Designing a lifting tool work using SNQ and anthropometry

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Abstract. The production process at PT. Florindo Makmur the operator manually raised 400 sacks during 1 work shift. The sack weight is 25 kg and the number of workers is 5 workers. The problem is that there is a workload on activities at packing stations that have an impact on operator health and safety. Based on the background described, there is a workload that results from a poor work posture which results in complaints from operators. The improvements are needed with the Ergonomics approach. Based on data processing and problem-solving analysis, activities carried out by operators on the production floor using manual methods result in complaints of the pain of the body section. Improvements after measurements of REBA are needed as soon as possible to improve work posture. The work facility that will be designed is an ergonomic hand truck that can ease the work at the packing station. The height of the hand truck is adjusted based on the operator's standing elbow height which is 79 cm because the operator can reach the right and left parts. The hand truck is also equipped with wheels.

1. Background
At the packing station there is an activity that results in operator complaints that the operator raises 400 sacks for 1 work shift. The sack weight is 25 kg and the number of workers is 5 workers. According to the ILO (International Labor Organization) if the burden lifted by 25 kg requires direct action to reduce the workload.
Figure 1. Manual Lifting by Operator at Packing Station

REBA method was used for ergonomic evaluation. Shoulders, middle back, hand and arm pain was identified. The evaluation results indicated a medium risk level for both work stations according to REBA. Recommendations for changes in equipment components and the workstation are presented and it is found that models that would help identify and evaluate ergonomic aspects related with AMT equipment are desirable among decision makers, owners and users [1]. Work-related musculoskeletal disorders (WMSDs) are considered an important source of occupational morbidity. Musculoskeletal disorders (MSDs) associated with occupational computer use are primarily linked to the upper limbs. MSD result from repeated motions, no rest sufficient, and forces placed on human bodies while performing various job actions. WMSDs are a group of painful disorders of muscles. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are examples. Unsuitable posture and over exertion forces or over exposure time are the causes of this disorder. Almost all work requires the use of the arms and hands. Therefore, most WMSD affect the hands, wrists, elbows, neck, and shoulders. Some back problems also result from repetitive activities. MSDs have been observed and experienced widely at workplaces where the computers are frequently used. MSDs are associated with high costs to employers, such as absenteeism, lost productivity, and increased health care, disability, and worker’s compensation costs. MSDs cases are more severe than the average nonfatal injury or illness [2]. The ergonomics approach in designing tools is emphasized in the research of the limitations of physical human abilities and their interactions in an integral human-machine system. Then the ergonomic approach systematically will then utilize that information for design goals, so that products, systems or work environments are more suitable to humans. Ergonomic design of tools will be able to improve efficiency, effectiveness and work productivity, and can create a suitable, safe, comfortable and healthy system and work environment so that the ENASE concept can be achieved (effective, comfortable, safe, healthy and efficient) [3].

Based on the background described above, there are workloads that result from poor work postures so that operators feel pain when working. So it needs improvement with the Ergonomics Approach by utilizing worker anthropometric data.
2. Methodology

2.1. Steps to Assess Workload and Work Posture
Here are some steps in the assessment of workload and work posture [4], namely:
- Share the SNQ questionnaire with workers
- Recapitulate complaints data from the questionnaire
- See the mode that appears in the complaint data
- Perform work posture measurements using REBA
- See results that show postures that need improvement

2.2. Corrective Steps Using the Ergonomics Approach
The following are some steps in improvement using the ergonomics approach, namely:
- Judging from the results of fishbone diagram problems related to workload and work posture of workers.
- Design improvements to work facilities and work methods

3. Analysis and Discussion

3.1. Assessment
Questionnaires were distributed to packing section operators who directly carried out activities that had the Standard Nordic Questionnaire (SNQ) distributed to the packing operator to find out complaints that occurred in the body part of the operator working in packing, sewing sacks and transporting to the forklift.

In the recapitulation of operator complaints, it was obtained that operators experience the most pain and pain in complaints number 1, 5, 7, 16, 17, 23, 24, 25, 26, and 27.

Work posture at tapioca flour packing stations is shown in the REBA (Rapid Entire Body Assessment) sheet:

- In carrying sacks to the weighing station, the operator works in a balanced manner but with the condition of the back bent up to 90o, the assessment carried out is necessary to act quickly on the left and right parts of the body.
- In sack sewing activities, the operator works in balance with the back not too bent, so the assessment is needed to take action to improve the work movement.
- In lifting flour to the forklift, the operator works with his back slightly bent. Assessment needs immediate action for the right body and the left body.

The following are some steps in improvement using the ergonomics approach. Based on activities related to body posture and workers' complaints, there is a flour stacking activity that has been carried out at the packing station. Measurement of posture in activity 14 to see which posture will be repaired with a repair facility. Measurement data can be seen in Table 1.

| Operator Activity 14 | Value of load | Grasp value | Value of load | Grasp value | Value of load | Grasp value |
|---------------------|---------------|-------------|---------------|-------------|---------------|-------------|
| Neck                | 1             | Wrist       | 2             |             |               |             |
| Leg                 | 1             | Lower Arm   | 2             |             |               |             |
| Body                | 4             | Upper Arm   | 3             |             |               |             |
| Tabel A             | 3             | Tabel B     | 5             |             |               |             |
After the activities to be repaired are selected, the next step is to improve the packing section facilities in accordance with worker anthropometric data [5]. The percentage of the data will be determined by the percentile value. The percentile value to be chosen is the 5th, 50th and 95th percentile values. The anthropometric data used in the calculation are standing elbow height (TSB) and hand reach (JT).

The following are the steps in calculating the anthropometric data percentile to be used:

- High Percentile Standing Elbow (TSB)

TSB data that has been tested for uniformity and test the adequacy of the data are then calculated as percentiles.

\[ P5 = \bar{x} - 1.645s \]

\[ = 105.1 - 1.645 (5.28) \]
\[
P_{50} = x \approx 96 \text{ cm}
\]
\[
P_{95} = x + 1.645s \approx 105 \text{ cm}
\]
\[
P_{95} = 105.1 + 1.645(5.28) \approx 113 \text{ cm}
\]

- Hand Reach Percentile (JT)

JT data that has been tested for uniformity and test for the adequacy of the data are then calculated as percentiles. P5 is 71 cm, P50 is 79 cm and P95 is 87 cm. Based on the calculations, the 50th percentile is chosen as a value that represents anthropometric data in carrying out the design process.

After the percentile value is obtained, the next step is to design work facilities [6][7]. The work facility that will be designed is an ergonomic hand truck that can ease the work at the packing station. The height of the hand truck is adjusted based on the operator's standing elbow height with a 50th percentile that is 105 cm and its length is based on the value of the hand reach with 50 percent, which is 79 cm because the operator can reach the right and left parts. The data is used in the design so that the operator does not bend while arranging the sack filled with flour and the operator can easily reach the sack to sew with the use of the JT width. The hand truck is also equipped with wheels so that in the transfer of the operator there is no need to lift and speed up the process at the packing station. The tool designed can be seen in Figure 2.

![Figure 2. Proposed Design of Handtruck for Workers](image)

4. Conclusion

Based on the results and discussion above, it can be concluded that by applying the Ergonomics approach, the quality of work can be improved. Especially when viewed from the perspective of Occupational Health and Safety. Through the use of SNQ and REBA, the workload and risk can be analyzed and assessed. While anthropometric data has been proven capable of assisting in the design of work aids to ease the workload and reduce the risk of injury to the workers.
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