# CHAPTER V
# DISCUSSIONS

This chapter contains an analysis of the discussion based on the results of data collection and processing that has been carried out previously, which is adjusted to the research objectives and produces a recommendation for Yanna Bakery

## 5.1 Current Value Stream Mapping Analysis

The flow of information and materials in the Yanna Bakery production process is mapped using a technique called current value stream mapping (CVSM), which starts with raw materials and ends with finished goods that reflect the real conditions of the manufacturing process there. The current value stream mapping, or CVSM, serves as the foundation for streamlining the production process and getting rid of waste. **Figure 4.1** shows the Yanna baking's current Value Stream Mapping (CVSM) for the bakery production process. The image depicts the movement of information and materials during the Yanna Bakery's production process. Retailers provide information to the head of production, Yanna Bakery's direct owner, on the quantity of requests for bakery goods received each day. This information is used to manage the production system. The production process uses this data as a guide to figure out how much is produced each day. Each week, the production manager gives suppliers the information they need to order raw materials for baking. The materials are sent once a week to the materials warehouse of Yanna Bakery.

Furthermore, the material will go through nine processes to become a bakery for one batch of bakery products or the equivalent of 350 loaves. The process starts from weighing materials, mixing materials in horizontal mixer machine, mixing materials in spiral mixer machine, pressing process, forming and filling bakery, proofing, frying, and packaging. Each process box in VSM contains

information about the cycle time of each process (C/T), the amount of labor (MP), and the number of machines used for each work station.

At the bottom of each process box are Value Added (VA) and Non-Value Added (NVA) activity times. The total Value Added (VA) time for 1 production batch is 228.5 min and the total Non-Value Added (NVA) time for 1 production batch is 84.29 min. Total Non-Value Added (NVA) time is obtained from production activities such as searching for tools and materials, especially in the weighing materials process, set up horizontal mixer machine, set up spiral mixer machine, dough rework, over processing, especially in the mixing materials and pressing process, and long transportation between 2 interrelated departments. From CVSM, we can also calculate the leadtime for 1 batch production, which is 312.79 min. After mapping the flow of information and materials on the CVSM, Process Cycle Efficiency (PCE) can be calculated using equations **5.1.**

$$\text{Process Cycle Efficiency} = \frac{\text{Value Added (VA)}}{\text{Lead time}} \times 100\% \quad \textbf{5.1}$$

$$\text{Process Cycle Efficiency} = \frac{228.5}{312.79} \times 100\%$$

$$= 0.7305 \times 100\%$$

$$= 73.05\%$$

Based on the PCE value obtained on CVSM, it can be seen that the bakery production process at Yanna Bakery is less efficient. This value can be increased by implementing improvement recommendations to improve the efficiency of the bakery production process at Yanna Bakery, so that waste that occurs in the bakery production process at Yanna Bakery can be minimized or even eliminated. Through improvement recommendations, it is expected to be able to increase the PCE value in VSM which will be described and explained in Future Value Stream Mapping (FVSM).

## 5.2 Waste Asessment Model (WAM) Analysis

Identification of waste in the bakery production process at Yanna Bakery is carried out using the Waste Assessment Model (WAM) method. This method is used because it can identify waste that occurs on the production floor and show the relationship that occurs between these wastes. The results of this WAM are in the form of waste ratings and the weight of each, so that waste priorities can be determined to be given improvement recommendations.

### 5.2.1 Waste Relationship Matrix (WRM) Analysis

The Waste Relationship Matrix (WRM) is a tool for matrix-based waste relationship analysis. The waste in each row of the matrix indicates how it may influence the occurrence of other waste. However, every column in the matrix displays waste that is impacted by additional waste. The relationship's maximum value can be seen on the matrix's diagonal. The percentage of linkage of each waste can be seen in **Table 4.13**

Based on **Table 4.13** shows the percentage of waste relationship from the categories "from" and "to". The percentage of "from" is the value in each row of the matrix, where this value indicates the largest waste in influencing the occurrence of other waste. In the table, it can be seen that over processing is the highest type of waste for the entire matrix row, which is 26%. This shows that waste over processing is a type of waste that has a major influence in triggering the occurrence of other waste. This was followed by waste transportation at 25%, waste defects and motion with the same percentage at 20%, waste waiting at 10%. waste overproduction and inventory at 0%

Then, there is the percentage "to" obtained from the value in each column of the matrix. This value shows the waste that is most affected by other waste. In the table, the largest "to" percentage value is occupied by waiting. This shows that waste of waiting is the type of waste that is most influenced by other types of waste.

