SHELVES RE-DESIGN TO CONSIDER ASPECTS OF ERGONOMICS IN KOPETRI MINI MARKET, KARAWANG

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ABSTRACT

Shelf is one of the very important facility to place the items that will be sold in Kopetri Mini market, Karawang. Shelve sizes currently used are not ergonomically designed, which is based on the assessment by RULA (Rapid Upeer Limb Assessment) method, operator working posture while taking the goods from the shelves in a state with high to very high risk, so we need to make improvements. The repair is done by changing the size of the shelve in accordance with the size of operator anthropometry. The result of data processing shows that the change in the size of the shelve in accordance with the size of the operator anthropometry, the posture of the work done by the operator to be better than ever.
Key words: working posture, ergonomics, RULA, anthropometry.

1. INTRODUCTION

Mini market business growth across Indonesia today is very fast, not least in Karawang, West Java. This causes an increase in competition between mini markets. To win the competition, then the mini market management must consider the various aspects of its business, which are in terms of storage of goods in the warehouse.
Kopetri Mini market in Karawang is one form of business mini market which is owned by the Peruri Cooperative Employees. To store the goods in the warehouse, Kopetri Mini market use some facilities, one of them is a shelves. The shelves consists of 5 (five) tiers placement of goods.
One of the problems is that the shelves are currently used in the Kopetri Mini market not designed according to ergonomic aspects, so that the posture of the work done when the operator took the goods from the shelves in general in adverse conditions.
This study aimed to evaluate the operator working posture when taking goods off the shelves by using RULA (Rapid Upper Limb Assessment). The results of this evaluation will subsequently serve as the basis for redesigning the size of the shelves used items so that operators working posture while taking the goods from the shelves the better.

2. THEORETICAL BACKGROUND

2.1. Ergonomics

Nurmianto (1996) states that the term ergonomics is derived from Latin, namely Ergon (work) and nomos (natural laws). Ergonomics can be defined as the study of the human aspects in the work environment are reviewed in anatomy, physiology, psychology, engineering, management and design.
According to Sutalaksana et.al (2006), the term ergonomics is different in some countries, such as the "Arbeltswissenschaft" in German, "Biotechnology" in the countries of Scandinavia, "Human Engineering" and "Human Factor Engineering" for countries of North America. Ergonomics is the branch of science that systematically to utilize information about the properties, capabilities, and human limitations in designing a working system so that people can live and work on the system to be effective, safe, healthy, comfortable, and efficient.

2.2. Working Posture

Susihono and Prasetyo (2012) mentions that ergonomic considerations relating to the working posture can help get a comfortable

working posture for workers, both working posture standing, sitting or other work posture. In some types of work are working postures unnatural and takes place in the long term. This will lead to pains in the body, defective products even disability. Some things to consider with regard to posture while working among others as much as possible reduce the necessity operator to work with a stooped posture with the frequency of activities which often or in the long term. Operator should not use maximum range.

2.3. RULA

RULA (Rapid Upper Limb Assessment) was developed to evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity MSD. The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities. A single page worksheet is used to evaluate required body posture, force, and repetition. Based on the evaluations, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.
The RULA was designed for easy use without need for an advanced degree in ergonomics or expensive equipment. Using the RULA worksheet, the evaluator will assign a score for each of the following body regions: upper arm, lower arm, wrist, neck, trunk, and legs. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.

2.4. Anthropometric

According to Wignjosoebroto (2003) Anthropometric term comes from "antro" which means human and "metri" which means the size. Definitively anthropometry can be expressed as a study related to the measurement of the dimensions of the human body covers an area the size, strength, and other aspects of body movement.
Anthropometric is part of ergonomics specifically study the size of the body which includes the linear dimensions, weight, contents, and also covers an area the size, strength, speed, and other aspects of body movement. Anthropometric is derived from the word anthopos which means body and metrikos which means size.
One of the factors limiting the performance of labor is the absence of harmony of size, shape tools, and infrastructure work on employment. In order to remedy the situation anthropometric data necessary labor as the basic reference design and quality of infrastructure. Anthropometric as one of the disciplines that are used in ergonomics play a major role in building design and quality of infrastructure.

