrist / hand (29.5%). According to Choobineh et al. (2009), workplace activities such as heavy lifting, repetitive work and awkward work postures are factors causing musculoskeletal injuries.

CV.Valasindo is one of the furniture industries that produce various processed products, one of them is the chair. The chair's making process in CV. Valasindo is divided into several processes, namely the preparation of materials and production processes. The preparation of materials starts from log cleavage, oven and the process of molding. While the production process begins with the construction process with various types of machines, assembly process until the finishing process. After the process is complete, then proceed with the packaging process. This study focuses on the work postures performed by workers in the production process. Production process is selected because the process of production on the production area is still done

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manually by the operator. In addition to this process there is also a series of work postures that are not ergonomic either at work stations construction, assembly, and finishing.

At the construction work station, the operator must operate machines with static work posture both in sitting and standing positions. In addition, operators also get exposure in the form of vibration from the machine being operated. While at the work station assembly process is done with the posture of the body sitting on a chair, squatting on the floor and bending to take part to be assembled. Awkward work posture such as working with excessive standing, squatting, bending, and vibration from machines and equipment used can lead to musculoskeletal complaints that can impact on declining work performance (Nugraha et al., 2013). According to Suhardi (2008), working position with squatting or bending is allowed, provided that working time is not more than 2 hours per day, because this position will cause pain and discomfort to the worker. While in the CV. Valasindo Sentra Workers have to work for 5 hours each day.

Therefore, it is necessary to assess the work posture in the production section to determine the risk level of musculoskeletal injury. The risk level of musculoskeletal injury can be determined by assessing work posture. Working appraisal methods used are Quick Exposure Check (QEC), Rapid Entire Body Assessment (REBA) and Ovako Work Postur Analysis System (OWAS). QEC was chosen because it can combine operator ratings and observer ratings (David et all, 2005). While the REBA method can be used to perform the assessment of work postures on the body as a whole (Hignett, 2000). OWAS is used because this method is easy to used and fast in assessing work posture (Karhu, 1997). Furthermore, to know the impact of posture work conducted interview with Nordic Body Map (NBM) questionnaire. Thus, from the results of this evaluation it can be proposed improvement of work facilities to improve work posture so as to reduce the level of risk at work. Based on the existing problems then the results of this study is expected to be used as a reference in improving the work posture of the operator especially in the production area to minimize the risk of musculoskeletal injuries.

II. RESEARCH METHODS

Theresearchis done gradually and systematically. Here are thestepsundertaken in thisstudy: initial stage and data collection and processing stage.

Initial Stage

Initial stages of the study were conducted by conducting literature studies and field studies. After that proceed with identifying the problem and then proceed to formulate the problem and determine the purpose and benefits of research.

Literature studies are carried out by exploring literatures such as books, articles, research and other sources related to design science, ergonomics and work posture, which underlie the research to be carried out. Literature study is carried out to get an overview of the theories and concepts that will be used in solving the problems under study and obtain strong reference bases in applying a method used.

Field studies are carried out by observing directly the activities that occur in the field. The field study was carried out by direct observation, taking pictures of the operator's work posture while carrying out activities at each work station, giving the QEC questionnaire to assess the risk of work posture and continued by giving a NBM questionnaire to detect complaints in the body which is felt by the operator, as well as conducting direct interviews with operators and supervisors to obtain supporting data.

Data Collection and Processing Phase

This stage is carried out through several stages of data collection and processing. In this research there are two sources of data collected, namely primary data and secondary data. Primary data is obtained from direct observation in the field which includes production process data, photo documentation of work posture, operator and observer QEC data, and complaint data experienced by the operator in accordance with the NBM questionnaire. While secondary data consists of supporting information obtained from

the company.

Image taking is done to find out directly the operator's work posture when carrying out the production process. Documentation results showing images of operator work postures from the side can be used to evaluate the operator's work attitude and can be used as a reference for improving work methods.

Interviews and filling out the QEC questionnaire were conducted to assess the work risks associated with muscle disorders in the workplace. While the interview and filling in the NBM questionnaire was used to determine the percentage of pain complaints experienced by the operator. QEC and NBM questionnaires are provided to all operators in the production section. Data processing is carried out includes the assessment of work posture with the method of QEC, REBA and OWAS then followed by the NBM method to assess the impact of the current work posture, and proposed improvements.

First, we assess work posture with the REBA method. Data collection documentation of the operator's work posture when performing his work is used to determine the angles of the operator's work posture which is then given a score using the REBA method so that it can know the level of work risk level and the level of action to be taken.

