Working Posture Improvement on Batik Coloring Process using Rapid Upper Limb Assessment Method

Agatha Sola Gracia Christy, Adelia Vira Andhini, Sinta Wulandari
Industrial Engineering Major, Faculty of Engineering
Dian Nuswantoro University, Semarang, Indonesia
gathachristy006@gmail.com, adelvira02@gmail.com, sintaw3883@gmail.com

Abstract

There are two techniques in Batik coloring process i.e dyeing process known as "pencelupan*"* and painting process known as *"*pencoletan*"*. "Pencoletan" process in Batik SMEs still improper in accordance with occupation health standard. This process performed manually without the right workbench even the right working posture. Most batik workers in Central Java still use inappropriate work postures, especially in the process of "pencoletan". Some complaints that are often experienced by batik workers is on their body, neck, arms and shoulders with 36% of complaint rate (Pratiwi & Kartikasari, 2018). In this paper, the researcher wants to analyze the various postures of workers at the "pencoletan" work station at Batik SMEs in Central Java as well as providing recommendations for improving the right work posture. Data and informationthat have been collected will be analyzed and synthesized using Rapid Upper Limb Assessment (RULA) on the Ergofellow Software. There are 3 work postures performed by workers in the "pencoletan" process, namely the working position with a chair and workbench, the working position without a chair and workbench, and the standing work position with workbench.The idea of this suggestion is expected to be a solution to the problem of improper work posture that impacts complaints on batik industry workers and will also have an impact on the quality of batik that will be produced.

Keywords
Pencoletan, RULA, Work Posture, Batik.

1. Introduction

Batik coloring is important aspect in the process of making Batik. There are two techniques in Batik coloring process i.e dyeing process known as "pencelupan*"* and painting process known as *"*pencoletan*"*. "Pencoletan" is an eminent stain technique in batik coloring process in Indonesia, which produces beautiful color variations on a batik cloth. "Pencoletan" process in Batik SMEs still improper in accordance with occupation health standard. Thus, "pencoletan" process have not been applied in accordance to ergonomics aspects. In ergonomics, humans are the most important component. Unfortunately, batik worker has limited knowledge about occupational safety and health, both short-term and long-term health impacts. It becomes one of the factors that increase the risk of work accidents and ergonomics problems.That ergonomics problems also caused by unstandardized work posture and repetitive work. According to Devreux, et al. (2012), some of these factors are related to the work environment, such as sustained and awkward postures, bending, carrying, repositioning or lifting patients.

"Pencoletan" process performed manually with various work posture by workers. Proper work posture will make the performance of batik coloring process more effective, more efficient, and more comfortable. Most batik workers in Central Java still use inappropriate work postures, especially in the process of "pencoletan". According to Shamsudin, et al. (2017), incorrect work posture will lead to work related musculoskeletal disorders (MSDs). Some complaints that are often experienced by batik workers is on their body, neck, arms and shoulders with 36% of complaint rate(Pratiwi, 2018).

Revolution of technology make it possible to identify complaints experienced by workers. Rapid Upper Limb Assessment (RULA) is one of the tools or methods that used to measure effective work posture through the risk value of musculoskeletal work posture experienced. RULA has final score between 1 and 7. The higher score the greater the risk level (Talab ,2017). Based on the complaints experienced by batik workers during work, it is necessary to improved working posture by concern to the level of risk of complaints so that inappropriate work

© IEOM Society International

postures can be fixed.The idea of this suggestion is expected to be a solution to the problem of improper work posture that impacts complaints on batik industry workers and will also have an impact on the quality of batik that will be produced.

1.1 Objectives

The goal of this research is to know the illustration of batik worker's bodies posture especially in the "pencoletan" process and providing recommendations for improving the right work posture that will impact the quality of batik that will be produced.

2. Literature Review

2.1 Ergonomics

Ergonomic comes from Greek word which means "work law", it also describes as "the effort to fit the system to the human" which means that to fit the unique human limitation and abilities by selecting and designing the informed decision, tasks, environment, tools and equipment (Kamat et al, 2017). S, Shwetha (2021) define ergonomics as the study of work and working conditions emphases on the people who do it and the way work is being done so as to improve people's efficiency.Ergonomics or human engineering deals with the aspect of man-machine system which means engineering the product or machine to fit the operator (Rajvir, 2020). Ergonomics also defined as an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely(HT, 2020). Ergonomics is to fit task to the individual but not to fit an individual to the task.Management should apply ergonomics in their workplace because the focus is on the indiviuals. People also should make understand the importance of it. Not only at the workplace at home also they should follow it in order to keep themselves Accident –free (Bretten, 1975).