3. RESEARCH METHOD

This research was initiated by direct observation in the warehouse of Kopetri Mini market to know the real working conditions. For the purpose of solving the existing problems, carried out shooting against the posture of the operator at the time of taking the goods from the shelves for each tiers. The shelves of goods which currently used have 5 (five) tiers, then the image is taken for five positions. Shots from the working posture is then analyzed using the RULA method for assessing the working posture level of risk in each position. RULA scores obtained serve as the basis to make improvements such as redesigning the size of the shelves.
For the purpose of redesigning the goods shelves, then do the measurement of body anthropometry data of storage warehouse operator. Based on the anthropometry data, further determined measures shelves of goods. The next step is to conduct a simulation making goods using the shelves design obtained. Using the simulation results taking pictures of the goods, the next step is to re-assess the risk level of the new working posture by using RULA.

4. RESULT AND DISCUSSION

Overview of warehouse operator working postures in Kopetri Mini market while taking the goods on the shelves are as follows:

Figure 1. Operator working posture

Size of the shelves that are currently used are as follows:

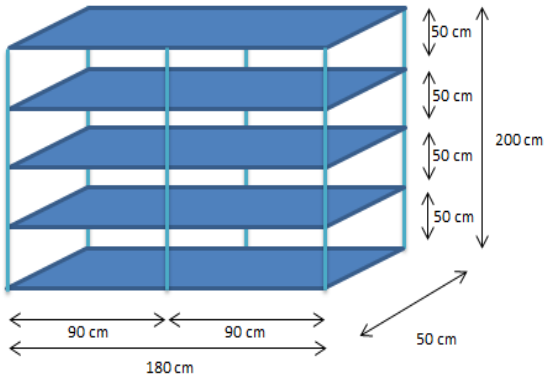

Figure 2. Shelves size currently used

Here are the results of working posture assessment at five positions above using methods RULA:

Table 1. Current operator working posture assessment by RULA method

No	Working Posture	Assessment	Score
1		**Table A:**	
		- Upper arm position	6
		- Lower arm position	2
		- Wrist position	3
		- Wrist twist	1
		Table A score	**8**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**9**
		Table B:	
		- Neck position	5
		- Trunk position	4
		- Leg position	1
		Table B score	**8**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**9**
		Table C:	
		- Wrist & Arm Score	9
		- Neck, Trunk and Leg Score	9
		RULA Score	**7**
2		**Tabel A:**	
		- Upper arm position	4
		- Lower arm position	2
		- Wrist position	3
		- Wrist twist	1
		Table A score	**4**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**5**
		Table B:	
		- Neck position	4
		- Trunk position	4
		- Leg position	1
		Table B score	**7**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**8**
		Table C:	
		- Wrist & Arm Score	5
		- Neck, Trunk and Leg Score	8
		RULA Score	**7**
3		**Tabel A:**	
		- Upper arm position	2
		- Lower arm position	2
		- Wrist position	2
		- Wrist twist	1
		Table A score	**3**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**4**
		Table B:	
		- Neck position	1
		- Trunk position	1
		- Leg position	1
		Table B score	**1**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**2**
		Table C:	
		- Wrist & Arm Score	4
		- Neck, Trunk and Leg Score	2
		RULA Score	**3**
4		**Tabel A:**	
		- Upper arm position	1
		- Lower arm position	1
		- Wrist position	2
		- Wrist twist	1
		Table A score	**2**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**3**
		Table B:	
		- Neck position	1
		- Trunk position	5
		- Leg position	1
		Table B score	**6**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**7**
		Table C:	
		- Wrist & Arm Score	3
		- Neck, Trunk and Leg Score	7
		RULA Score	**6**
5		**Tabel A:**	
		- Upper arm position	2
		- Lower arm position	1
		- Wrist position	2
		- Wrist twist	1
		Table A score	**3**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**4**
		Table B:	
		- Neck position	4
		- Trunk position	5
		- Leg position	1
		Table B score	**8**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**9**
		Table C:	
		- Wrist & Arm Score	4
		- Neck, Trunk and Leg Score	9
		RULA Score	**6**

