



## IMPROVEMENT OF WORK METHOD TO REDUCE REPETITIVE WORK IN PT. TRIJAYA PLASTIK UTAMA WITH OCRA METHOD

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### ABSTRACT

*PT. Trijaya Plastik Utama is a company that manufactures raincoats. Based on the results of interviews with workers in 3 production departments, most experienced complaints in the upper limbs, especially the neck, back, and hands. Most of the work does repetitive activities with long cycles, so the nature of the work is suspected to cause musculoskeletal disorders for the operator. This study aims to identify the presence of musculoskeletal risks due to repetitive work using the Occupational Repetitive Action (OCRA) method. Based on the identification results of each department section, the packing section has the highest OCRA index value with a value of 3.86 for the right hand and 3.01 for the left hand. Improvement efforts to reduce risk due to repetitive work is to apply the concept of Eliminate, Combine, Re-Arrange and Simplify (ECRS) and the proposed design of work facilities. As a result, the OCRA index value dropped to 0.95 for the right hand and 0.85 for the left hand where the conditions were optimal.*

### INTRODUCTION

Humans are one factor that has an important role in an industry. At present there are still many industries that involve human labor directly in the production process, especially small and medium industries. This is due to the fact that most of the tools used are manual that require humans to operate. Nadri et al (2015) states that an increasing number of industrial diseases that occur such as accidents, cardiovascular disease and musculoskeletal disorders are caused by most of the work done manually. Musculoskeletal disorders (MSDs) are a significant problem in industrialized countries that have an impact on economic and social conditions, such as declining quality, productivity and causing health problems (Chiasson et al, 2012). Musculoskeletal disorders are a grouping of diseases / disorders caused by repetitive activities, static work, and unnatural work postures (Ma'ruf, Adiyanto, & Triesnaningrum, 2020).

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Unnatural work postures can cause injury to workers (Susihono and Prasetyo, 2012; Sari et al, 2017; Pembayung et al, 2018). Workers are often not aware that work postures arising from work can cause bodily injury which can result in MSDs. Efforts that can be made to reduce these risks are by evaluating or evaluating ergonomics, one of which is work posture analysis. One method of working posture analysis is the Occupational Repetitive Action (OCRA) method. OCRA method is a quantitative method that identifies procedure used in repetitive work, especially on the upper part (Occhipinti and Colombini, 2004). This method is predictive to the occupational risk of upper limbs associated with musculoskeletal disorders. This method pays attention to 5 objective factors and 1 subjective factor. OCRA Index is a ratio between Actual Technical Action (ATA) or actual technical action with Recommended Technical Action (RTA) or recommended technical action (The International Organization Standard, 2007).

Several previous studies have used OCRA methods to assess repetitive work. Application of OCRA methods in the industrial sector, for example Sharma and Singh (2016) in the production of bearing race, Najarkola (2006) in the metal industry. Madia et al (2006) in the textile industry. Habibi et al (2012) assessed the physical risk of workers in the handicraft industry. The application of OCRA methods in the agriculture and livestock sector, for example Reis et al (2017) in the livestock industry, Anwar and Putri (2017) in the corn seed factory, Colantoni et al (2012) in the vegetable industry. Ruddy et al (2012) applied the OCRA method in the process of harvesting sugar cane. OCRA level risks are also proven to be in line with the results of risk assessment with other observation methods. Roman Liu et al (2013) show that OCRA and ULRA values can produce the same assessment of the burden of the upper limb. Joseph et al (2011) prove a positive relationship between QEC and OCRA results. Franseda et al (2014) tried to prove the relationship between EU-WRMSDs and their relationship with work biomechanics based on the OCRA method. Motamedzade et al (2018) tried to compare the HAL-TLV, Strain Index, OCRA and ART methods to analyze repetitive work.

PT. Trijaya Plastik Laweyan is a company that produce raincoat. There are 3 production departments in PT. Trijaya Plastik namely the screen printing department, assembly department, and finishing department. Each department consists of several sections that carry out different work activities. The number of workers in PT. Trijaya Plastik Utama currently are 60 people whose working hours per day are 8 hours, from 07:00 WIB to 15:00 WIB. Based on the results of interviews with operators in each production department, most workers experienced complaints about the upper body limb, like the neck, back and hands after finishing their work. With an average number of raincoat production per day, that are 500 sets, and most of the works done by repetitive activities with a long cycle, then the nature of the work is suspected to cause musculoskeletal disorders for the operator. The presence of musculoskeletal disorders is an indication that work methods and work conditions still do not meet ergonomic work standards. This study aims to identify the symptoms of musculoskeletal disorders among workers in the production of raincoat.