2.2 Work Posture

Most of the production in the small-medium industries still rely heavily on human labor. Most of the work is done manually. Posture is defined as the physical position of the body, such as standing, sitting or lying down. Correct posture will minimizing tension and preserve the balance of muscle and skeletal body (Rizkya, 2018). Problem related to body posture and repetitive work is one of the problems of ergonomics and has the potency to cause Cumulative Trauma Disorder and Repetitive Strain Injuries(Suhardi et al., 2021). The posture may be regarded as the result of a large number of sense-motors integrated reflections, at different levels of the central nervous system, with an automatic and extremely precise adjustment (Carini et al, 2017).

2.3 Musculoskeletal Disorders

MSDs are complex group of painful disorders of tendons, muscles and ligaments caused by frequent and recurrent work activities or awkward occupational posture (Njaka et al., 2021).MSDs can be caused by different factors,such as over-stressing factors, physical factors (by exposure to biomechanical load applied to the musculoskeletal tissues that can cause MSDs)(Arenas, 2020). According to WHO Newsroom (2021),musculoskeletal conditions include conditions that affect joints, bones, muscles, and spine. Musculoskeletal conditions are also the biggest contributor to years lived with disability (YLDs) worldwide with approximately 149 million YLDS, accounting for 17% of all YLDs worldwide. The main contributor to the overall burder of musculoskeletal conditions is low back pain. Other contributors to the overall burden of musculoskeletal conditions are fractures, osteoarthritis, other injuries, neck pain, amputations, and rheumatoid arthritis. Ramadhani, et.al. (2018) state about the main cause of musculoskeletal disorders (MSDs) is improper or not ergonomic or poor working posture while doing activities in the workplace.

2.4 Rapid Upper Limb Assessment (RULA)

RULA was first developed in 1993 by McAtamney and Corel et al. This observational method is used to identify musculoskeletal disorder risk factors where tasks are performed in a sitting position and upper limb disorders are common (Talab, 2017). Rapid Upper Limb Assessment (RULA) is an assessment that used to analyze the disclosure

of workers to ergonomic risk related to upper extremity musculoskeletal disorder (Kamat et al., 2017). RULA is based on measurements of upper and lower arm position, wrist twist and position and neck and trunk positionto determine the final risk score(Jukariya & Singh, 2018). Final risk score in this method can be used as a reference that a worker's body posture is good or not, so that it can be used as the basis for a workstation redesign. RULA has final grades ranging from 1 (low risk) to 7 (high risk) (Widiyawati et al., 2020).

2. Methods

The methods that we use to collect data and information in this research paper are observation and literature studies. Observations done by observing the "pencoletan" process at Batik SMEs in Central Java.The object observed in this research is the work posture of the “pencoletan” process in Batik SMEs. The literature that we use in this research are in the form of journals, books, or other reliable literature that discusses ergonomics, work postures, MSDs, and RULA.

3. Data Collection

Based on observations and literature studies, the data acquired are work posture performed by batik workers in the “pencoletan” process.From the observations there are 3 work postures performed by workers in the “pencoletan” process, namely the working position with a chair and workbench (figure 1), the working position without a chair and workbench (figure 2), and the standing work position with workbench (figure 3). This work posture will be the main object in this research.

Figure 1. “Pencoletan” Work Posture with Chair and Workbench

Figure 2. “Pencoletan” Work Posture without Chair and Workbench

Figure 3. “Pencoletan” Work Posture With Workbench

From the three figures that have been observed, measurements of work posture will be generatingscore of complaints that occur in batik workers.

4. Results and Discussion

The angle measurement of the body posture such as neck, back, hands and wrists is done in advance before measuring the working posture.

5.1 Work Posture Data

The angle measurements can be seen in the Figure 4, Figure 5, and Figure 6.

Figure 4. "Pencoletan" Work Posture with Chair and Workbench Measurement

Figure 5. "Pencoletan" Work Posture without Chair and Workbench Measurement

Figure 6. "Pencoletan" Work Posture With Workbench Measurement

5.2 Assesment of Work Posture Using Worksheet

Assessment of body posture using a worksheet of three batik workers in the "pencoletan" process is done by classifieds into two segments of body posture assessment, which is body posture assessment group A and body posture assessment group B. Group A body posture assessment includes upper arms, lower arms, wrists, and wrist twist. While the assessment of body posture in group B includes neck, trunk, and legs.