RULA scores of each work position at the top are:

- Posture 1 = 7: very high risk, investigate and implement change
- Posture 2 = 7: very high risk, investigate and implement change
- Posture 3 = 3: medium risk, further investigation, change may be needed
- Posture 4 = 6: high risk, further investigation, change soon
- Posture 5 = 6: high risk, further investigation, change soon

Based on the above results, it can be concluded that in general, the posture of the work done by the operator while taking the goods from the shelves, including in conditions with high to very high risk, so it should be repaired immediately.
Posture work done by the operator while taking the goods on the shelves are formed due to the size used today, so as to correct the posture of the work can be a way to change the size of the shelves goods used up in accordance with the operator's body size. For this purpose, it is necessary that the operator's body anthropometric data in Kopetri Mini market.

Table 2. Anthropometric Data Kopetri Mini market Operator

No	Operator	Height (mm)	Reach Hands Ahead (mm)	Hands Reach Up (mm)	Elbow Height (mm)
1	Sri	1590	705	1980	1050
2	Heni	1600	655	1940	1033
3	Ikeu	1565	680	1955	1025
4	Solihin	1650	820	2050	1020
5	Sugeng	1650	834	2084	1010
6	Supriadi	1678	804	2137	1055
7	Abdurrahman	1725	800	2185	1075
Averages		1636,9	756,9	2047,3	1038,3
Std deviation		55,6	74,2	93,9	22,7
Percentile 95%		1728,3	878,8	2201,8	1075,7
Percentile 5%		1545,5	634,9	1892,8	1000,9

From the results of anthropometric measurements can be used to redesign the size of shelves that are used in the warehouse, the following overview of the proposed storage shelves:

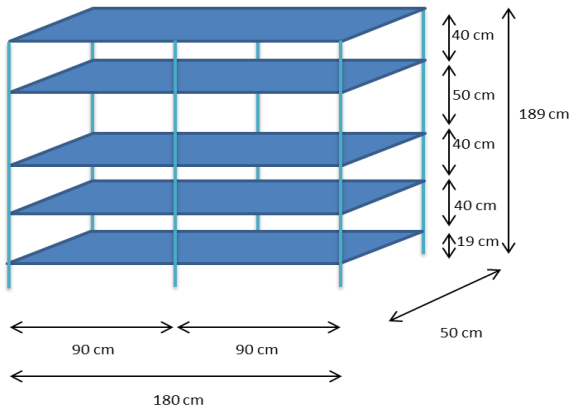

Figure 3. Shelves design proposed

Shelf height percentile obtained from 5% of overall high average size range of the hands of employees. High shelf rate to 3 are measuring 50 cm, while the shelf height to 4 and 5 to 40 cm and made its legs measuring 19 cm so that the combined total is 99 cm and the size of the approaching fifth percentile calculation of the average height of the elbow employees.
Having obtained the size of the proposed shelf, to be reenacted RULA analysis to determine whether the proposed shelf racks better than previously used. The analysis was performed by means of simulation using the data size of shelving the proposal as follows:

