CHAPTER I
INTRODUCTION

This chapter will be discussed the background of the research, problem formulation, the objectives of the research, the research scope, and the outline of the research.

1.1 Background

Many Indonesian people set up their businesses nowadays, starting from the service, production, to technology. However, the new founder of the businesses carrying out the work mostly found many aberrations so that workers' welfare, health, and safety guarantees are often ignored.

Lifting is one of the work types that needs attention because these work processes they carry out many risks to their health status. In general, these workers use their body as a tool for carrying and shouldering. Manual object lifting or in the ergonomic study known as Manual Material Handling (MMH) is the movement of moving objects by humans using their workforce. The most common manual material handling activities included lifting tasks, carrying tasks, pushing tasks, and pulling tasks (Karwowski, 2005).

Physical loads are found during lifting that uses physical as the main tool for moving the objects. An occupational illness is a disease that arises due to work related to lifting, lowering, and carrying goods that are carried out directly without the help of any tools that can be a risk factor for accidents to workers such as pain or injury to the back.

Musculoskeletal Disorders (MSDs) are often referred to as skeletal muscle disorders and are injured to some part of the body. MSDs are injured that are commonly experienced by workers during lifting activities (Hikmah et al., 2015).

According to the National Occupational Health Strategy results, the Department of Health (2005) stated that if 40.5% of workers had jobs that could cause a related complaint with health problems, one of them was an MSDs of 16%.

There are many production businesses in Indonesia, and one of the businesses that using MMH more often is the drinking water refill business. The business of producing refill drinking water was established as an industrial business that processes raw water into drinking water and sells directly to consumers. A gallon is a unit for measuring liquid. However, the use of gallons is familiar in society as a place or container to store or store drinking water in it.

The development of gallon refill depots can also have a negative impact on workers lifting gallons. Almost all work processes involve manual handling without using any lifting equipment or tool, with a weight of more than 20 kg and a long duration of work, regular lifting frequency, and improper work postures can cause MSDs complaints to the workers. Although the mechanization system is quite expensive with an abundant workforce, it should not neglect work safety and health, which will cause many illnesses and injuries to workers.

At gallon refill depot, some workers serve the lifting of gallons from the work station to the customer or delivery vehicle. Lifting the gallon requires special attention from the technical lifting and the object being carried. Mostly the workers work in an unstable arm position, lean body position when lifting or lowering, unnatural body posture when pushing or pulling, twisting, carrying, and holding. This activity is carried out for an average of 12 hours a day, with the number of gallons lifting from 80 to 150 gallons per day. In this condition, the workers can feel discomfort and risk of musculoskeletal complaints. The workers' posture can be seen in **Figure 1.1** and **Figure 1.2**.

Figure 1.1 Lifting Gallon Position

Figure 1.2 Laying the Gallon on Customer's Vehicle.

Depitra Wiguna, Head of Public Health Sector in Padang, said there were 780-gallon refill depots in Padang. This is based on routine checks conducted by Padang Public Health Sector throughout 2018. Preliminary data obtained from ten workers in gallon refill depots in Padang, 16 body segments of the workers are classified to the degree of complaints as pain and very pain from 28 body segments of the workers. This data are shown in **Table 1.1**.

Table 1.1 Recapitulation of Workers' Nordic Body Map

Number	Musculoskeletal Complaint	Degree of Complaint				Total Complaints
		No Pain	Rather Pain	Pain	Very Pain	
0	Pain in the upper neck	9	1			10
1	Pain in the lower neck	1	4	5		10
2	Pain in the left shoulder		2	2	6	10
3	Pain in the right shoulder		2	6	2	10
4	Pain in the left upper arm		2	5	3	10
5	Pain in the back			1	9	10
6	Pain in the right upper arm	1	3	5	1	10
7	Pain in the waist			1	9	10
8	Pain in the buttock	4	3	3		10
9	Pain in the bottom	10				10
10	Pain in the left elbow		1	6	3	10
11	Pain in the right elbow	2	4	2	2	10
12	Pain in the left lower arm		2	1	7	10
13	Pain in the right lower arm			6	4	10
14	Pain in the left wrist		1	1	8	10
15	Pain in the right wrist			6	4	10
16	Pain in the left hand	2	3	3	2	10
17	Pain in the right hand	5	3	2		10
18	Pain in the left thigh	2	7	1		10
19	Pain in the right thigh	3	6		1	10
20	Pain in the left knee			2	8	10
21	Pain in the right knee		2	4	4	10
22	Pain in the left calf		1	7	2	10
23	Pain in the right calf		5	3	2	10
24	Pain in the left ankle			1	9	10
25	Pain in the right ankle		2	3	5	10
26	Pain in the left foot		5	2	3	10
27	Pain in the right foot	1	4	4	1	10
Total		**40**	**63**	**82**	**95**	

Table 1.2 Workers Nordic Body Map Individual Sum Score

No.	Worker's Name	Gender	Age (years)	Years of Service	Number of Gallons	Working Hours	NBM Individual Sum Score
1	Dayat	Man	44	7	around 150	14	89
2	Anton	Man	27	6	100-150	14	71
3	Suhendri	Man	53	11	100-150	13	83
4	Bambang	Man	40	6	80-100	13	78
5	Taufik	Man	42	7	100-150	14	77
6	Burhan	Man	47	8	100-120	14	78
7	Deni	Man	28	11	80-100	13	73
8	Rudi	Man	32	6	100-200	12	72
9	Awaludin	Man	53	10	around 100	12	88
10	Rinaldi	Man	45	8	around 150	14	83

The preliminary data calculations from the Nordic Body Map questionnaire are obtained from ten workers, and the scores are to 71 to 89. It means that the activity required immediate action (Tarwaka, 2015). The calculation of the scores can be seen in **Appendix A**.