This value is followed by waste motion and defects with the same percentage at 21%, transportation at 16%, process at 16%, inventory and overproduction at 0%

### 5.2.2 Waste Assesment Questionnaire (WAQ) Analysis

Waste that develops on production lines is identified and distributed using the Waste Assessment Questionnaire (WAQ). The 59 questions in the questionnaire outline the circumstances and actions that lead to waste. Furthermore, this survey has two question kinds—"from" and "to"—and is divided into four question categories: "material," "method," "man, machine," and so on. This assessment yielded the following output: a sequential waste ranking with each waste's percentage of weight. The following are the results of the waste ranking contained in the bakery production process at Yanna Bakery which can be seen at **Figure 5.1.**

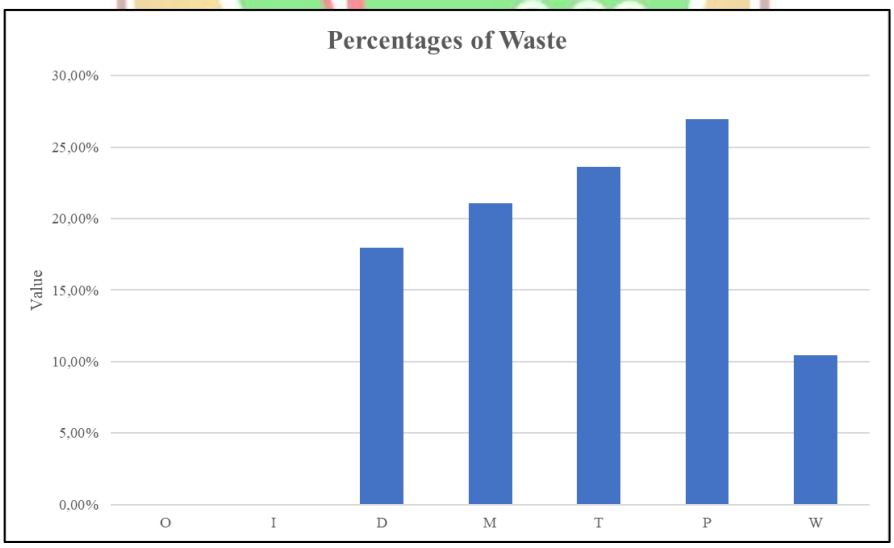


**Figure 5.1** Waste Rating on Bakery Production Process at Yanna Bakery

Based on **Figure 5.1**, it can be seen that the waste with the highest rank is over processing, which is with a percentage of 27%. This shows that over processing is the dominant waste that occurs and is prioritized to immediately get recommendations for improvement. Mathematical calculations for waste ratings that have been carried out in accordance with actual conditions found during initial observations, where the obvious waste is over processing, especially in the mixing process at the horizontal mixer machine, mixing at the spiral mixer machine,

pressing process that is not in accordance with company standards causing the dough to start over mixing, looks wet, sticky, flabby and inelastic. As a result of this over-processing process, the dough must be reworked starting from the material weighing process, mixing in the horizontal mixer machine, mixing in the spiral mixer machine, and pressing process so that the resulting dough is smooth, namely dough that has the characteristics of soft, elastic, dry, and resistant to stretching (not easily torn). The total time to rework in 1 production batch is 29.3 min so that the production lead time is getting longer.

