
WORKING POSTURE ANALYSIS AND DESIGN USING RULA (RAPID UPPER LIMB ASSESSMENT) METHOD IN PRODUCTION PROCESS AT PT. INDANA PAINT

Yongky Kusnandar Djiono¹ dan Sunday Noya²

Abstract: Working posture can affect the comfort and productivity of labor in doing manual work. In this study, RULA method is used to determine the risk level of musculoskeletal disorders (MSDs) injury in the production process at PT. Indana Paint (consists of mixing and packaging steps for water-based paint, solvent-based paint, and base paint production), and then given proposed improvements to reduce the risk level. Method used in this research is direct observation and video recording of every work element to determine some awkward postures that will be assessed using RULA method. Thirty awkward postures are found, there are 7 working posture (23.3%) have low risk level, 11 working posture (36.7%) have medium risk level, and 12 working posture (40%) have high risk level. Proposed improvements given is to brief the workers on appropriate lifting technique and working methods, adding mechanical aids for handling drums, and working position height adjustment.

Keywords: *working posture, RULA method, musculoskeletal disorders (MSDs)*

INTRODUCTION

Human is one of the input components required for the production process in industry. Until now the use of human labor in the industry in Indonesia is still dominant, especially to perform manual work activities (Budiman and Setyaningrum, 2006). However, the physical human body has limited ability and work capacity. One factor to consider in doing manual work is the posture done by the workers. Good working posture can indicate a safe, comfortable, and productive work, while awkward posture have an increased risk to cause pain or injury in the skeletal muscle system called musculoskeletal disorders. This is due to awkward working postures involving the body parts that undergo significant deviation from normal anatomical position of the human body, as the body is too bent, hands are reaching too far forward, the neck is twisted, and so on (Albugis, 2009).

There are many methods which have been developed by ergonomics experts to assess and analyze the risks of MSD on working posture. One of those methods is RULA(Rapid Upper Limb Assessment) which was created in 1993 by Dr. Lynn McAtamney and Dr. Nigel Corlett from the University of Nottingham, UK. RULA is a very effective method for assessing the risk level of activity dominated by the movement of the upper limbs, like the hands, arms, shoulders, neck, and back (McAtamney and Corlett, 1993). RULA methods provide a complete and detailed assessment on each body parts, there are group A (upper arm, lower arm, wrist, wrist twist) and group B (neck, trunk, and legs), muscle use (static or repetitive), and

¹ Industrial Engineering Study Program, Ma Chung University
Jalan Villa PuncakTidar N-01, Malang 65151, JawaTimur, Indonesia
E-mail: 410910030@student.machung.ac.id

² Industrial Engineering Study Program, Ma Chung University
Jalan Villa PuncakTidar N-01, Malang 65151, JawaTimur, Indonesia
Email: sunday.alexander@machung.ac.id

force/load (Hignett and McAtamney, 2005). Based on the results of a survey conducted by Dempsey, et.al. (2005), RULA method is the most widely used by the international ergonomic experts because its procedure is appropriate and easy to use.

Research on working posture analysis using RULA method has been widely applied in various types of industrial tasks in Indonesia. Sartika (2010) conducted an analysis of working postures using RULA method in boiling oil palm operators and proposes a better working posture so as to ease the work load of the operator physically. Desky (2010) using the RULA method on working posture done by the ointment packaging operators and has found some postures that apparently needs to be changed immediately to prevent musculoskeletal disorders injury. Abdillah (2013) analyzed the posture of fruit posters in a traditional market using RULA method and can provide safer work movements to reduce the risk of back pain injury. RULA method has also been used by Pangaribuan (2009) to enhance support facilities for employees working in a university library so that these employees are no longer experiencing excessive fatigue due to unnatural working posture.

In this study, RULA method will be used to assess the risk of working postures in PT. Indana Paint, a paint manufacturing company in Malang. Work activities that will be analyzed is the production process of water-based paint, solvent-based paint, and base paint, which each of them include mixing and packaging process. Based on initial observation, almost all production activities at PT. Indana Paint are still done manually and involve less comfortable working posture. This condition causes the workers often feel some pains in the upper body parts, even those pains sometimes still remain up to several days. Therefore, the working postures in PT. Indana Paint will be analyzed further using RULA method to know the risk level and can be given appropriate proposed improvements to reduce the risk level.

