CHAPTER I
INTRODUCTION

This chapter contains the background of the research, the problem formulation, the research objective, the research scopes, and the outline of the report.

1.1 Background

Work facilities are defined as "anything used in the form of facilities and infrastructure to support the implementation of employee work in order to facilitate task completion" (Rifa'i, 2019). This facility comes in a variety of forms, including tables, chairs, machines, and others. The use of this facility is critical for everyone involved in the manufacturing process.

It is important to consider the operator's movement elements when designing a work system. Musculoskeletal complaints are common among workers in a non-ergonomic work environment. The complaint is in the form of pain in specific body parts as a result of a load that exceeds the operator's ability limit or is too long in duration. If the muscles are subjected to static loads repeatedly for an extended period of time, it can result in complaints in the form of joint, ligament, and tendon damage. These damage-related complaints are commonly referred to as Musculoskeletal disorders (MSDs). If repetitive work is done in a comfortable, healthy, and ergonomic manner, it will not cause musculoskeletal disorders and all work will be done effectively and efficiently. As a result, human movement at work must be ergonomically designed to avoid fatigue and pain while also balancing body load with workload through the design, redesign, substitution, or modification of work environment tools (Tumanggor et al, 2013).

There are numerous work facilities scattered throughout companies and Micro, Small, and Medium Enterprises (MSMEs). A bakery is one of the MSMEs

that frequently uses work facilities. Yanna Bakery is a food business that makes various types of bread, including dry bread, fried bread (chocolate flavor), and wet bread (cheese flavor, butter meses, and cappuccino). This factory was established in 2006, when it was still under contract in Lubuk Lintah, Kuranji, Padang. The factory has currently relocated to Dadok Tunggul Hitam, Koto Tangah, Padang. This bread is made using a variety of work facilities, including mixers, press machines, packing machines, frying machines, ovens, and trolleys.

The issue that arises in the Yanna Bakery is non-ergonomic work facility, which can cause fatigue and operator discomfort when used. This risk must be managed by improving existing facilities in order to keep the production process running smoothly. The work facility analyzed in this bakery is a trolley that is used to transport a baking sheet containing the formed dough to the loaf steamer. This trolley can usually carry several pans that have been arranged on the bottom of the trolley in this specific way. As a result, the operator must repeatedly bend over to place the pan on the trolley.

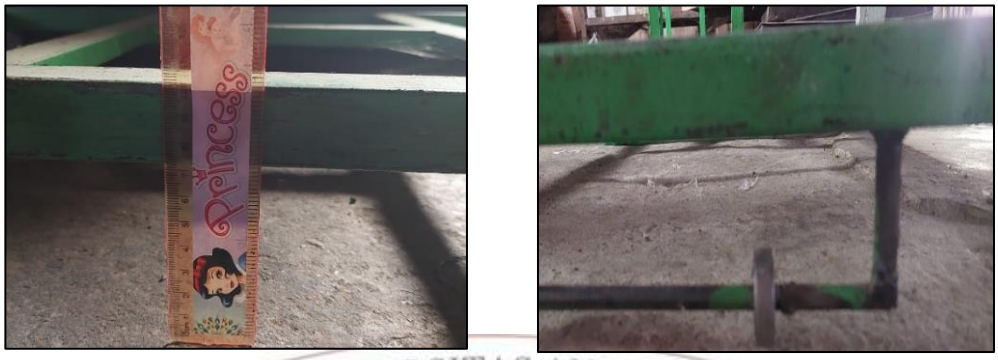
This trolley was built at the workshop in mid-May 2021 for IDR 500,000 to fulfill an inspection permit where the baking sheet is not permitted to be placed on the floor. When moving the pan from the dough forming point to the loaf steamer, the trolley travels approximately 10 meters. The trolley is used not only to transport the dough to the loaf steamer, but also to transport the baking sheet containing the baked dough from the oven to the bread cooler. **Figure 1.1** shows the design of the trolley used by Yanna Bakery.

Figure 1.1 Recent Trolley Used by Yanna Bakery

Reich (1995) defines design as "a process by which the required functions and constraints are defined, and as a result, the process of describing tools that fulfill the defined functions and constraints." Pahl et al. (1995) proposed several design processes models, one of which is detail design. The exact design of each component that integrates the product according to the specifications specified in the conceptual design, along with the size of each component, will be included in the detail design (Ellacuria et al, 2016). The design of the trolley, according to the owner of the Yanna Bakery, is less ergonomic when used, so the owner wants to design a work tool in the form of a more ergonomic trolley. **Appendix A** shows the dimension of recent trolley at Yanna Bakery.