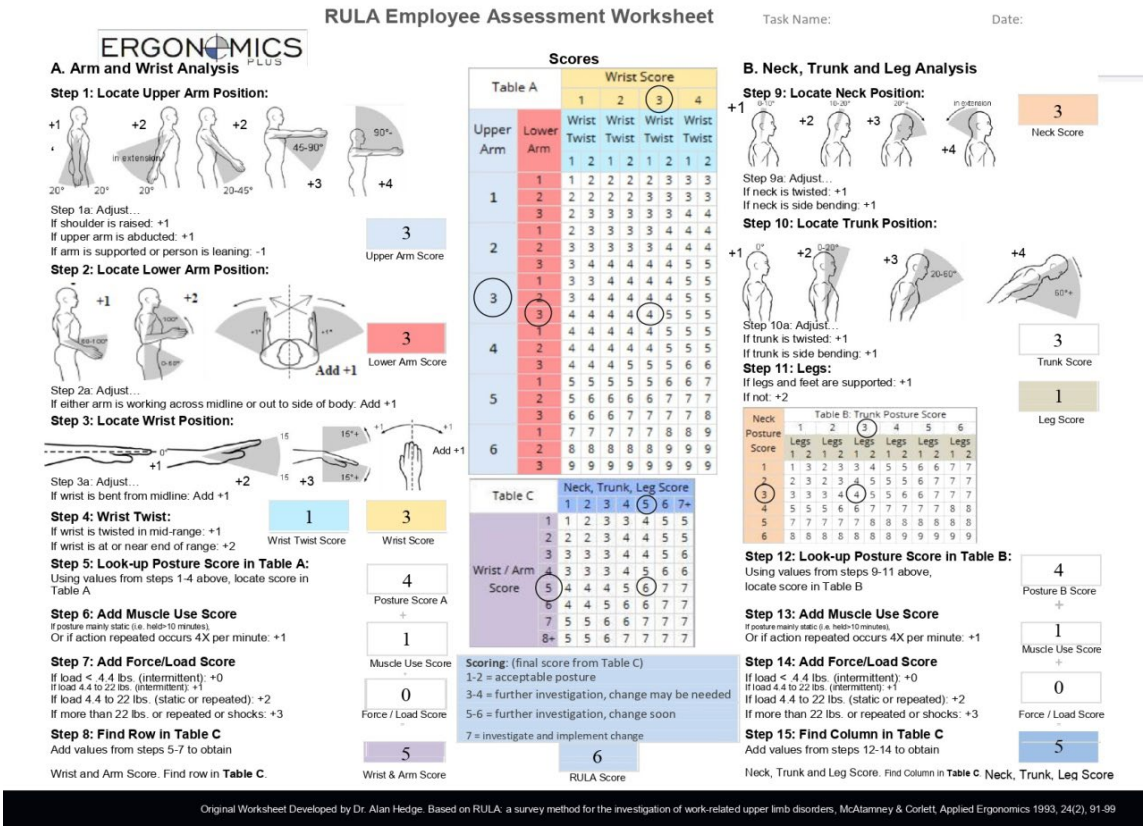

Figure 7. Assesment of "Pencoletan" Work Posture with Chair and Workbench

In the figure 7, the upper arm score is 3, lower arm 3, wrist twist score 1, wrist score 3, neck 3, trunk 3, and legs 1, therefore the RULA score is 6, that means further investigation and immediate improvements is needed.