## RESEARCH METHOD

The study was conducted in 3 production departments. They are the screen printing department in the plastic presses of screen printing section and attach ret section, the assembly department in the periphery tide section, and the finishing department in the packing section. Research methods conducted in data collection are record documentation of workers' activities, work duration and cycle time in 4 sections of production. Retrieval of employee activity data is used to determine the technical actions of each part of the production. The next step is the processing of the collected data using the OCRA Index method to get the initial index and determine the risk evaluation. OCRA index is a comparison between Actual Technical Action (ATA) value and Recommended Technical Action (RTA) value.

$$OCRA\ Index = \frac{Actual\ Technical\ Action\ (\Sigma ATA)}{Recommended\ Technical\ Action\ (\Sigma RTA)} \quad (1)$$

ATA is the number of actual technical actions taken by the operator in work station. The steps to determine ATA are as follows:

1. Determine the number of technical actions. Video recordings are played back in slow motion (slow motion) to identify technical actions and count the number of technical actions.
2. Determine the frequency per minute by dividing the number of technical actions with the time in one cycle.
3. Determine the duration of repetitive work, that is the interval of that repetitive work which done by operator in one work shift in minutes
4. Determine ATA by multiplying the frequency per minute and the duration of repetitive work

$$ATA = (\text{The frequency of technical actions}) \times (\text{The total duration of repetitive work}) \quad (2)$$

RTA is a recommended technical action during 1 shift, by doing the calculation where observed technical action multiplied by the weight of the strength factor calculation results, posture and movement, additional factors, lack of recovery period and duration of repetitive work (Febrianti, et al 2017). The steps to determine RTA are as follows:

1. Strength Factor (Ff)  
Determination of the deployment of strength when working is using the Borg scale. The selection of Borg scale that used is by calculating the average score of the used technical actions.
2. Posture Factor (Fp)  
Determine the factors of posture and movement of the operator is by observing the movement of the hand segments like the shoulders, wrists, elbows, and hand grips. Then, select the smallest multiplier factor score of the four hand segments as a score of the posture and movement factors.
3. Additional Risk Factor (Fc)  
Additional risk factors are considered because they are not always present, if risk factors are not present, then the value is equal to 0. Determination of the risk factor score if one or more additional factors exist for 25% -50% of the cycle time then the multiplying factor is 0.95, while if 51% -80% of the cycle time the multiplying factor is 0.9, and if > 80 % of cycle time, the multiplying factor is 0.8.
4. Recovery Period Factor (Fr)  
Recovery time is the time where the hand is at rest. Table 2 is a factor of recovery period.
5. Duration Factor (Fd)  
The duration factor is based on the duration or the length of time where workers make repetitive movements in 1 work shift. To change the duration of repetitive work into a duration factor (Fd), it can be seen in Table 1.

Table 1. Repetitive work duration factor

Repetitive work duration (minute)	< 121	121-180	181-240	241-300	301-360	361-420	421-480	>480
Fd	2	1.7	1.5	1.3	1.2	1.1	1	0.5

6. The following formula calculates the total number of Recommended Technical Actions (RTA) in a shift:

$$RTA = \sum_{i=1}^n [CF \times (Ffi \times Fpi \times Fci) \times Di] \times Fr \times Fd \quad (3)$$

7. The RTA calculation results are then compared with the OCRA Index.

8. The proposed improvement using the ECRS concept (Eliminate, Combine, Re-Arrange, Simplify) is used to improve work methods and make a balance work between the right hand and the left hand so it can reduce repetitive movements and reduce cycle time at the work station that need to be improved.

## RESULTS AND DISCUSSION

### A. The Calculation of Actual Technical Action (ATA)

Work activity data on the packing section in 1 work shift as many as 171 cycles with a work duration of 405 minutes. The technical action of one cycle in the packing section can be seen in Table 2.