RESEARCH METHODS

The steps are performed in this study systematically expressed in the form of a flow diagram as shown in figure 1.

An initial observation was done by the direct observation to obtain an overview of the profile and operations of PT. Indana Paint. Literature study was done by collecting the scientific basis from the various references and previous research related to the problems in this study, the working posture analysis using RULA method.

The data required for this research are work elements and awkward work postures from each of these elements. The methods of data collection are direct observation and video recording of the work activities being performed by production workers at PT. Indana Paint. Direct observation was conducted to know the work elements and understand the order. Video recording is done by using a camcorder to document the details of posture and movement done on each work element, and then some selected awkward postures will be analyzed further using RULA method. Data collection was conducted in three separate production rooms, from the production of water-based paint, solvent-based paint, and base paint, which each have mixing and packaging process. Data collection was conducted over three weeks (15 working days) in the effective working hours in PT. Indana Paint.

Working posture of each element will be processed according to the steps in the RULA method as follows:

1. Assessing posture for group A (upper arm, lower arm, wrist, wrist twist).
2. Adding muscle use and force scores for group A.

3. Assessing posture for group B (neck, trunk, and legs).
4. Adding muscle use and force scores for group B.
5. Determining RULA grand score and action level.

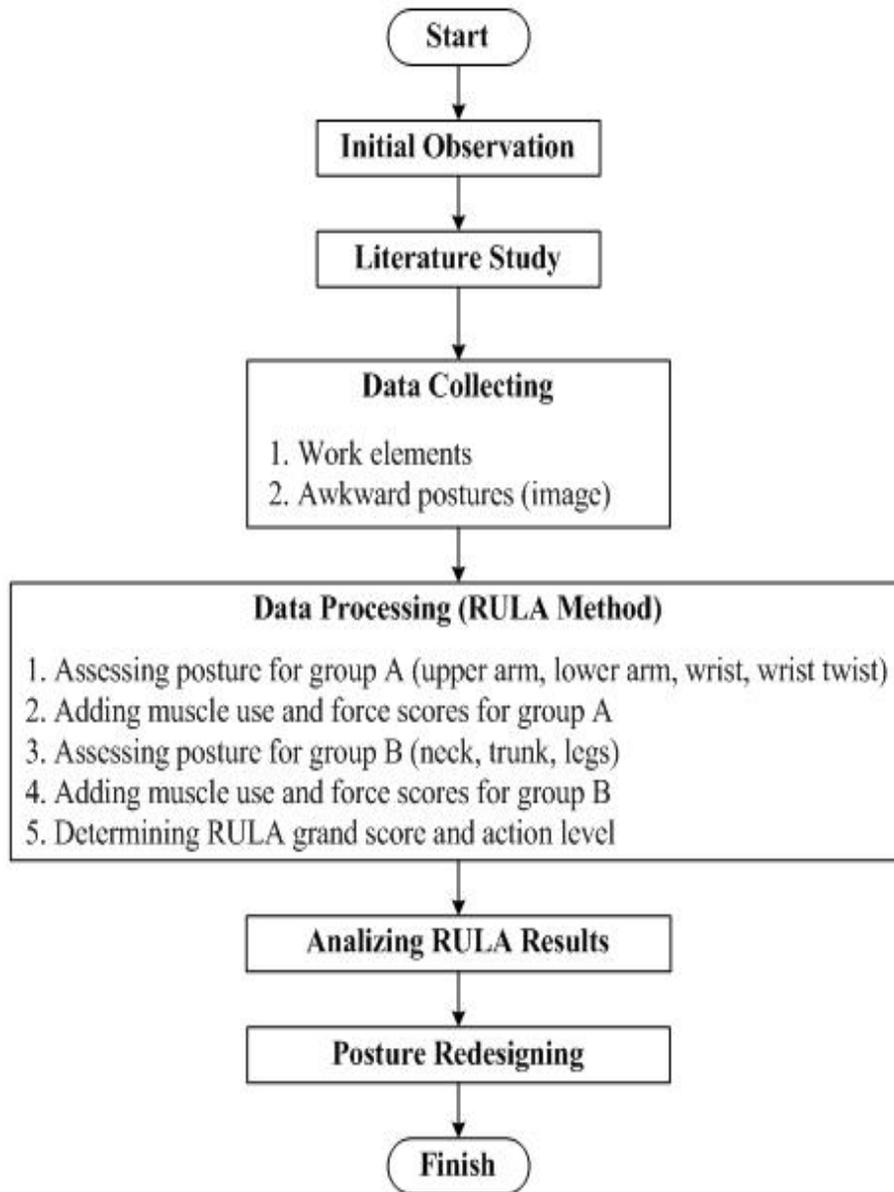


Figure 1. Flow Diagram of Research Method

The RULA assessment results of each working posture will be analyzed. The analytical method used is descriptive method to provide an evaluation about the body parts which considered vulnerable to injury and anything that cause the workers doing an awkward posture. Based on that analysis, the proposed improvements can be given to the working postures which need improvements based on the RULA assessment result. Figure 2 shows sample of RULA Assessment worksheet.

RULA Analysis Worksheet