Waste with the 2nd highest rank is transportation, with a percentage of 24%. This is shown by the production layout at Yanna Bakery does not pay attention to the relationship between facilities so there is a lot of bypassing and backtracking movement, especially, forming, proofing, frying, and packaging work stations. Hence, that distance and transportation time are getting longer which causes the production lead time to also be longer. For example, after the dough is formed into bakery and placed in a baking sheet, the production employee must pass through the bakery forming and cutting work station of the dough to get to the proofing place. After the dough is proofing and ready to fry, the production employees must pass through the dough cutting and bakery forming work station to arrive at the bakery frying station. After the bakery is fried and cooled for packaging, the production employee must pass through the bakery forming work station to get to the packaging station. The ineffective material flow condition causes production time to be longer and wasted unnecessary labor.

## 5.3 Value Stream Analysis Tools (VALSAT) Analysis

Value Stream Analysis Tools (VALSAT) are a set of tools designed to help in understanding current value streams and simplifying waste-related solutions. Based on waste that has been recognised in the previous stage, VALSAT is utilised to pick precise mapping tools. A programme called VALSAT was created to help with waste management within value streams and to make it easier to comprehend

the value streams that currently exist. Based on the VALSAT calculations that have been done previously can be seen on **Figure 5.2**

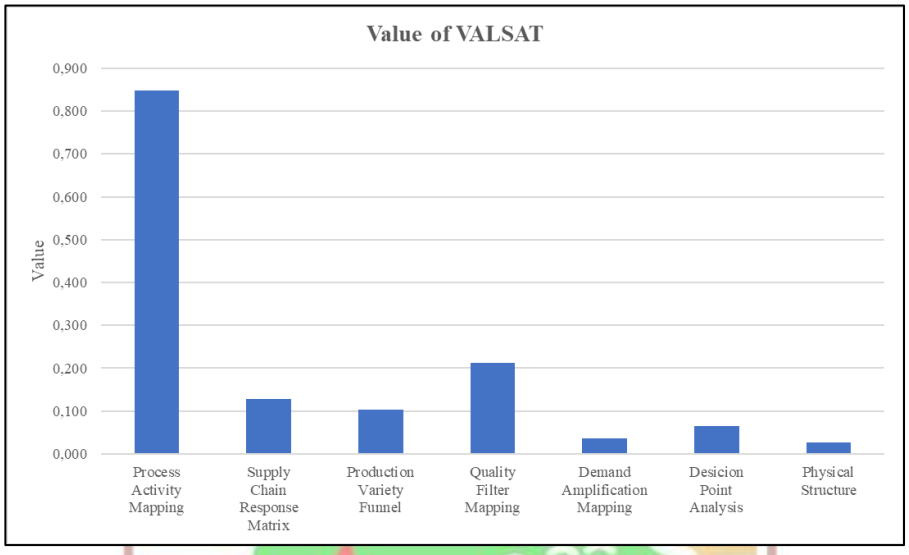


**Figure 5.2** VALSAT Calculation Results

Based on **Figure 5.2**, it can be seen that Process Activity Mapping (PAM) has the highest score of 0.848, so this tool will be used for understanding of existing value streams and waste contained in the value stream. Process Activity Mapping (PAM) will further map all activities that take place in the production process and classify these activities into several categories, namely Value Added (VA), Non-Value Added (NVA) and Necessary Non-Value Added (NNVA). Based on **Table 4.25** to **Table 4.27,** Process Activity Mapping (PAM) of the Bakery Production Process at Yanna Bakery can be seen all activities in the production process, machines and tools used, the time of each activity, the type of activity consisting of operation, inspection, transportation, delay, storage, and also the category of each activity whether Value Added (VA), Non-Value Added (NVA) and Necessary Non-Value Added (NNVA).