Table 2. Technical action in the packing section

Technical Action	Total	Time (Second)	Technical Action	Total	Times (Second)
Holding the sack	90	83	Putting raincoat into the sack	90	83
Moving the sack	1	3.73	Moving the sack	1	3.73
Tidy up the tip of the sack	6	12	Tidy up the tip of the sack	6	12
Folding the tip of the sack	10	16.22	Pick up iron	1	3.54
			Folding the tip of the sack	10	16.22
			Pick up sewing tools	1	2.88
Sewing the sack	5	12.46	Sewing the sack	5	12.45
			Put down the sewing tools	1	4.1
Mowing the sewn up sack	1	3.1	Moving the sewn up sack	1	3.1
<b>Total</b>	<b>113</b>	<b>130.5</b>	<b>Total</b>	<b>116</b>	<b>141.02</b>

The frequency of technical actions produced for the right hand is 47.678 actions / minute and the left hand is 47.678 actions / minute with a total repetitive work is 405 minutes. The ATA value based on equation (2) for the right hand is 19,309.5 actions and the left hand is 18,810.11 actions.

### B. The Calculation of Recommended Technical Action (RTA)

#### 1. Strength Factor (Ff)

The action that requires the smallest muscle strength, is given a value of 0.5 on the Borg scale. Then this value is used as a reference to assess other actions. The action that requires the smallest packing operator muscle strength is tidying the end of the sack and it is given a value of 0.5 on the Borg scale. Strength data using the CR-10 Borg scale approach for the right hand of the packing operator can be seen in Table 3 and for the left hand in Table 4.

Table 3. Calculation of CR-10 Borg scale for right hand

Right Hand's Technical Action	Times (Second)	Borg's Scale Score	Times Proportion (1 Cycle)	Average Score
Putting raincoat into the sack	83	1.5	0.569	0.853
Moving the sack	3.73	3	0.026	0.077
Tidy up the tip of the sack	12	0.5	0.082	0.041
Pick up iron	3.54	0.5	0.024	0.012
Folding the tip of the sack	16.22	1	0.111	0.111
Pick up sewing tools	2.88	1	0.02	0.02
Sewing the sack	12.45	2	0.085	0.171
Put down the sewing tools	4.1	1	0.028	0.028
Lifting the sack	3.1	3	0.021	0.064
<b>Total</b>	<b>141.02</b>			<b>1.376</b>
	<b>Strenght Factor</b>			<b>0.7748</b>

Table 4. Calculation of CR-10 Borg scale for left hand

Left Hand's Technical Action	Times (Second)	Borg's Scale Score	Times Proportion (1 Cycle)	Average Score
Holding the sack	83	1	0.569	0.57
Moving the sack	3.73	3	0.026	0.08
Tidy up the tip of the sack	12	0.5	0.082	0.04
Folding the tip of the sack	16.22	1	0.111	0.11
Sewing the sack	12.45	2	0.085	0.17
Lifting the sack	3.1	3	0.021	0.06
<b>Total</b>	<b>130.5</b>			<b>1.030</b>
	<b>Strenght Factor</b>			<b>0.822</b>

## 2. Posture Factor (Fp)

Based on the measurement results that the posture of taking iron experienced shoulder flexion or abduction  $> 80^\circ$  with a proportion of time of 2% of cycle time and experienced elbow flexion-extension motion  $\geq 60^\circ$  with a proportion of 9% of cycle time. The type of grip on *palmar grip* in the activity of moving sacks has a proportion of 5% of the cycle time and the type of grip on *pinch grip* has a proportion of 84% of the cycle time. The posture score for the right hand is 0.6 and the left hand is 0.7.

## 3. Recovery Period Factor (Fr)

The risk value in the event of a lack of recovery period is 1 for the right hand because the comparison between actual work time and actual rest time  $> 10:1$  then the risk factor for recovery period is 0.9. Whereas, the left hand has a risk value of 0 with a risk factor of 1.