A. Arm and Wrist Analysis

Step 1: Upper Arm Position

Step 1a: Adjust....
 If shoulder is raised: +1
 If upper arm is abducted: +1
 If arm is supported or person is leaning: -1

FINAL UPPER ARM SCORE

Step 2: Lower Arm Position

Step 2a: Adjust....
 If arm is working across midline of the body or if arm is out to side of body: +1

FINAL LOWER ARM SCORE

Step 3: Wrist Position

Step 3a: Adjust....
 If wrist is bent from the midline: +1

FINAL WRIST SCORE

Step 4: Wrist Twist

If wrist is twisted in mid-range: -1
 If twist is at or near end of range: -2

WRIST TWIST SCORE

Step 5: Look-up Posture Score in Table A

Use values from steps 1,2,3,4 to locate Posture Score in Table A

POSTURE SCORE A

Step 6: Add Muscle Use Score

If posture mainly static (i.e., held for longer than 1 minute), or if action repeatedly occurs 4 times per minute or more: +1

MUSCLE USE SCORE

Step 7: Add Force/Load Score

If load less than 2 kg (intermittent): -0
 If 2 kg to 10 kg (intermittent): +1
 If 2 kg to 10 kg (static or repeated): +2
 If more than 10 kg load or repeated or shocks: +3

FORCE/LOAD SCORE

Step 8: Find Row in Table C

The completed score from the Arm/Wrist analyses is used to find the row in Table C

FINAL WRIST AND ARM SCORE

		Wrist							
		1		2		3		4	
Upper Arm	Lower Arm	Wrist Twist							
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	8	9	9	9	9	9	9	9

		1	2	3	4	5	6	7+
1	1	1	2	3	3	4	5	5
2	2	2	3	4	4	5	5	5
3	3	3	3	4	4	5	6	6
4	3	3	3	4	5	6	6	6
5	4	4	4	5	6	7	7	7
6	4	4	5	6	6	7	7	7
7	5	5	6	6	7	7	7	7
8+	5	5	6	7	7	7	7	7

FINAL SCORE

1 or 2 = Acceptable
 3 or 4 = Investigate Further
 5 or 6 = Investigate Further and change soon
 7 = Investigate and change immediately

B. Neck, Trunk and Leg Analysis

Step 9: Neck Position

Step 9a: Adjust....
 If neck is twisted or if neck is side-bending: -1

FINAL NECK SCORE

Step 10: Trunk Position

Step 10a: Adjust....
 If trunk is twisted: +1
 If trunk is side-bending: +1

FINAL TRUNK SCORE

Step 11: Legs

If legs and feet are supported and balanced: +1 If not: -2
 If the worker is standing with the body weight evenly distributed over both feet with room for changes of position: +1
 If the legs and feet are not supported while the worker is sitting or the weight is unevenly balanced when sitting or standing: +2