Non-Value Added activities (NVA) and Necessary Non-Value Added activities (NNVA) are activities that are wasteful and have no added value will be eliminated or minimized such as finding and retrieving scales and containers, material is waiting to be stirred in the horizontal mixer machine, set up horizontal mixer machine, rework bakery dough, and others. By eliminating this activity, it is

hoped that the production process at Yanna Bakery can run more effectively and efficiently so that the production lead time is smaller and production targets can be met. Based on **Table 4.28** can be seen the recap of Process Activity Mapping (PAM) with a total of 61 activities that took place during the bakery production process with 37 activities being operations with a percentage of 60.66% of the total existing activities, 19 transportation activities with a percentage of 31.15%, 3 inspection activities with a percentage of 4.92%, 1 storage activity with a percentage of 1.64%, and 1 activity delay with a percentage of 1.64%. Furthermore, there are 32 activities classified as value added activities with a percentage of 52.46% of total production activities, 7 activities classified as non-value added activities with a percentage of 11.48%, and 22 activities classified as necessary but non value added activities with a percentage of 36.07%.

## 5.4 Analysis of Proposed Improvement

Improvement proposals are given to waste with the highest percentage. Based on calculations and data processing using the Waste Relationship Matrix (WRM) and Waste Assessment Questionnaire (WAQ), the highest waste found at Yanna Bakery is over processing followed by waste transportation. Both of these wastes must be immediately eliminated and prioritized to immediately get recommendations for improvement. Based on the fishbone diagram that can be seen in **Figure 4.2,** over processing often occurs in the process of weighing materials, mixing in horizontal mixer machine, mixing in spiral mixer machine, and pressing process. As a result of this over-processing process, dough for 1 batch production must be reworked starting from the weighing material process, mixing in the horizontal mixer machine, mixing in the spiral mixer machine, and pressing process so that the resulting dough is smooth, namely dough that has the characteristics of soft, elastic, dry, and resistant to stretching (not easily torn). As a result of waste over processing, the amount of bakery production per day is less than optimal, which should be able to produce 11-12 batches per day, is actually only able to produce 9-10 batches per day because of waste over processing which results in

longer production time and also causes the production target per day is sometimes not achieved.

Based on the fishbone diagram that can be seen in **Figure 4.2** that already done by brainstorming with Yanna Bakery to agree on the cause of the problems that occur, waste over processing occurs due to the absence of Standard Operating Procedure (SOP) for bakery production at Yanna Bakery and also the absence of work instructions, especially at work stations that often cause waste over processing such as work station weighing materials, mixing in horizontal and spiral mixer machines, and pressing processes. Standard Operating Procedure (SOP) can assist in the implementation and work of a particular function or activity to run effectively and efficiently (Prasanna, 2013). The function of SOP become production activities can run consistently so that production quality can be maintained, help prevent confusion in doing work (role clarification), and ensure work is done well (Bhattacharya et al., 2015).

Thus, implementing SOPs can reduce errors during the bakery production process so that rework on dough and carry out activities that are not needed during the bakery production process which is part of waste overprocessing can be eliminated or minimized. Therefore, it is necessary to make Standard Operating Procedures (SOP) for bakery production and work instructions at work stations that produce waste over processing. Yanna Bakery's bakery production Standard Operating Procedure (SOP) can be seen in **Figure 5.3**, work instructions on the weighing material work station can be seen in **Figure 5.4**, work instructions on the work station mixing in horizontal mixer machine **Figure 5.5**, work instructions on the work station mixing in spiral mixer machine **Figure 5.6** and work instructions on the pressing process work station can be seen in **Figure 5.7.**