Trolleys used in industry should be ergonomically designed to accommodate humans in the environment (Santoso, 2013). The handle of the trolley used by the Yanna Bakery has been designed to meet the needs of the operator, with the handle being pushed with both hands of the operator. The trolley's base is only 7.5 cm from the floor, indicating that the location of the base is less ergonomic, where a baking sheet containing bread can be considered unhygienic if exposed to dust or something else with the height of the existing base. The distance from the base to the ground surface is displayed in **Figure 1.2** (a). The trolley's wheels are made of iron, which, if pushed through the cement-based floor surface, can cause

deterioration and cause the floor surface to become more uneven over time. The trolley's wheels are displayed in **Figure 1.2** (b).



(a) (b)

Figure 1.2 (a) Distance from the trolley's base to the floor surface; (b) Trolley Wheels

Aside from the design aspect, the trolley can also be measured in terms of quality dimensions. According to the observations, the trolley performs admirably on a level surface. The trolley's durability can be described as quite strong because it has been used for more than a year and is still in use today. Trolleys are easy to repair because the components used are easily obtainable. Considering the quality of the trolleys available at the moment, it is fair to conclude that there is a need for significant improvements to the trolley design in terms of the design that affects user comfort and the hygiene standards that must be met by bakery products.

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Humans will suffer a variety of negative effects if the product design is less ergonomic. These negative effects on humans can occur both in the short and long term. Working in non-ergonomic conditions can result in a variety of worker complaints, such as pain, fatigue, and even accidents (Santoso, 2013). The following are some of the problems highlighted by trolley operators. The first is that the operator is subjected to a heavy load while pushing the trolley, necessitating the use of more power because the wheels are still in the form of bearings on the cement floor surface. The stacked baking sheet in **Figure 1.3** may also fall if there is an incident, whether caused by an uneven floor surface or something else. This is due to the trolley's lack of a stopper in dealing with the incident.

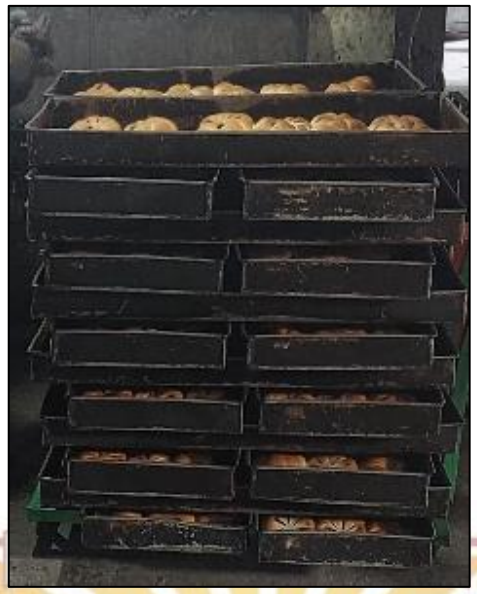

Figure 1.3 Trolley with a Pile of Baking Pans

It is reviewed not only based on the operator's complaints, but also on ergonomics. Workplace ergonomic risks include improperly adjusted workstations, frequent lifting, and awkward movements especially if they are repetitive (Asumeng et al, 2015). According to the observations, the trolley's base cannot be adjusted in height because it is made static. Secondly, for the frequency of lifting then placing the pans into the stacked trolley as shown in **Figure 1.3**, 8 times per day. Lastly, the awkward movement of poor posture, which is repeated when placing the baking sheet on the trolley.

Based on the ergonomic risk previously described, the ManTRA scoring matrix was completed to make an assessment of the exposure to musculoskeletal risk factors associated with manual tasks in the workplace. This research uses ManTRA scoring matrix for workplace which was undertaken by operators who perform the task. **Table 1.1** shows one of the ManTRA scores when lifting the baking sheet containing the baked dough onto the trolley.

Table 1.1 ManTRA Score when Lifting the Baking Sheet Containing the Baked Dough onto The Trolley

Body Region	**Task Codes**									Cumulative Risk
	Total time	Duration	Cycle time	Repetition Risk	Force	Speed	Exertion Risk	Awkwardness	Vibration	
Lower Limbs	1	3	1	2	5	4	5	5	2	15
Back	1	3	1	2	5	4	5	5	2	15
Neck/ Shoulder	1	3	1	2	5	4	5	2	2	12
Arm/ Wrist/ Hand	1	3	1	2	5	4	5	5	2	15

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The activity of lifting the baking sheet containing the baked dough onto the trolley shows several risk factors with the cumulative results of each risk on the back, forearms, neck/shoulders, and wrists based on one of the ManTRA scores shown in **Table 1.1**. Because of the score of exertion risk is worth 5, the sum of the exertion and awkwardness scores is worth 9 (8 or more), and the cumulative risk score is worth 15 (except neck/shoulder), further action may be indicated. Other activities' ManTRA scores can be seen in the **Appendix**. Furthermore, this is caused by the operator, who repeatedly performs the activity of placing the pan on the trolley with less ergonomic work postures. The working posture of the operator when using a trolley is displayed in **Figure 1.4**.