FINAL LEGS SCORE

		Trunk					
		1	2	3	4	5	6
Neck	Legs	1	2	1	2	1	2
	Legs	1	2	1	2	1	2
1	1	1	2	1	2	3	4
2	1	2	2	3	4	4	4
3	2	2	3	3	4	5	5
4	2	3	2	3	4	4	5
5	3	4	4	4	5	5	6
6	3	4	4	4	5	6	6

Table B

Use values from steps 9,10,11 to locate Posture Score in Table B

POSTURE B SCORE

Step 13: Add Muscle Use Score

If posture mainly static (i.e., held for longer than 1 minute), or if action 4/minute or more: +1

MUSCLE USE SCORE

Step 14: Add Force/Load Score

If load less than 2 kg (intermittent): -0
 If 2 kg to 10 kg (intermittent): +1
 If 2 kg to 10 kg (static or repeated): +2
 If more than 10 kg load or repeated or shocks: +3

FORCE/LOAD SCORE

Step 15: Find Column in Table C

The completed score from the Neck/Trunk and Leg Analysis

FINAL NECK, TRUNK AND LEG SCORE

Original source: McAtamney, L. & Corlett, E.N., "RULA: A Survey Method for the Investigation of Work-Related Upper Limb Disorders", Applied Ergonomics, 24(2) 91-99 (1993). Ergonomics Inc. © 2003

Figure 2. Sample of RULA Assessment Worksheet (McAtamney & Corlett, 1993)

RESULTS

Based on the data collection has been done, there are 30 awkward postures were found and will be analyzed further using RULA method. Here are the results of the RULA assessment for those 30 awkward postures. Table 1 shows the RULA Assessment results for those postures. Working posture has been assessed using RULA method can also be grouped based on its risk level as shown on Table 2.

Table1.RULA Assessment Results for 30 Awkward Postures

Process	Posture	Work Activity	RULA Score	Risk Level
Mixing Water-based Paint	1	Pouring additives	5	Medium
	2	Lifting filler sacks	7	High
	3	Pouring latex	7	High
	4	Pouring color paste	7	High
	5	Pouring thickening agent	7	High
	6	Taking paint samples	5	Medium
Packaging Water-based Paint	7	Filling the cans	6	Medium
	8	Tightening the lids using a wooden bat	6	Medium
	9	Lifting a 20 kg paint can	7	High
Mixing Solvent-based Paint	10	Pushing a vertical-lift drum pourer	7	High
	11	Pouring color paste into a drum	3	Low
	12	Moving a drum to the mixer machine	7	High
	13	Pouring thinner	5	Medium
	14	Cleaning the stirrer of mixer machine	5	Medium
Packaging Solvent-based Paint	15	Filling the cans	4	Low
	16	Putting the lids	6	Medium
	17	Tightening the lids using a can press tool	5	Medium
	18	Sealing the boxes using adhesive tape	4	Low
	19	Lifting a sealed box	7	High
Mixing Base Paint	20	Filling an empty drum with water	4	Low
	21	Pouring water into the mixing tank	7	High
	22	Pouring the first-section additives	3	Low
	23	Pouring fillers	7	High
	24	Pouring color paste	3	Low
	25	Pouring latex	7	High
	26	Pouring the second-section additives	3	Low
Packaging Base Paint	27	Ladling out the paint from a drum	6	Medium
	28	Sealing the cans using a can sealer machine	7	High
	29	Sealing the boxes using adhesive tape	5	Medium
	30	Taking the carton sheets	6	Medium

Table2. Working Postures Grouping Based on Its Risk Level

Action Level	Risk Level	Explanation	Posture Number	Total	Percent
1	Minimum	Safe and acceptable	-	0	0%
2	Low	Investigation and changes may be required	11, 15, 18, 20, 22, 24, 26	7	23,3%
3	Medium	Investigation and changes required soon	1, 6, 7, 8, 13, 14, 16, 17, 27, 29, 30	11	36,7%
4	High	Investigation and changes required immediately	2, 3, 4, 5, 9, 10, 12, 19, 21, 23, 25, 28	12	40%

RULA assessment result of the 30 working postures on the production process in PT. Indana Paint showed that those posture’s risk ranging from low level to high level and none of them have the minimum risk level. RULA assessment result states

that there are 7 working posture (23.3%) have a low risk level, 11 working posture (36.7%) have a medium risk level, and 12 working posture (40%) have a high risk level.