| Yanna Bakery | **STANDARD OPERATING PROCEDURE OF BAKERY PRODUCTION** | | |
|---|---|---|---|
| | No. Document: | No. Revision: | Page: |
| STANDARD OPERATING PROCEDURE | Date published: | Assigned:<br>Head of Production Yanna Bakery<br><br>Mr. Yanna | |
| OBJECTIVE | This procedure aims to ensure the quality of bakery produced from the initial stage of production to the hands of consumers | | |
| SCOPE | This procedure covers all bakery production activities and is used as a guide for workers in carrying out the production process | | |
| TOOLS /MATERIALS/ MACHINE | Machine: horizontal mixer, spiral mixer, pressing, frying. | | |
| | Tools: scales, containers, measuring cups, knives, plastic packaging, baking sheets, spoons, tarpaulins, scissors, gloves, baskets | | |
| | Materials: flour, baker's yeast, salt, sugar, eggs, milk, butter | | |
| RESPONSIBLE PERSON | Owner as head of production | | |
| WORK | 1 The production process starts at 08.00 WIB<br>2 Taking raw materials and auxiliary materials in bread production<br>3 Preparing the necessary tools for producing bakery<br>4 Each type of material is weighed exactly approximately 9.36 min<br>5 Putting the weighing material in the container<br>6 Stirring the material in the horizontal mixer machine is approximately 9.49 min until it becomes coarse dough with the characteristic of a rather rough and slightly lumpy dough<br>7 After forming the coarse dough, then the dough is stirred again using a spiral mixer machine with gradual speed until a smooth dough is obtained with a processing time of approximately 5.11 min<br>8 After that the dough is processed in a press of approximately 4.21 min to ensure that there is no lumpy dough and add to the elasticity of the dough | | |

**Figure 5.3** Standard Operating Procedure (SOP) at Yanna Bakery Bakery Production

| | |
|---|---|
| | 9 The dough is weighed and divided using a manual dough divider tool so that the pieces are more homogeneous and the weight is more uniform approximately 4.26 min<br>10 Forming and filling bakery with chocolate approximately 16.20 min<br>11 The formed dough is put into a baking sheet that has been smeared with margarine to be carried and processed at the proofing stage<br>12 Cover the baking sheet with a tarp and make sure there is no tarp open on the side to maintain the temperature of the dough so that the fermentation process runs smoothly<br>13 120 min proofing process<br>14 Inspect bread dough before entering the frying process<br>15 The dough is put in the frying machine<br>16 Frying process for 17.08 min<br>17 Putting cooked bread onto a baking sheet<br>18 Bread cooling process for 9.29 min<br>19 Bakery inspection to see if there is charred bread or<br>20 Bread packing process for 11.46 min<br>21 Putting packaged bread in the basket<br>22 Transfer of bakery baskets to the storage area of finished products<br>23 Product storage |

**Figure 5.3** Standard Operating Procedure (SOP) at Yanna Bakery Bakery Production

| | | | |
|---|---|---|---|
| Yanna Bakery | **MATERIAL WEIGHING PROCESS WORK INSTRUCTIONS** | | |
| | No. Document: | No. Revision: | Page: |
| WORK INSTRUCTIONS | Date published: | Assigned:<br>Head of Production Yanna Bakery<br><br>Yanna | |
| OBJECTIVE | Ensure that each materials is weighed correctly so that there are no dosing errors that cause damage to bakery dough or decrease in bakery quality | | |
| TOOLS /MATERIALS | Tools: scales, containers, measuring cups, knives, spoons, scissors, gloves<br>Materials: flour, baker's yeast, salt, sugar, eggs, milk, butter | | |

**Figure 5.4** Work Instructions on Material Weighing Process

| | |
|---|---|
| RESPONSIBLE PERSON | Workers in charge of the material weighing process at Yanna Bakery |
| SEQUENCE OF WORK | 1 Prepared necessary tools such as: scales, containers, measuring cups, knives, spoons, scissors, gloves<br>2 The main materials have been prepared, among others: wheat flour, yeast, salt, and water<br>3 Auxiliary materials have been prepared, among others: margarine, sugar, milk powder, eggs<br>4 Pay attention to the accuracy of the scale you want to use and make sure the scale needle starts from the number<br>5 Weighing must be done carefully and precisely choose a weighing device according to the weight of the material to be weighed<br>6 Weigh the main materials and auxiliaries with recipes/1 kilogram are as follows:<br>- wheat flour 1000 gr<br>- yeast 20 gr<br>- salt 17 gr<br>- water 350 gr<br>- eggs 200 gr<br>- butter 180 gr<br>- sugar 200 gr<br>7 Salt weighing must be done as carefully as possible, the difference in salt use of more than 1% has hampered the fermentation process<br>8 Do not weigh salt and yeast on the same scale mat because salt is toxic to yeast that can inhibit fermentation in bakery dough<br>9 Water weighing must be done as carefully as possible because the use of too much water, the dough will become sticky and difficult to handle during the bakery making process. Conversely, if too little water is used, the final product of the bakery will become hard.<br>10 The weighed materials are put into containers to be carried and processed in the horizontal mixer machine |