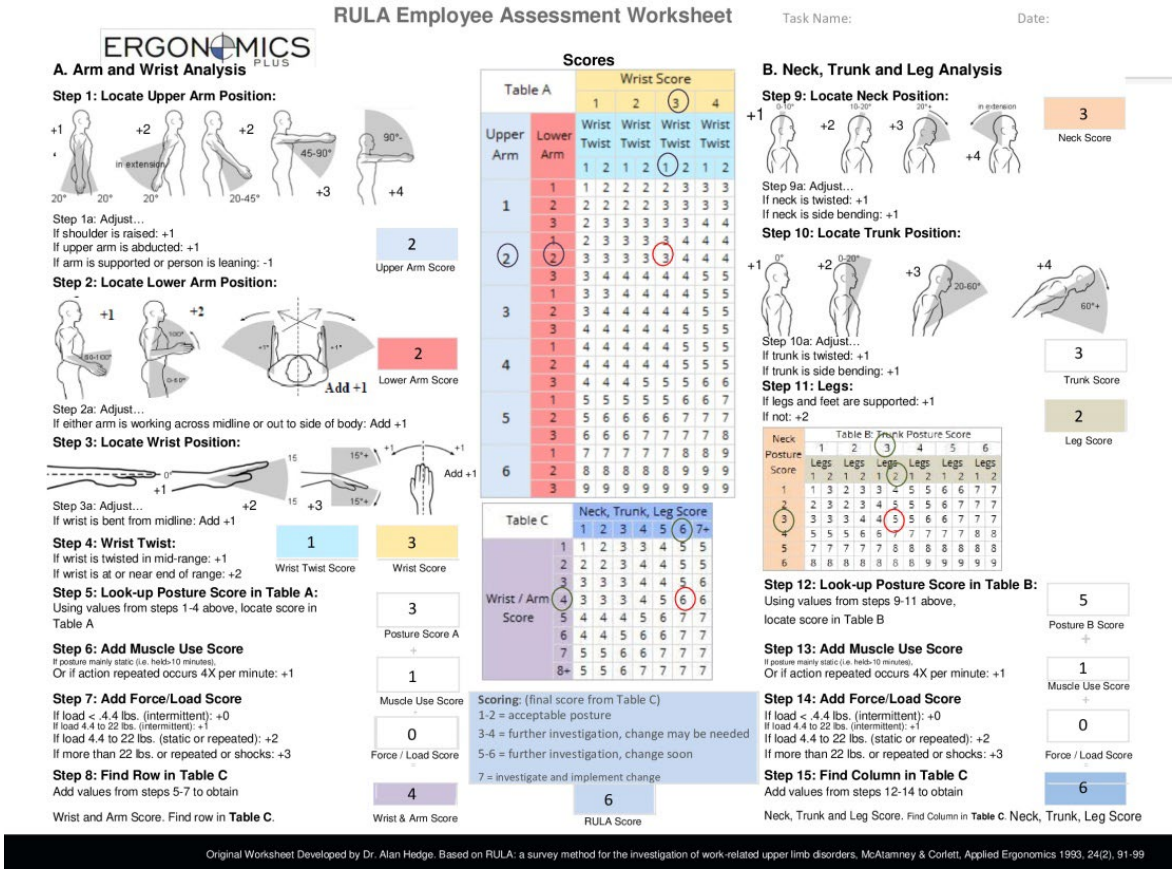

Figure 8. Assesment of "Pencoletan" Work Posture without Chair and Workbench

In the figure 8, the upper arm score is 1, lower arm 1, wrist twist score 1, wrist score 3, neck 3, trunk 3, and legs 2, that means further investigation and immediate improvements is needed.