ANALYSIS

Each awkward posture that has been assessed using RULA method will be further analyzed based on its risk level. The analysis is performed sequentially starting from the postures which have low risk level to the high risk level as follows:

1. Analysis of working posture with a low risk level

Working posture with 3 or 4 RULA grand score is a low risk posture. Such posture can actually be declared safe enough, but the investigation is still to be done in an effort to increase the productivity. Based on the results of data processing, there are 7 working posture with a low risk level:

Table 3. Analysis and Proposed Improvement on Low Risk Level Working Postures

No.	Working Postures	Analysis and Proposed Improvement
1	<p>Posture 11: Pouring color paste into a drum</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task, which the worker repeatedly takes and pours the paste. - Wrist is twisting to pour the paste using a bailer. - Shoulder looks slightly raised because the drum is a bit too high. - Other parts of the body are in a normal position. - This working posture is still acceptable and not requires significant changes.
2	<p>Posture 15: Filling the cans</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task, because the packaging process is done for dozens of paint cans. - The position of the lower arm a little too high and the neck slightly bent, which can becomes ore if working for a long time. - Other parts of the body are in a reasonable position. - There is a long idle time after packing the paint from a single drum. - This working posture is still acceptable and not requires significant changes.
3	<p>Posture 18: Sealing the boxes using adhesive tape</p> 	<ul style="list-style-type: none"> - This activity is done for a while (not static or repetitive) without including significant load. - The position of the body slightly bent and arms stretched far to the front. - Improvement: change the working position from the seated task to the standing task on a table, so that the body becomes more upright.

Table 3. Analysis and Proposed Improvement on Low Risk Level Working Postures (cont'd)

<p>4</p>	<p>Posture 20: Filling an empty drum with water</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task, which the worker repeatedly take and pour water until obtain the required quantity. - Lower arm moves through the center line of the body. - Other parts of the body are in a normal position. - This working posture is still acceptable and not requires significant changes.
<p>5</p>	<p>Posture 22: Pouring the first-section additives</p> 	<ul style="list-style-type: none"> - This activity is a static task, which the worker continues to hold the additives' plastic bag for more than 1 minute. - Wrist has the highest risk level. - Other parts of the body are in a normal position. - This working posture is still acceptable and not requires significant changes.
<p>6</p>	<p>Posture 24: Pouring color paste</p> 	<ul style="list-style-type: none"> - This activity is about the same as the activity in posture 22. - This activity is a static task, which the worker continues to hold the paste's plastic bag for more than 1 minute. - Wrist has the highest risk level. - Other parts of the body are in a normal position. - This working posture is still acceptable and not requires significant changes.
<p>7</p>	<p>Posture 26: Pouring the second-section additives</p> 	<ul style="list-style-type: none"> - There is one kind of additives that are packed in a plastic drum. - The upper arm and lower arm are raised slightly higher to adapt the tank's height. - Other parts of the body are in a normal position. - This working posture is still acceptable and not requires significant changes.

2. Analysis of working posture with a medium risk level

A working posture has medium risk level if the RULA grand score is 5 or 6. To reduce the risk of MSD injury, the further investigation and changes are needed soon. There are 11 working postures which have medium risk level:

Table 4. Analysis and Proposed Improvement on Medium Risk Level Working Postures

No.	Working Postures	Analysis and Proposed Improvement
1	<p>Posture 1: Pouring additives</p> 	<ul style="list-style-type: none"> - The back is bent which make it as the most injury-prone parts. - The hands and arms are still quite safe because this activity is done in a short time with a light weight. - Improvement: make tank a little higher from the floor, so the back will not be too bent.
2	<p>Posture 6: Taking paint samples</p> 	<ul style="list-style-type: none"> - Neck and back have a high risk. - This work activity performed in a short time with a light weight so that the arm is still safe. - Improvement: make tank a little higher from the floor, so the back will not be too bent.
3	<p>Posture 7: Filling the cans</p> 	<ul style="list-style-type: none"> - High repetitive level in this task can cause fatigue that accumulates on the entire arm and hand. - The body is slightly bent which also can cause pain if this task done continuously in a long time. - Improvement: make a closer distance between the worker and the cans to reduce the deviation of the body and upper arms position.
4	<p>Posture 8: Tightening the lids using a wooden bat</p> 	<ul style="list-style-type: none"> - The arms and hands will be easier to feel tired because of high repetitive levels of this task. - The body is slightly bent which also can cause pain if this task done continuously in a long time. - Improvement: make a closer distance between the worker and the cans to reduce the deviation of the body and upper arms position.

Table 4. Analysis and Proposed Improvement on Medium Risk Level Working Postures (cont'd)

<p>5</p>	<p>Posture 13: Pouring <i>thinner</i></p> 	<ul style="list-style-type: none"> - The drum position is a little too high. - Worker must lift the weights until high enough so that the position of the upper arm bending backwards, raised shoulders, and necks lightly bowed. - Improvement: worker can step up to the wooden pallet that is located under the drum, so that he weight does not need to be raised too high.
<p>6</p>	<p>Posture 14: Cleaning the stirrer of mixer machine</p> 	<ul style="list-style-type: none"> - This activity involving repetitive hand movements vertically. - The neck looks slightly bowed. - This activity is done in a very short time. - This working posture is still acceptable and not requires significant changes.
<p>7</p>	<p>Posture 16: Putting the lids</p> 	<ul style="list-style-type: none"> - The table is too high from the worker's sitting position. - Hands should reach a little higher and the neck turned to the left to be able to put the lid on the table. - Improvement: change the working position from the seated task to the standing task on a table, so that the body becomes more upright.
<p>8</p>	<p>Posture 17: Tightening the lids using a can press tool</p> 	<ul style="list-style-type: none"> - The neck is bent down and the wrist must bent away from the hand's center line to move the lever of the press tool. - Improvement: change the working position from the seated task to the standing task on a table, so that the body becomes more upright.

Table 4. Analysis and Proposed Improvement on Medium Risk Level Working Postures (cont'd)

9	<p>Posture 27: Lading out the paint from a drum</p> 	<ul style="list-style-type: none"> - The neck is bent down and twisted, body is bent and side-tilted, and one leg is raised. - Occurs when a little amount of paint remains in the drum. - Improvement: tilt the drum position from its back side, so it will be easier to take out the paint from the drum.
10	<p>Posture 29: Sealing the boxes using adhesive tape</p> 	<ul style="list-style-type: none"> - The back and neck have the highest risk level in this working posture. - The hand is not too risky because of this activity performed in a short time. - Improvement: change the working position from the seated task to the standing task on a table, so that the body is not bent anymore.
11	<p>Posture 30: Taking the carton sheets</p> 	<ul style="list-style-type: none"> - The carton sheets is stacked at a very low place, which causing the neck and back tilted in order to reach those carton sheets. - Improvement: change the working position from the seated task to the standing task on a table, and then put the carton sheets on the same table.

3. Analysis of working posture with a high risk level

Working postures which have 7 as its RULA grand score is a high risk level posture. Such work posture often causes pain in certain body parts and can cause severe MSD injury. Therefore, investigation and changes must be done immediately. Based on the results of data processing, there are 12 working postures with a high risk level.

Table 5. Analysis and Proposed Improvement on High Risk Level Working Postures

No.	Working Postures	Analysis and Proposed Improvement
1	<p>Posture 2: Lifting filler sacks</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task with a very heavy weight (25 kg filler sack). - The bent position of the body will cause a high risk of injury to the spine. - The worker does the lifting with a wrong technique. - Improvement: fix the lifting technique, beginning with the squatting position (do not start from the standing position).