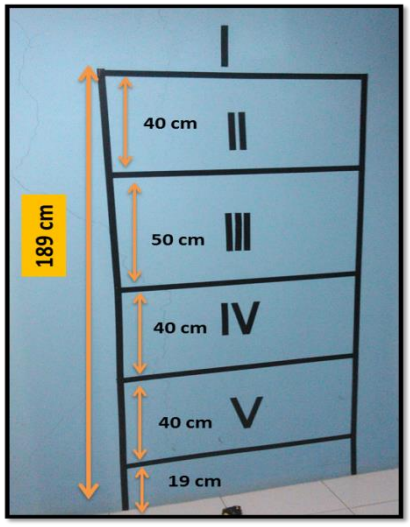

Figure 4. Simulation of the proposed shelf

Table 3. Proposed operator working posture assessment by RULA method

No	Working Posture	Assessment	Score
1		**Tabel A:**	
		- Upper arm position	4
		- Lower arm position	1
		- Wrist position	1
		- Wrist twist	1
		Table A score	**4**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**5**
		Table B:	
		- Neck position	2
		- Trunk position	1
		- Leg position	1
		Table B score	**2**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**3**
		Table C:	
		- Wrist & Arm Score	5
		- Neck, Trunk and Leg Score	3
		RULA Score	**4**
2		**Tabel A:**	
		- Upper arm position	4
		- Lower arm position	1
		- Wrist position	1
		- Wrist twist	1
		Table A score	**4**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**5**
		Table B:	
		- Neck position	1
		- Trunk position	1
		- Leg position	1
		Table B score	**1**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**2**
		Table C:	
		- Wrist & Arm Score	5
		- Neck, Trunk and Leg Score	2
		RULA Score	**4**
3		**Tabel A:**	
		- Upper arm position	3
		- Lower arm position	1
		- Wrist position	1
		- Wrist twist	1
		Table A score	**3**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**4**
		Table B:	
		- Neck position	1
		- Trunk position	1
		- Leg position	1
		Table B score	**1**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**2**
		Table C:	
		- Wrist & Arm Score	4
		- Neck, Trunk and Leg Score	2
		RULA Score	**3**
4		**Tabel A:**	
		- Upper arm position	2
		- Lower arm position	1
		- Wrist position	1
		- Wrist twist	1
		Table A score	**2**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**3**
		Table B:	
		- Neck position	1
		- Trunk position	1
		- Leg position	1
		Table B score	**1**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**2**
		Table C:	
		- Wrist & Arm Score	3
		- Neck, Trunk and Leg Score	2
		RULA Score	**3**
5		**Tabel A:**	
		- Upper arm position	2
		- Lower arm position	1
		- Wrist position	1
		- Wrist twist	1
		Table A score	**2**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Wrist & Arm Score	**3**
		Table B:	
		- Neck position	3
		- Trunk position	3
		- Leg position	1
		Table B score	**4**
		- Posture mainly static	0
		- Load 4.4-22 lbs (intermittent)	1
		Neck, Trunk and Leg Score	**5**
		Table C:	
		- Wrist & Arm Score	3
		- Neck, Trunk and Leg Score	5
		RULA Score	**4**

Based on the above results, it can be compared to the RULA score before and after improvements are:

Table 4. Comparison of RULA before and after improvement

Working Postures	RULA score before		RULA score after		Remark
	Score	Risk category	Score	Risk category	
Posture 1	7	Very high	4	Medium	Improved
Posture 2	7	Very high	4	Medium	Improved
Posture 3	3	Medium	3	Medium	Constant
Posture 4	6	High	4	Medium	Improved
Posture 5	6	High	4	Medium	Improved

Based on the above table, it can be seen that by redesigning the shelves of goods that are used in accordance with the size of the existing operators anthropometry, then the condition of the operator working posture while taking the goods in all positions for the better. Nevertheless, the posture of the work produced is still in the moderate risk category, which means there is a risk the possibility of health problems. For this, a further investigation is needed to obtain a working posture that results in a low risk and not dangerous.

5. CONCLUSION

Shelves size affects the posture of the work done by the operator. RULA method assessment result shows that the size of the shelves currently used in Kopetri Mini market cause poor working posture, which in general are in a condition with high to very

high risk and thus require immediate repair. By redesigning the shelves size according to the size of existing operators anthropometry, the posture of the operator to be better than ever.

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