## 4. Duration Factor (Fd)

The duration factor based on Table 1 shows that the duration of repetitive work for 405 minutes has a multiplier factor of 1.1. RTA calculation based on equation (3) is as follows:

$$\begin{aligned} \text{RTA of The Right Hand} &= (30 \text{ action/minute} \times 0.7448 \times 0.6 \times 405 \text{ minute} \times 0.9 \times 1.1) \\ &= 5,246.18 \text{ actions} \end{aligned}$$

$$\begin{aligned} \text{RTA of The Left Hand} &= (30 \text{ action/minute} \times 0.822 \times 0.7 \times 405 \text{ minute} \times 1 \times 1.1) \\ &= 6,991.1 \text{ actions} \end{aligned}$$

OCRA Index calculations based on equation (1) are as follows:

$$\begin{aligned} \text{OCRA Index for the right hand} &= \frac{19,309.5}{5,246.18} \\ &= 3.86 \end{aligned}$$

$$\begin{aligned} \text{OCRA Index for the left hand} &= \frac{18,810.11}{6,991.1} \\ &= 3.01 \end{aligned}$$

The classification of the OCRA Index of the right hand is 3.86 (3.6 - 4.5) included in the *Red-Low* area which means that the condition on the right hand is at low risk of experiencing musculoskeletal disorders. While the left hand has a value of 3.01 (2.3 - 3.5) included in the *Yellow* area which means that the condition on the left hand needs to be checked or improved.

## C. Proposed Improvement

Based on the OCRA Index classification, in the packing section, improvements are needed because the right hand is included in the *Red-Low* area which indicates a risk of experiencing musculoskeletal disorders, and the left hand is included in the *Yellow* area which indicates the condition needs to be checked or improved. The concept of ECRS (Eliminate, Combine, Rearrange, Simplify) is used to improve work methods and improve work elements so that it can result in a reduction of cycle time in the packing section. Improvements using ECRS concept can be seen in Table 5.

Table 5. The Improvement of work elements in packing section

Before Improvement			After Improvement		
Section: Packing			Section: Packing		
No	Tasks	Process Time (Second)	No	Tasks	Process Time (Second)
1	Putting raincoat into the sack	83	1	Putting raincoat into the sack	83
2	Moving the sack	3.73	2	Pick up iron	1.93
3	Tidy up the tip of the sack	12	3	Tidy up the tip of the sack using the iron	28
4	Pick up iron	3.54	4	Pick up sewing tools	2.88
5	Folding the tip of the sack	16.22	5	Sewing the sack	12.45
6	Pick up sewing tools	2.88	6	Put down the sewing tools	4.1
7	Sewing the sack	12.45	7	Moving the sewn up sack	2.72
8	Put down the sewing tools	4.1	<b>Total</b>		<b>135.08</b>
9	Moving the sewn up sack	3.1			
<b>Total</b>		<b>141.02</b>			

Information:

Task number 2 is deleted (before improvement)
Task number 4 (before improvement) is changed to task number 2 (after improvement)
Task number 3 and 5 (before improvement) are combined into task number 3 (after improvement)

Based on the table above, the details of the improvement made for the packing section are as follows:

- a. Eliminate  
The improvement of work elements using *eliminate* occurs in work element that is moving the sack before it is sewn. The elimination of the work elements is carried out to be more efficient so it can reduce cycle times in packing activities.
- b. Combine  
The improvement of work elements using *combine* occurs in work elements, that are tidy up the end of the sack before sewing in 12 seconds and fold the end of the sack using iron with a time of 16.22 seconds. That work elements can be simplified into one work element, which is to tidy up and fold the end of the sack with 28 seconds of time.
- c. Re-arrange  
The improvement of work elements using *rearrange* occurs in work element taking the iron where the work element was previously in fourth of sequence. After re-arranging the work element, the work element taking the iron become the second in sequence, which is after the operator put the raincoat in the sack.

#### D. Proposed Work Facility Design

The design of work facilities is carried out based on the desire and needs of the owner and operator of the packing section by considering the results of the assessment based on the OCRA method. Based on the stage to build the concept of NIDA, an alternative design was found in the form of packing aids as a place to put sack during the packing process so that the operator does not need to hold the sack and so that the sack remained upright during the process of inserting a raincoat into it. The design of the proposed work facilities for packing aids is shown in the following figure:



Figure 1. 3D display of packing aids

The size of the tool matches the size of the bag which is 1140 mm x 750 mm and it is equipped with a handle to facilitate the operator to push that. In addition there is an iron holder attached to the side of the tool to facilitate the operator when they need the iron to fold the sack. So the operators do not need to take the iron that was previously placed on the left side which requires the operator to bend the body to pick it up. The tool is equipped with a slot at the front side so that it can be opened or closed which has the function to remove the sack after it is sewn.