Table5. Analysis and Proposed Improvement on High Risk Level Working Postures (cont'd)

<p>2</p>	<p>Posture 3: Pouring latex</p> 	<ul style="list-style-type: none"> - The load is very heavy (200 kg drum), so it must be done by two workers. - The arms, hands, and back are likely to get injured. - Actually, lifting technique performed by the workers to lift the drum is correct, which is starting from a squatting position. - Improvement: uses mechanical aid tools called portable drum pourer to ease the work load.
<p>3</p>	<p>Posture 4: Pouring color paste</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task, which the worker takes and pours the color paste in a few times. - The position of the body continues to bend for a few minutes. - The position of the arm is out stretched from the side of the body and the wrist is also twisting, which will increase the muscle workload. - Improvement: elevating the position of the tank and paste container, so the body will not bent.
<p>4</p>	<p>Posture 5: Pouring thickening agent</p> 	<ul style="list-style-type: none"> - This activity is a static task (more than 1 minute) with a heavy weight (25 kg plastic drum). - Almost all of the body parts (arm, hand, neck, and back) have a high risk to cause injury. - Improvement: make tank a little higher from the floor, so the back will not be too bent.
<p>5</p>	<p>Posture 9: Lifting a 20 kg paint can</p> 	<ul style="list-style-type: none"> - Highest injury risk level located in the back and arms. - This activity is neither static nor repetitive, because there is a long waiting time between the tasks. - Improvement: fix the lifting technique, beginning with the squatting position (do not start from the standing position).

Table5. Analysis and Proposed Improvement on High Risk Level Working Postures (cont'd)

<p>6</p>	<p>Posture 10: Pushing a vertical-lift drum pourer</p> 	<ul style="list-style-type: none"> - A very heavy load to be driven (the weight of the resin is 200kg, plus the weight of the drum, and the weight of the vertical-lift drum pourer). - This activity is done in a very short time and only as needed, when pouring distance is not proper. - Improvement: perform a better working method by pushing the empty drum (where the resin will be poured) rather than the heavy resin drum.
<p>7</p>	<p>Posture 12: Moving a drum to the mixer machine</p> 	<ul style="list-style-type: none"> - Moving the heavy drum (which contain the mixture of resin and color paste) will cause high risk of injury in the back and both hands. - Improvement: uses mechanical aid tools called drum carrier to ease the workload.
<p>8</p>	<p>Posture 19: Lifting a sealed box</p> 	<ul style="list-style-type: none"> - The box located on the floor causing bent body position of the worker when lifting that box. - Improvement: change the working position from the seated task to the standing task on a table, so that the body is not bent anymore.

Table5. Analysis and Proposed Improvement on High Risk Level Working Postures (cont'd)

<p>9</p>	<p>Posture 21: Pouring water into the mixing tank</p> 	<ul style="list-style-type: none"> - Because of the tank's height, the worker must stand on a lifted forklift to be able to pour water into the tank. - The body is bent and both hands have to push a very heavy drum. - Improvement: uses mechanical aid tool called power-propelled drum pourer to pour the contents of the drum from a certain height.
<p>10</p>	<p>Posture 23: Pouring fillers</p> 	<ul style="list-style-type: none"> - High risk level due to a very heavy load (25 kg filler sack). - Neck and body is slightly bent down. - Improvement: make tank a little higher from the floor, so that the body becomes more upright.
<p>11</p>	<p>Posture 25: Pouring latex</p> 	<ul style="list-style-type: none"> - This activity is about the same as the activity in posture 21. - Because of the tank's height, the worker must stand on a lifted forklift to be able to pour latex into the tank. - The body is bent and both hands have to push a very heavy drum. - Improvement: uses mechanical aid tool called power-propelled drum pourer to pour the contents of the drum from a certain height.
<p>12</p>	<p>Posture 28: Sealing the cans using can sealer machine</p> 	<ul style="list-style-type: none"> - This activity is a repetitive task, because there are many cans to be sealed. - Neck and body must be twisted to reach cans on a table which is lower from the worker seating height. - Improvement: adjust the height of the table to the worker seating height.