Second, we assess work posture with the OWAS method. Assessment of work posture with the OWAS method can be used as an assessment of work posture with a simple assessment and can be done quickly. This assessment with the OWAS method will be used as a consideration in determining the work station to be repaired.

Third, we assess the impact of work posture with the NBM method. Assessment of work posture with the NBM method is a method for understanding the impact of the current work posture after identification of the initial work posture using the QEC and REBA methods. This method is used to find out the part of the human body that feels pain that has been divided into 9 main parts, namely the neck, shoulders, upper back, elbows, lower back, wrists.

Fourth, we select work stations used as focus of improvement. In this study, after assessing work posture with several methods of QEC, REBA and OWAS, it can be compared to find out which work station is the most risky of the three assessments. In addition to considering the three methods, a comparison of scores from the NBM method is also used to strengthen the selection of work stations that will be the focus of improvement.

Fifth, we describe selected work stations before repair. At this stage it will be described how the condition of the work station will be the focus of the improvement. The depiction of this work station aims to provide information about the work process and the work posture of the operator when carrying out his work before repairs. This information can later be processed as input in making improvements to the work station.

Sixth, we design work facilities with NIDA stages. In this study the design of work facilities is carried out through several stages, namely identification of needs in design (Need), generation of ideas or ideas (Idea), selection of product concepts (Decision), and product design (Action).

Identification of needs (Need) is obtained through interviews with operators. Based on the results of the interview, information will be obtained in the form of complaints of inconvenience and operator desires. The data will later be used as input and consideration in designing work facilities with an anthropometric approach.

Based on the inconvenience information obtained, it can be analyzed what factors are the cause. After knowing the causative factor, an idea or idea can be generated in the form of work facility design that can overcome the problems perceived by the operator. The design of work facilities made based on worker anthropometry so as to provide comfort to workers while doing their work. In addition, with the design of assistive devices in accordance with worker anthropometry, unnatural work postures can be minimized so that the risk of musculoskeletal injury can be reduced. Ideas or ideas will be developed into several alternative designs, in which one design will be chosen that is considered the most suitable or best.

Design design decision making (decision) is done through interviews with workers and

stakeholders. Opinions from operators and stakeholders are needed because it is this party that better understands the conditions directly in the field so that the chosen design can later provide optimal improvement.

After selecting the design of work facilities, the next step is the creation of work facilities (action). The design results of the selected work facilities will then be made in the form of a simulation.

Seventh, we assessof work posture after improvement with simulation. Illustration of work posture on design needs to be done to compare work posture before and after the design of work facilities. In addition, with this illustration, it can be known how the work facilities that have been made are working. In the study, the assessment of work posture after the design of work facilities will be carried out by simulating.

The initial stage is carried out in the making of a simulation that is to make the work environment to be used. Making this work environment is done by placing work facilities in accordance with their place. After the work environment has been completed, the next step is to create an operator model. This operator model will provide an overview of the operators that will carry out the production process in the work environment that has been created. The operator model that has been created will be simulated in accordance with the operator's work posture on real conditions in the field. Formation of work posture in the work environment is carried out manually by setting up joints and segments contained in the model. This joint arrangement is carried out so that a work posture is formed that matches the operator's work posture. After the work posture has been completed, posture analysis can be done. This work posture analysis is carried out to find out whether the design of work facilities made is safe and can reduce the risk of musculoskeletal injury.

III. Result and Discussion

In this research the work posture assessment was done using REBA and OWAS method, and also NBM method to determine the impact of current work posture. The assessment was done in 18 work stations in production area in the process of making chair. Here is the result of the assessment for every method.

REBA Assessment

Working posture assessment by REBA method conducted by withdrawing corner on the photo documentation of workers who have been taken. Withdrawal of the corner covering part of the upper arm, forearm, wrist position, neck, torso and assess the score to score muscle use, load scores, wrist rotation and footstool. Examples of the withdrawal of REBA angle is as shown in Figure 1.

Figure 1. Withdrawals work posture angle lock mounting base operator

Here is a recapitulation REBA votes on all workstations on the production (see Table 1)

Basedonthe REBA assessment, it can be determined that the work stations that have the highest risk of MSDs are assembly woven, installation of the lock seat, installation and mounting foot lock and assembly seat. The condition of work posture in these work stations need to be improved soon.