**Figure 5.4** Work Instructions on Material Weighing Process

| | | | |
|---|---|---|---|
| Yanna Bakery | **MATERIAL STIRRING PROCESS IN HORIZONTAL MIXER MACHINE WORK INSTRUCTIONS** | | |
| | No. Document: | No. Revision: | Page: |
| WORK INSTRUCTIONS | Date published: | Assigned:<br>Head of Production Yanna Bakery<br><br>Yanna | |
| OBJECTIVE | The result is coarse dough with the characteristic of a rather rough and slightly lumpy | | |
| TOOLS /MATERIALS /MACHINE | Tools: gloves, containers<br>Machine: horizontal mixer machine<br>Materials: materials that have been weighed in the material weighing process | | |
| RESPONSIBLE PERSON | Workers in charge of the mixing process in horizontal mixer machine at Yanna Bakery | | |
| SEQUENCE OF WORK | 1 Make sure that the horizontal mixer machine is ready for operation.<br>2 Set up horizontal mixer machine<br>3 Mix flour, water, and baker's yeast into a horizontal mixer first to make predough<br>4 The mixing process to form predough takes approximately 5 minutes<br>5 After the predough is finished, then add other enhancers, namely milk powder, sugar, and eggs<br>6 The mixing process lasts for 4.49 minutes<br>7 While the mixing process in the horizontal mixer machine takes place, set up the spiral mixer machine, so that there is no dough waiting to be processed in the spiral mixer machine after being processed in the horizontal mixer<br>8 The process in the horizontal mixer machine is said to be successful if the ingredients have been mixed evenly and have become coarse dough with the properties of a rather rough and slightly lumpy dough<br>9 After that, turn off the horizontal mixer machine<br>10 Take the coarse dough and put it in a container to be transported to the spiral mixer machine for further processing | | |

**Figure 5.5** Work Instructions on Mixing in Horizontal Mixer Machine Work Station

| | | | |
|---|---|---|---|
| Yanna Bakery | **MATERIAL STIRRING PROCESS IN SPIRAL MIXER MACHINE WORK INSTRUCTIONS** | | |
| | No. Document: | No. Revision: | Page: |
| WORK INSTRUCTIONS | Date published: | Assigned: Head of Production Yanna Bakery<br><br>Yanna | |
| OBJECTIVE | The resulting dough is a dough that has the characteristics of soft, elastic, dry, and resistant to stretching (not easily torn) | | |
| TOOLS /MATERIALS /MACHINE | Tools: gloves, containers<br>Machine: spiral mixer machine<br>Materials: materials that have been mixing in horizontal mixer machine | | |
| RESPONSIBLE PERSON | Workers in charge of the mixing process in spiral mixer machine at Yanna Bakery | | |
| | 1 While the mixing process in the horizontal mixer machine takes place, set up the spiral mixer machine<br>2 Put the coarse in the bowl<br>3 Mixing in spiral mixer machine starts by using gear 1<br>4 After that, add other enhancers, namely margarine and salt in the dough<br>5 After that, use gear 2 in the mixing process<br>6 Do not use gear 3 in the production process because the tool will be damaged quickly<br>7 The mixing process in the spiral mixer machine takes approximately 5.11 minutes<br>8 The process is said to be successful if the resulting dough is smooth, namely dough that has the characteristics of soft, elastic, dry, and resistant to stretching (not easily torn)<br>9 Press the off button on the machine, and take the finished dough to be placed in containers and transported for processing in the pressing process | | |