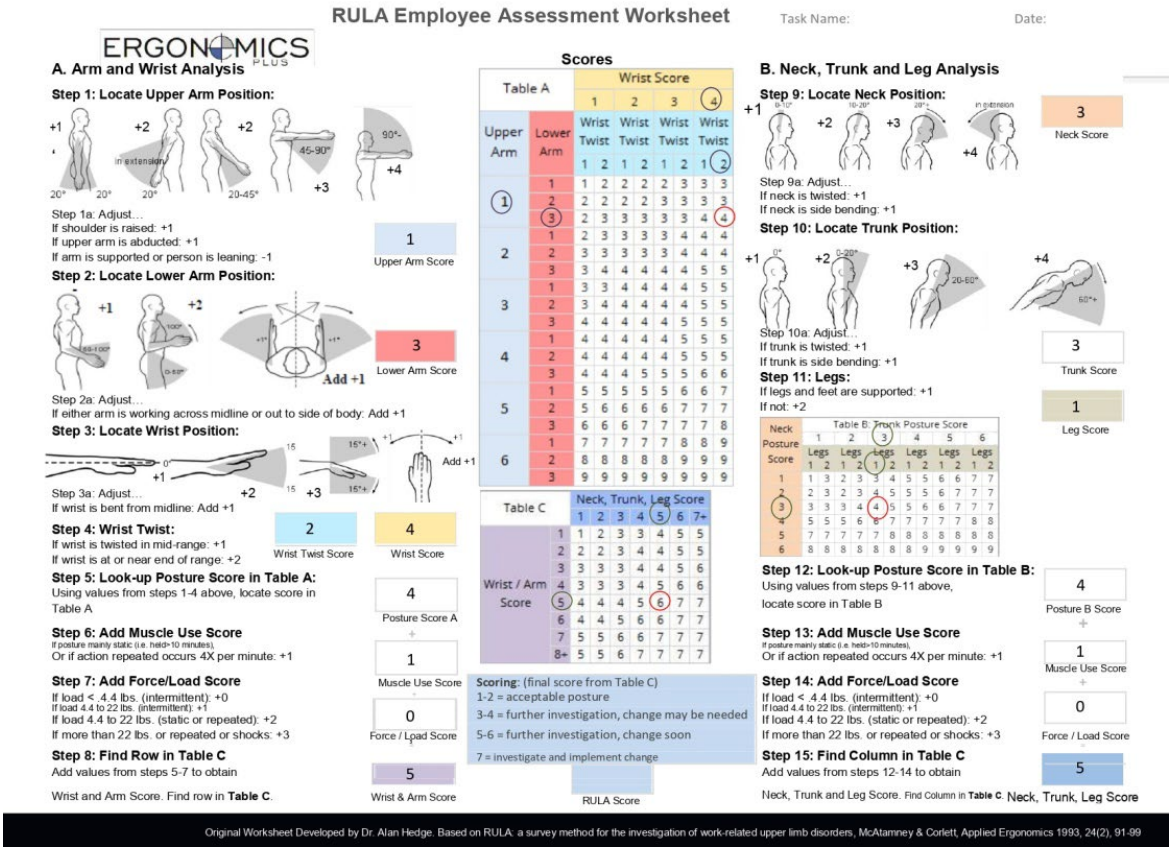

Figure 9. Assesment of "Pencoletan" Work Posture with Workbench

In the figure 9, upper arm score of 1, lower arm 3, wrist twist score 2, wrist score 4, neck 3, trunk 3, and legs 1, so that means further investigation and immediate improvements is needed.

5.3 Rapid Upper Limb Assesment (RULA) using Ergofellow

Rapid Upper Limb Assessment of body posture using ergofellow software on the three batik workers in the "pencoletan" process isdone by filling in the scores for each column for assessing body posture on the neck, trunk, wrists, and wrists twist.

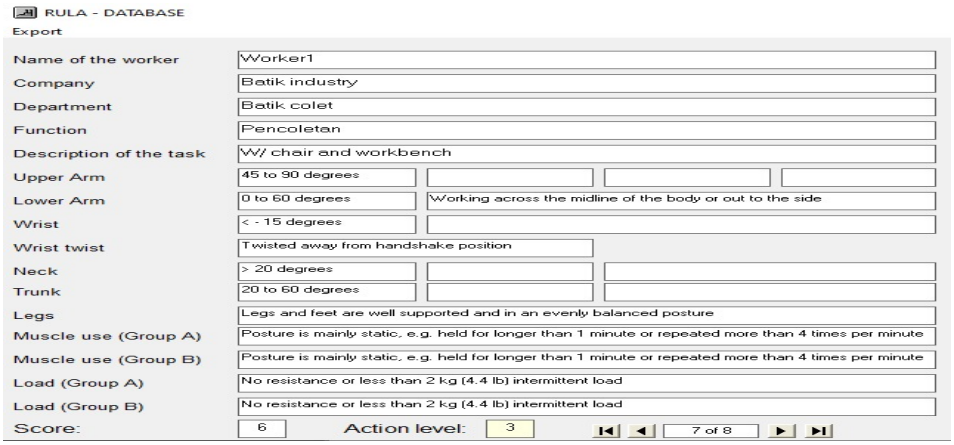

Figure 10. RULA Summary of "Pencoletan" Work Posture with Chair and Workbench

Figure 10 shows a RULA summary of "Pencoletan" Work Posture with Chair and Workbench using ergofellow software. The score that appears in the software is accordance to the score on the RULA worksheet, which is 6.