OWAS Assessment

Working posture assessment using OWAS method aims to obtain an overview of the risk posture of the operator at the time of doing his job. OWAS method of assessment to this will be known categories of occupational risk level to determine whether or not the work is safe and which body part most tingga risk can be determined so that corrective action should be performed. Here is the result of working with a posture assessment OWAS method (see Table 2).

NBM Assessment

Assessment of complaints made through the

Table 1. The result of REBA assessment

No	Work stations	Final score	Risk level	Action
1	Spindel	4	Moderate	Required
2	Radial	7	Moderate	Required
3	Tenon	6	Moderate	Required
4	Sanding	6	Moderate	Required
5	Drill	6	Moderate	Required
6	Mourtice	5	Moderate	Required
7	Assembly hind legs	4	Moderate	Required
8	Installation of locking the hind legs	5	Moderate	Required
9	Assembly seat	9	High	Required soon
10	Installation of the lock seat	9	High	Required soon
11	Assembly legs and seat	9	High	Required soon
12	Installation lock between leg and seat	6	Moderate	Required
13	Assembly arm	7	Moderate	Required
14	Installation of the lockng arm	6	Moderate	Required
15	Assembly woven	10	High	Required soon
16	Finishing grinding	7	Moderate	Required
17	Finishing webbing	5	Moderate	Required
18	Finishing fitting shoes	5	Moderate	Required

Table 2. The result of OWAS assessment

No	Work stations	Coding Trunk, Leg, Arm, Load	Risk Level	Action
1	Spindel	1111	1	Not required
2	Radial	1111	1	Not required
3	Tenon	2111	2	Maybe required
4	Sanding	1111	1	Not required
5	Drill	1221	1	Not required
6	Mourtice	2211	2	Maybe required
7	Assembly hind legs	2111	2	Maybe required
8	Installation of locking the hind legs	1211	1	Not required
9	Assembly seat	2511	3	Required soon
10	Installation of the lock seat	1211	1	Not required
11	Assembly legs and seat	2511	3	Required soon
12	Installation lock between leg and seat	1211	1	Not required
13	Assembly arm	2211	2	Maybe required
14	Installation of the lockng arm	2211	2	Maybe required
15	Assembly woven	2511	3	Required soon
16	Finishing grinding	2511	3	Required soon
17	Finishing webbing	1111	1	Not required
18	Finishing fitting shoes	2121	2	Maybe required

Table 3. The result of NBM assessment

No	Work stations	Working experience (year)	MSDs score	Risk level	Action
1	Spindel	3	60	Moderate	Required later
2	Radial	19	61	Moderate	Required later
3	Tenon	19	52	Moderate	Required later
4	Sanding	2	57	Moderate	Required later
5	Drill	16	69	Moderate	Required later
6	Mourtice	20	64	Moderate	Required later
7	Assembly hind legs	20	58	Moderate	Required later
8	Installation of locking the hind legs	18	73	High	Required soon
9	Assembly seat	18	75	High	Required soon
10	Installation of the lock seat	18	65	High	Required soon
11	Assembly legs and seat	17	65	High	Required soon
12	Installation lock between leg and seat	18	66	Moderate	Required later
13	Assembly arm	19	65	Moderate	Required later
14	Installation of the lockng arm	20	67	High	Required soon
15	Assembly woven	19	75	High	Required soon
16	Finishing grinding	20	61	Moderate	Required later
17	Finishing webbing	19	75	High	Required soon
18	Finishing fitting shoes	20	72	High	Required soon

interview by asking questions about the grievances felt by workers in 28 segments of the body from neck to toe by providing a scale of 1-4, where 1 indicates that the worker is almost no pain or pain, while the scale 4 shows that workers feel the complaint is very sick. From the results of the questionnaires, it can be done NBM calculating the total score of MSDs individuals as well as the risk level of each work station (see Table 3).

Based on comparative assessment by REBA method, OWAS and reinforced with NBM method it can be seen that the assembly work station OWAS seat has a high score, that is 3. As for the assessment by REBA method, the assembly work station obtained a score of 9 in which the score is smaller than with a woven assembly work stations. But the REBA assessment, a score of 9 and 10 is still in the same category that is at risk. Other that that the value of NBM on the seat assembly work