A preliminary study was also carried out using Workplace Ergonomic Risk Assessment (WERA) method. WERA method consists of three scoring system classifications; low, medium, and high. From the calculation of WERA data, one physical risk factor for the low category is vibration. Then two physical risk factors with medium category, shoulder, and leg posture. The high category's physical risk factors are six factors: hand posture, back posture, neck posture, forceful, contact stress, and task duration. The back, neck, and hands are categorized as high scores because the work position when lifting the gallon from the filling station to the customer's vehicle is carried out repeatedly with high intensity, which the gallon weights 19 kg. Work duration is categorized as a high score because workers work more than 4 hours per day. WERA analysis results obtained a final score of 44, meaning that this activity needs further investigation and required change (**Appendix B**).

Based on the current condition, it can be seen that gallon refill depot does not pay attention to the workers' situation, which will have an impact on work effectiveness and efficiency. The preliminary survey result showed that some of the workers used material handling shown in **Figure 1.3**.

Figure 1.3 Hand Pallet Gallon

The workers feel uncomfortable using the existing tools because they did not help the workers doing their job and still have some pain complaints in their bodies. From the previous research, the product design and development of the gallon lifting tool are not applicable in real life. Siska et al. (2011) did the gallon lifting tool design shown in **Figure 1.4**.

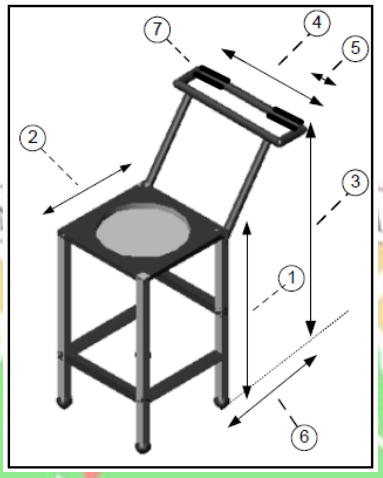

Figure 1.4 Previous Research of Gallon Lifting Tool (Siska et al., 2011)

The researchers only designed material handling recommendations for gallons lifting but did not continue their research at the prototype stage. So it cannot be determined whether the design that has been made can be stated as feasible and useful or not. According to several owners of gallon refill depot trolleys are easy to use and store, and do not require much space to store them. If using a crane or conveyor, it will take up a lot of time and space in the gallon refill depot to install and store it. Also, those material handling can lessen the space for workers to move. To accomplish this problem, it will be necessary to develop an ergonomic tool which is trolley-shaped that helps workers in gallon refill depot.

1.2 Problem Formulation

Based on the background above, the workers in gallon refill depot has the potential to have MSDs. This condition can affect the performance of workers and gallon refill depot business in financial aspects. This situation could be solved by designing a tool that can help workers to avoid the possibility of MSDs happens.

The problem formulation in this research is that it is necessary to have a tool for lifting and moving gallons from the refill work station to the customer or delivery vehicle to minimize the work-related MSDs.

1.3 Research Objectives

This research aims to design a gallon lifting and moving tool for the workers in gallon refill depot from the refill work station to the customer or delivery vehicle, so the possibility of MSDs to the workers will be minimized.

1.4 Research Scopes

The scopes of this research are:

1. Focus on designing a tool that fits in with Southeast Asian ethnic adult workers.
2. The load of the equipment to be designed is limited to carrying 2 gallons (40 kg).
3. The tool to be designed can only be applied to the gallon refill depot with the same floor height and smooth surface, also the distance between the refill station to the customer's vehicle is 3 – 5 meters.

1.5 Outline of Report

To understand the final project report easily, the proposal report follows the report's outline as follows.

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CHAPTER II LITERATURE REVIEW

This chapter consists of literature review about ergonomic, work system, Musculoskeletal Disorder (MSDs), anthropometry, assessment method of body posture, work physiology, product design and development, Ergonomic Function Deployment (EFD), and previous research has taken or quoted from books, journal, and internet references.

CHAPTER III RESEARCH METHODOLOGY

This chapter discusses the stages that will be carried out in research. The stages are preliminary studies, literature studies, methods determination, collecting and processing data, design, analysis, closing, and the research methodology flowchart.

CHAPTER IV DATA COLLECTION AND ANALYSIS

This chapter contains the stages in data collection and analysis in order to achieve the objectives.

CHAPTER V PROTOTYPE AND DISCUSSION

This chapter discuss about the result of research that achieve the objectives. The results will be analyses as detailed as needed.

CHAPTER VI CLOSING

This chapter contains the conclusion of the research and the recommendation for the next research.