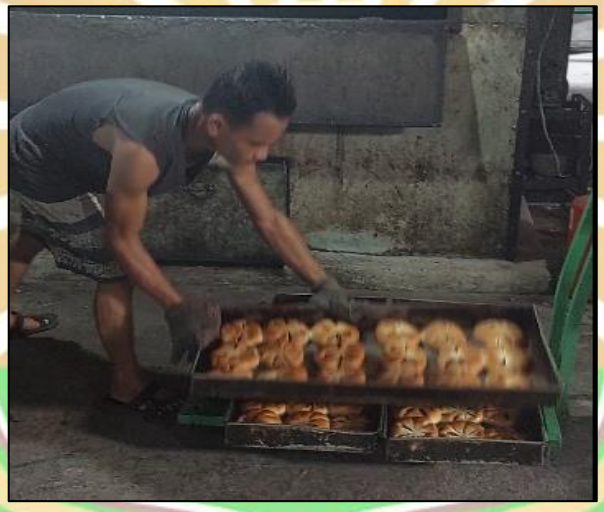

Figure 1.4 Operator Work Posture When Using a Trolley

The Rapid Entire Body Assessment (REBA) questionnaire is used after the ManTRA scores have been assessed. Rapid Entire Body Assessment (REBA) is an ergonomics method for quickly assessing workers' neck, back, wrists, and feet posture (Musyarofah et al, 2019). The REBA questionnaire can be found in **Appendix B**, where a REBA score of 9 is obtained, indicating a high risk when placing the baking sheet in the trolley.

Based on the trolley design, ManTRA, and current REBA scores, it can be stated that activities involving trolleys pose a risk of musculoskeletal disorders for the operator. As a result, trolley repair is required to ensure that the manufacturing

process runs smoothly and does not cause operator fatigue. If the trolley at Yanna Bakery is not repaired immediately, it will disrupt production activities. Concerning the consequences, such as a decrease in production results due to the length of time the operator spends moving the dough pan and the pain experienced by the operator in several parts of the body as a result of manually lifting the stacked dough pan as high as 78 cm.

This trolley can be repaired using the Design Analysis method by clarifying design needs, setting objectives as well as strategies of the design, establishing design concept as well as specification, selecting feasible design alternatives, selecting as well as specifying design parameters, evaluating the design, and implementing the design, resulting in a more ergonomic trolley.

1.2 Problem Formulation

Based on observations made at Yanna Bakery and contained in the background presented previously, the problems that arise are the height of the trolley base, which is close to the floor surface, so that it is indicated to be unhygienic on the bread dough. The wheels are in the form of bearings that can erode the floor surface, and there is no barrier on the inner base to hold the pan, so it does not fall on the floor surface. Thus, it is necessary to redesign the transport trolley of baking sheets at the Yanna Bakery in Koto Tangah District to facilitate operators so that the production process occurs more effectively and efficiently.

1.3 Research Objective

The objective of this research is to redesign the transport trolley of baking sheets at the Yanna Bakery in Koto Tangah District to facilitate operators so that the production process occurs more effectively and efficiently.

1.4 Research Scopes

The scopes of this research are as follows:

1. The anthropometric data from Yanna Bakery operators will be used in the design of this trolley.
2. There is no change in the construction of the factory during the implementation of this final project.

1.5 Outline of Report

The outline of this report can be seen as follows:

CHAPTER I INTRODUCTION

This chapter discusses the research background, the problem formulation, the research objectives, the research scopes, and the outline of report.

CHAPTER II LITERATURE REVIEW

This chapter aims to obtain theories and methods that are relevant to the problem being solved.

CHAPTER III RESEARCH METHODOLOGY

This chapter describes the stages of implementation from the beginning to the end of the research.

CHAPTER IV PRODUCT DEVELOPMENT

This chapter outlines the data collection stages required for problem solving and redesigning industrial trolleys.

CHAPTER V ANALYSIS

This chapter contains an analysis of the results of alternative trolley designs based on optimum performance.

CHAPTER VI CONCLUSION AND SUGGESTION

This chapter contains conclusions from the results and analysis and offers suggestions for improvement to improve further research.

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