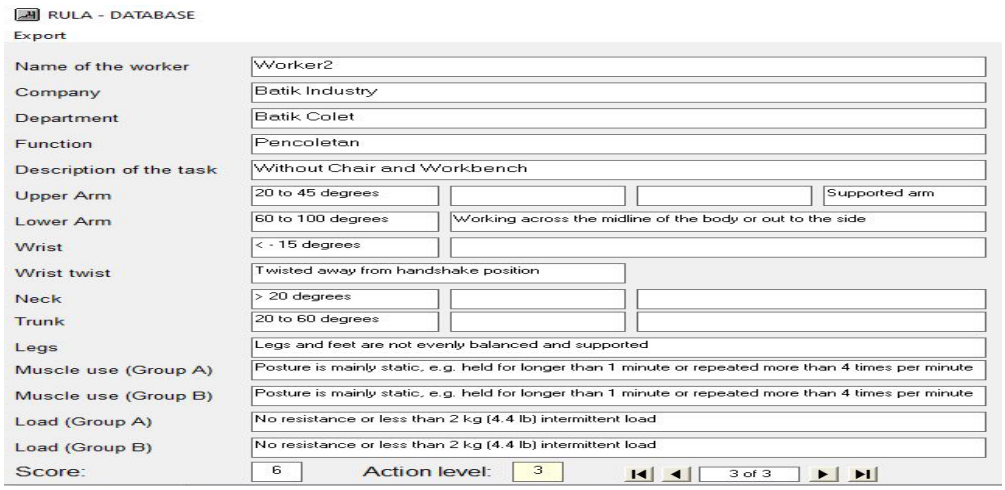

Figure 11. RULA Summary of "Pencoletan" Work Posture without Chair and Workbench

Figure 11 shows a RULA summary of "Pencoletan" Work Posture with Chair and Workbench using ergofellow software. The score that appears in the software is accordance to the score on the RULA worksheet, which is 6.

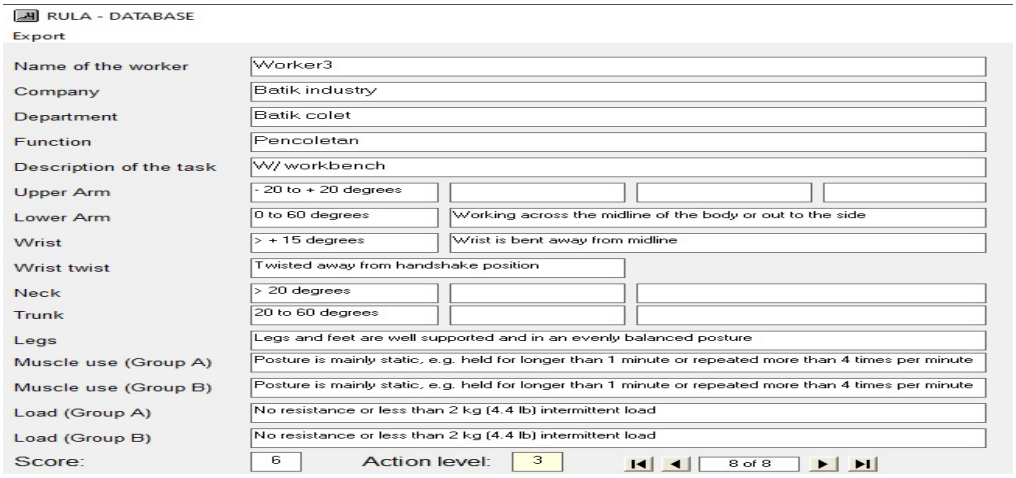

Figure 12. RULA Summary of "Pencoletan" Work Posture without Chair and Workbench

Figure 12 shows a RULA summary of "Pencoletan" Work Posture with Chair and Workbench using ergofellow software. The score that appears in the software is accordance to the score on the RULA worksheet, which is 6.

From the three assessments of work posture for musculoskeletal complaints experienced, the total score for the assessment of body posture is obtained.

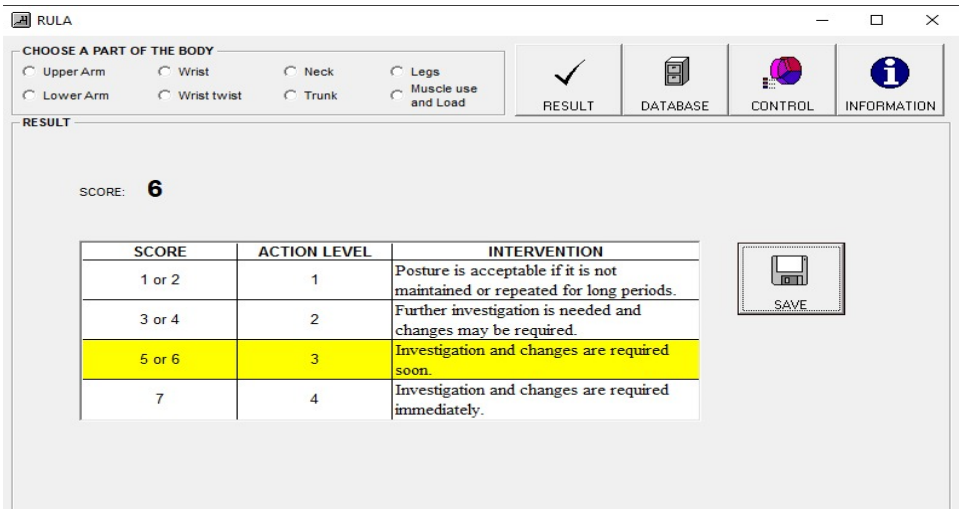

Figure 13. Total Score of RULAusing Ergofellow

Figure 13 shows the final score of RULA using ergofellow. The score that appears is 6 that means further investigation and immediate improvements is needed.