By using that tool, there is a change in the work method from before. In the proposed design, the activities of both hands can be balanced because both hands can put a raincoat together and do not need to hold a sack anymore. In addition, there is no longer any lifting activity and moving sacks that require a large operator's hand power, but rather the operators can simply push the tool to move the sack. Also, the operators do not need to carry out bending movements to insert a raincoat into the sack.

#### E. Determination of the Effect of Improving Working Methods

Based on the previous ATA calculation, it can be seen that operators use their right hand more than the left hand, so there is a work imbalance between right hand and left hand activities that can affect the OCRA index results. Work balancing is carried out with the ECRS concept and the design of additional facilities to reduce the number of technical actions and reduce the expended power. The number of actual technical actions before improvement can be seen in Table 6.

Table 6. Proposed technical action

Left Hand			Right Hand		
Technical Action	Total	Times (Second)	Technical Action	Total	Times (Second)
Putting raincoat into the sack	45	41.5	Putting raincoat into the sack	45	41.5
Tidy up the tip of the sack using the iron	6	28	Tidy up the tip of the sack using the iron	1	1.93
			Pick up sewing tools	6	28
Holding the sack while sewn	1	12.45	Sewing the sack	1	2.88
			Put down the sewing tools	1	12.45
			Moving the sewn up sack	1	4.1
Moving the sewn up sack	1	3.1	Moving the sewn up sack	1	2.71
<b>Total</b>	<b>53</b>	<b>85.05</b>	<b>Total</b>	<b>56</b>	<b>93.58</b>

The frequency of proposed technical actions produced for the right hand is 24.874 actions/ minute and the left hand is 23.541 actions / minute with a total repetitive work of 405 minutes. The ATA value based on equation (2) for the right hand is 10,073.97 actions and the left hand is 9,534.1 actions.

Calculation of the proposed RTA based on equation (3) is as follows :

$$\begin{aligned} \text{RTA of The Right Hand} &= (30 \text{ action/minute} \times 0.807 \times 1 \times 405 \text{ menit} \times 1 \times 1.1) \\ &= 10,579.01 \text{ actions} \end{aligned}$$

$$\begin{aligned} \text{RTA of The Left Hand} &= (30 \text{ action/minute} \times 0.916 \times 1 \times 405 \text{ menit} \times 1 \times 1.1) \\ &= 11,129.4 \text{ actions} \end{aligned}$$

The OCRA Index calculation after improvement based on equation (1) is as follows:

$$\begin{aligned} \text{OCRA Index for the right hand} &= \frac{10,073.97}{10,579.01} \\ &= 0.95 \end{aligned}$$

$$\begin{aligned} \text{OCRA Index for the left hand} &= \frac{9,534.1}{11,129.4} \\ &= 0.85 \end{aligned}$$

The comparison of OCRA Index calculation results before and after improvement can be seen in Table 7.

Table 7. The Comparison of OCRA index before and after improvement

Moving Part	OCRA Index Before Improvement	Area	Information	OCRA Index After Improvement	Area	Information
Right Hand	3.86	Red low	Low risk condition	0.95	Green	Optimal
Left Hand	3.01	Yellow	Condition need to be checked or improved	0.85	Green	Optimal

## CONCLUSIONS

In the packing section, OCRA Index of the right hand is 3.86 (3.6 - 4.5), then the OCRA classification of the right hand is included in the Red Low area which means that the condition on the right hand is at low risk of experiencing musculoskeletal disorders. OCRA Index of the left hand is 3.01 (2.3 - 3.5), the OCRA index of the left hand index is included in the Yellow area which means that the condition on the left hand needs to be checked or improved.

The proposed improvement is given by improving work methods using the concepts of Eliminate, Combine, Re-arrange, Simplify (ECSR) and designing and an additional work facility. The ECSR concept is used to improve work methods and balance work elements so that cycle time can be reduced in the packing section. The design of additional facility aims to reduce the number of technical actions and reduce the expended power. The packing aid is designed as a place to put the sack during the packing process so that the operator does not need to hold the sack to keep it upright while inserting a raincoat into it. After improvement, the OCRA Index value of the right hand dropped to 0.95 and the left hand dropped to 0.85. Both hands are in the Green category which means that the packing section is in optimal condition.

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