Figure 2. 3D seat assemblytabledesign

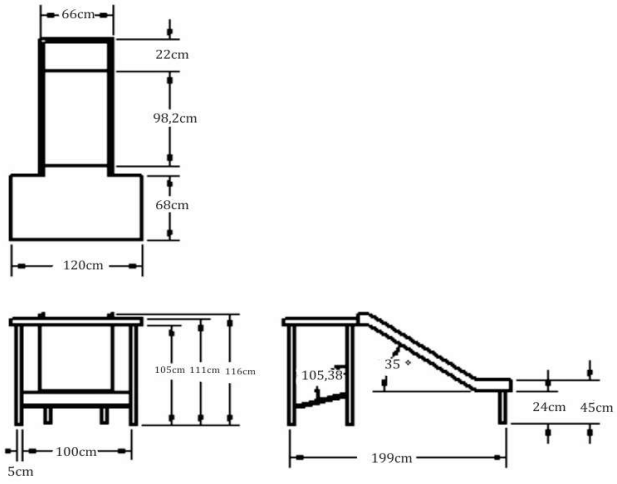

Figure **3.** 2D seat assemblytable design

station obtained the highest score is 75. Therefore, the work stations that have the highest risk score based on the assessment by REBA method, OWAS and reinforced with NBM methods that work station assembly seat so the focus of repairs will be done at the work station. Repair work at the station posture seat assembly is done by working facility design in the form of tables and chairs to seat concepts stand. Design created table there are two, the first is used for the assembly process while the second table is used to lay the material to be disassembly. Here is the result of facility design work (Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, and Fig. 7).

IV. CONCLUSION

Based on the analysis using REBA method shows that the work stations have a high risk and require immediate treatment are wovenassembly, installation of thelockseat, Installation locking beetwen legs dan seat. Assessment using OWAS method shows that the workstation has the highest risk seat assembly, assembly woven, Installation locking beetwen legs dan seat and gerinda finishing. Beside that, the value of NBM on the seat assembly work station obtained the highest score is 75. Therefore, the work stations that have the highest risk score based on the assessment by REBA method, OWAS and reinforced with NBM methods that is seta assembly work station. So the focus of improvement will be done at that work station.

The improvement of work posture done by designing facilities such as tables and chairs work in accordance with anthropometric workers by using the concept of sitting up.

Figure 4. 3D materialtable design

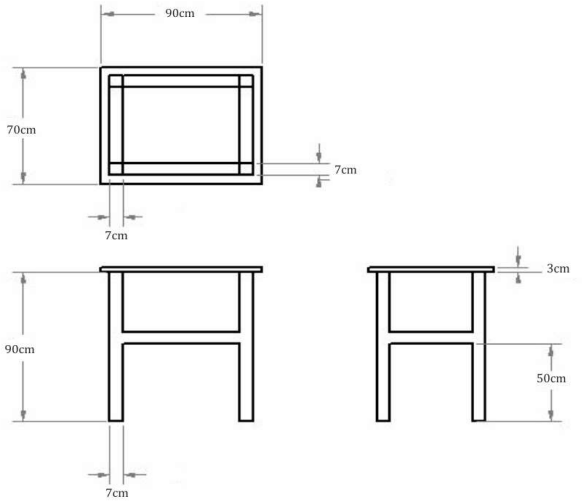

Figure 5. 2D Material table design

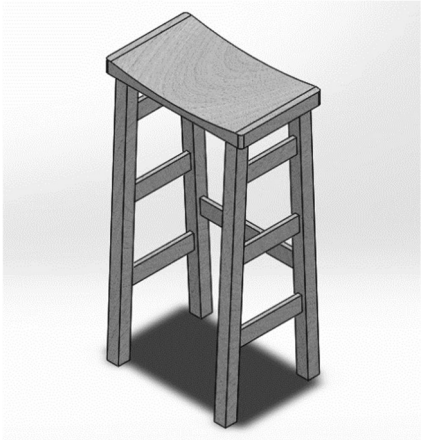

Figure 6. 3D seat proposeddesign

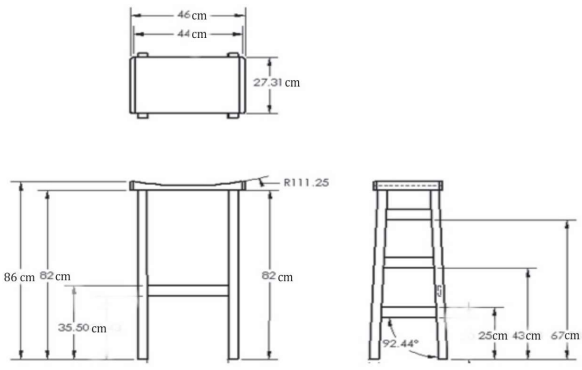

Figure7. 2D seat proposeddesign

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