5.4 Proposed Body Posture Improvement of Batik Workers

Assessment of body posture using the RULA method shows a fairly high score, which is 6 that means further investigation and immediate improvements of work posture is needed in the "pencoletan" process. Therefore, researcher suggest to fixes posture as a solution to reduce musculosceletal complaints that occur in workers. The suggestion to improve the work posture of workers in the "pencoletan" process is the work posture in a sitting position with chair and a workbench because it is considered to have the lowest risk of injury.

5.4.2 RULA Summary of Proposed Body Posture Improvement

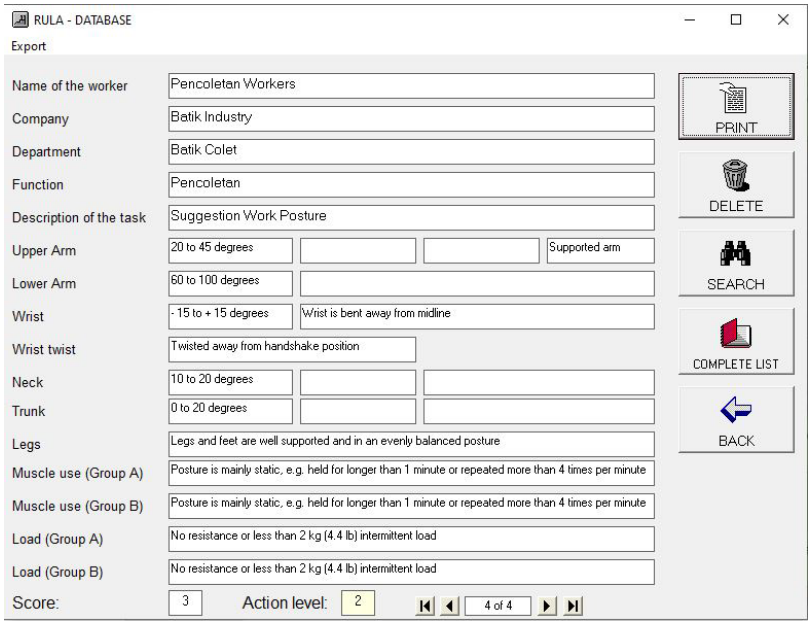

Figure 14. RULA Summary of Proposed Body Posture Improvement

Figure 14 shows a RULA Summary of Proposed Body Posture Improvement using ergofellow software. The score that appears in the software is 3.

5.4.2 Total Score of RULA of Proposed Body Posture Improvement

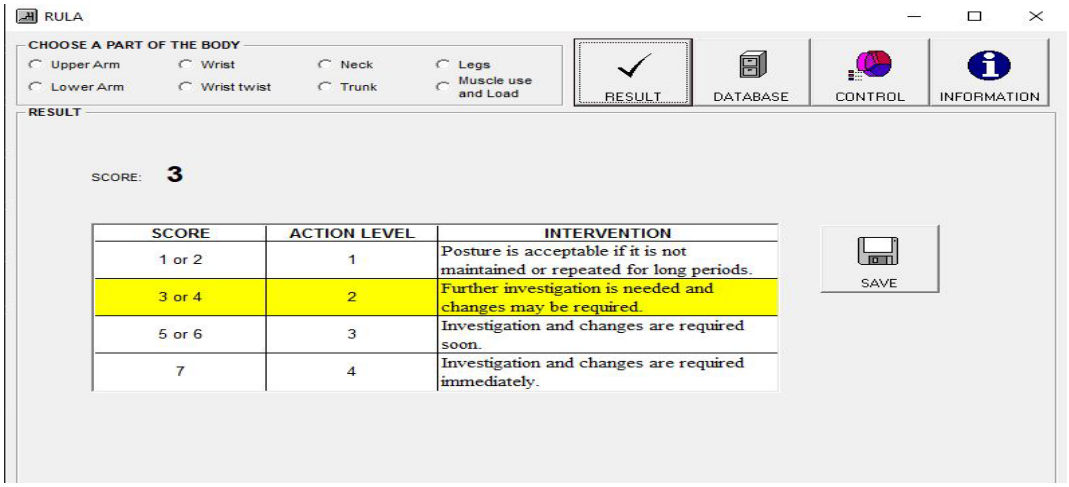

Figure 15. Total Score of RULA of Proposed Body Posture Improvement

Based on the RULA score of proposed body posture improvement which is 3, shows in Figure 15, that means the score is smaller than the existing posture.