CONCLUSION AND RECOMMENDATION

Based on the data processing and analysis has been carried out in this study, there are several conclusions as follows:

1. RULA assessment result stated that working postures in the production process at PT. Indana Paint has a low to high risk level and none of those postures has minimum risk level. From 30 awkward postures analyzed, there are 7 working posture (23.3%) have low risk level, 11 working posture (36.7%) have medium risk level, and 12 working posture (40%) have high risk level.
2. There are some fundamental issues that lead to awkward postures done by the workers, such as wrong lifting technique and working methods, manual handling on heavy drums, and working position heights variety. Proposed improvements are given in an attempt to overcome these problems is to provide guidance to employees regarding the proper lifting technique and better working methods, adding some mechanical aids to handling heavy drums, and adjust the height of the working position.

Here are some recommendations that can be given to PT. Indana Paint associated with the results of this research:

1. Make further and more routine assessment to the work activities which often cause awkward postures.
2. Provide closer supervision of the proper working methods and movement techniques, so that workers can avoid the risk of injury due to perform unnecessary awkward postures.
3. Remind the workers to utilize the idle time at work by doing some body stretching, especially on the neck, body, and hands, so that the body becomes more fit and the joints do not become stiff.
4. Provide training for workers about the correct working postures, so that workers can apply them in the work place and no longer do the job with the wrong posture.

References

- Abdillah, F. 2013. Analisis Postur Kerja dengan Metode Rapid Upper Limb Assessment (RULA) pada Pekerja Kuli Angkut Buah di Agen Ridho Illahi Pasar Johar Kota Semarang. *Jurnal Kesehatan Masyarakat FKM Undip*. Vol. 2, No. 1, January 2013, pp. 1-10.
- Albugis, D. Y. 2009. *Analisis Risiko Musculoskeletal Disorders (MSDs) Menggunakan Metode Rapid Entire Body Assessment (REBA) di Workshop Steel Tower PT. Bukaka Teknik Utama*. Skripsi. Departemen Keselamatan dan Kesehatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Indonesia, Depok.
- Budiman, E.; and R. Setyaningrum. 2006. Perbandingan Metode-metode Biomekanika untuk Menganalisis Postur pada Aktivitas Manual Material Handling (MMH). *Jurnal Teknik Industri Undip*. Vol. 1, No. 3, September 2006, pp. 46-52.
- Dempsey, P.G.; R.W. McGorry; and W.S. Maynard. 2005. A Survey of Tools and Methods Used by Certified Professional Ergonomists. *Applied Ergonomics*, Vol. 36, No. 4, January 2005, pp. 489-503.
- Desky, H. A. L. 2010. *Analisis Postur Kerja Ditinjau dari Segi Ergonomi di Bagian Pengemasan pada PT. Kimia Farma (Persero) Tbk Plant Medan*. Tugas Sarjana, Departemen Teknik Industri, Fakultas Teknik, Universitas Sumatera Utara, Medan.
- Hignett, S; and L. McAtamney. 2005. REBA and RULA: Whole Body and Upper Limb Rapid Assessment Tools, in W. S. Marras and W. Karwowski (Eds.),

- Fundamentals and Assessment Tools for Occupational Ergonomics* (Pg. 42-1 to 42-12). New York: Taylor & Francis Inc..
- McAtamney, L; and E.N. Corlett. 1993. RULA: A Survey Method for The Investigation of Work-Related Upper Limb Disorders. *Applied Ergonomics*. Vol. 24, No. 2, April 1993, pp. 91-99.
- Pangaribuan, D. M. 2009. *Analisa Postur Kerja dengan Metode RULA pada Pegawai Bagian Pelayanan Perpustakaan USU Medan*. Tugas Sarjana, Departemen Teknik Industri, Fakultas Teknik, Universitas Sumatera Utara, Medan.
- Sartika, U. 2010. *Analisis Beban Kerja dengan Metode RULA pada Stasiun Perebusan di Pabrik Kelapa Sawit PT. PP. London Sumatera Indonesia, Tbk*. Karya Akhir. Program Studi Teknik Manajemen Pabrik, Fakultas Teknik, Universitas Sumatera Utara, Medan.