5. Conclusion

Based on the results of observations and literature studies, there are 3 work postures performed by workers in the "pencoletan" process, namely the working position with a chair and workbench, the working position without a chair and workbench, and the standing work position with workbench. From the observations of3 work positions resulted in a RULA score of 6 that means further investigation and immediate improvements is needed. Therefore, researcher suggest to fixes posture as a solution to reduce musculosceletal complaints that occur in workers by considering the measurement of the working position angle and the RULA score from the observations of the three postures that have been done previously. The suggestion to improve the work posture of workers in the "pencoletan" process is the work posture in a sitting position with chair and a workbench because it is considered to have the lowest risk of injury.

References

Arenas, G. N. (2020). Ergonomic Risk By: Repetitive Movements, in the Operators of a Crude Oil Production Plant. *Ergonomics International Journal*, *4*(4). https://doi.org/10.23880/eoij-16000245

Bretten, P. (1975). Ergonomics. *Physiotherapy*, *61*(5), 146–149. https://doi.org/10.23880/eoij-16000239

HT, P. (2020). Role of Ergonomics and Innovation during Covid-19 Pandemic. *Ergonomics International Journal*, *4*(3), 2953. https://doi.org/10.23880/eoij-16000238

Jukariya, T., & Singh, S. (2018). Musculo-Skeletal Disorders (MSDs) Risk Assessment among Goldsmiths by Using RULA (Rapid Upper Limb Assessment) Method. *International Journal of Advances in Agricultural Science and Technology*, *5*(2), 33–39. www.ijaast.com

Kamat, S. R., Md Zula, N. E. N., Rayme, N. S., Shamsuddin, S., & Husain, K. (2017). The ergonomics body posture on repetitive and heavy lifting activities of workers in aerospace manufacturing warehouse. *IOP Conference Series: Materials Science and Engineering*, *210*(1). https://doi.org/10.1088/1757-899X/210/1/012079

Njaka, S., Mohd Yusoff, D., Anua, S. M., Kueh, Y. C., & Edeogu, C. O. (2021). Musculoskeletal disorders (MSDs) and their associated factors among quarry workers in Nigeria: A cross-sectional study. *Heliyon*, *7*(2), e06130. https://doi.org/10.1016/j.heliyon.2021.e06130

Pratiwi, I., & Kartikasari, I. (2018). Evaluation of work posture for non repetitive job in Kampoeng Batik Laweyan using PATH and OWAS method. *AIP Conference Proceedings*, *1977*(June). https://doi.org/10.1063/1.5042907

Suhardi, B., M, K. B., & A, R. D. (2021). Improvement Of Work Posture In Yarn Removal Operator To Reduce Risk Of Musculoskeletal Disorders. *Article in International Journal of Scientific & Technology Research*, *10*(02), 230–236. www.ijstr.org

Widiyawati, S., Lukodono, R. P., Lustyana, A. T., & Pradana, I. A. (2020). Investigation of the risk of daily officer work posture based on rapid upper limb assessment (rula) method. *International Journal of Human Movement and Sports Sciences*, *8*(1), 24–31. https://doi.org/10.13189/saj.2020.080103

Biographies

Agatha Sola Gracia Christy is a student in the Industrial Engineering Study Program, Faculty of Engineering at Dian Nuswantoro University, Semarang. She has participated in the 2020 Indonesian Essay Writing Competition held by Samudra University, Aceh and won 2nd place at that competition. She has also participated in several scientific writing competitions such as the 2021 National Essay Competition held by STIKes Bakti Husada, Tasikmalaya and Logistic Case Competition held by IPB University.

Adelia Vira Andhini is a third years student in Dian Nuswantoro University Semarang in Industrial Engineering Major. She has been joining Industrial Engineering Student Association since her first years in college and currently she is serves as the Treasurer of Industrial Engineering Student Association. She has also several times joined the committee of various seminars and competitions such as Industrial Engineering National Seminar 2019 "Big Data di Era Industri 4.0" and Industrial CAD Competition 2020 at Dian Nuswantoro University.

Sinta Wulandari is a student in the Industrial Engineering Major at Dian Nuswantoro University, Semarang. She has been joining the Student Executive Board of the Faculty of Engineering since her first years in college and currently she is serves as secretary. She has achieved 5th place in the 2020 Industrial Idea National Scientific Writing Competition held by Telkom Purwokerto Institute of Technology and 3rd place in the 2nd National Student Scientific Writing Competition 2021 held by Duta Bangsa Surakarta University.