**Figure 5.6** Work Instructions on Mixing in Spiral Mixer Machine Work Station

| Yanna Bakery | **PRESSING PROCESS WORK INSTRUCTIONS** | | |
|---|---|---|---|
| | No. Document: | No. Revision: | Page: |
| WORK INSTRUCTIONS | Date published: | Assigned: Head of Production Yanna Bakery<br><br>Yanna | |
| OBJECTIVE | Ensure that there is no lumpy dough and add elasticity to the dough for easy processing during forming and filling bakery | | |
| TOOLS /MATERIALS /MACHINE | Tools: gloves, containers<br>Machine: pressing machine<br>Materials: dough that has been stirred in spiral mixer machine | | |
| RESPONSIBLE PERSON | Workers in charge of the pressing process | | |
| SEQUENCE OF WORK | 1 Make sure that the pressing machine is ready for operation.<br>2 Before the machine is turned on, the tool is sprinkled with a little wheat flour so that the dough does not stick to the tool<br>3 Turn on the pressing machine<br>4 Perform the pressing process with a maximum duration of 5 min<br>5 During the pressing process, the operator's hand presses the dough to ensure that there is no clumping of dough<br>6 If the pressing process time is more than 5 min, the dough starts to overmix, looks wet, sticky, mushy and inelastic<br>7 After the pressing process is complete, press the off button on the machine<br>8 Take the dough and put it on a container for processing at a later stage | | |

**Figure 5.7** Work Instructions on Work Station Pressing Process

After designing SOPs and work instructions, a Flow Process Chart (FPC) was designed before and after recommendations for improvement to minimize or eliminate waste over processing to see the differences and changes that occur when implementing SOPs and work instructions. Flow Process Chart (FPC) before recommendations to minimize or eliminate waste over processing with the

application of SOPs and work instructions which can be seen in **Table 5.1** to **Table 5.3.**

**Table 5.1** Flow Process Chart Before Implementation SOP and Work Instructions

FLOW PROCESS CHART

| SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| ACTIVITIES | NOW | | PROPOSED | | DIFFERENT | |
| | Total | Time | Total | Time | Total | Time |
| ○ OPERATION | 39 | 276,72 | | | | |
| □ INSPECTION | 3 | 19,52 | | | | |
| ⇨ TRANSPORTATION | 18 | 21 | | | | |
| D DELAY | 1 | 2,34 | | | | |
| ▽ STORAGE | 1 | 3,18 | | | | |
| TOTAL DISTANCE | 76,09 | | | | | |

ACTIVITIES : Bakery Production at Yanna Bakery
MAP NUMBER : 01
PERSON [V] MATERIAL [ ]
NOW [V] PROPOSED [ ]
MAPPED BY : Muhammad Fauzan Syahputra
MAPPED DATE : 17 February 2023

| DESCRIPTION OF ACTIVITIES | SYMBOL | | | | | DISTANCE (m) | TIME (min) | ANALYZES | | | | | NOTE | ACTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ○ | □ | ⇨ | D | ▽ | | | WHAT | WHERE | WHEN | WHO | HOW | | ROOM | MERGE | UBAH | | | REPAIR |
| | | | | | | | | | | | | | | | | ORDER | PLACE | PERSO | |
| Taking scales and containers | | | | | | | 1,32 | | | | | | | | | | | | |
| Picking up raw materials to weighing work station | | | | | | 1 | 2,05 | | | | | | | | | | | | |
| Weighing materials | | | | | | | 7,48 | | | | | | | | | | | | |
| Putting the weighing material in the container | | | | | | | 2,02 | | | | | | | | | | | | |
| The materials are transferred to the horizontal mixer machine work station | | | | | | 2 | 1,28 | | | | | | | | | | | | |
| Set up horizontal mixer machine | | | | | | | 2,01 | | | | | | | | | | | | |
| The material is waiting to be stirred in the horizontal mixer machine | | | | | | | 2,34 | | | | | | | | | | | | |
| The material is put into the horizontal mixing machine | | | | | | | 0,07 | | | | | | | | | | | | |
| Stirring bread dough ingredients | | | | | | | 6,32 | | | | | | | | | | | | |
| The operator goes to the raw material warehouse | | | | | | 2 | 0,36 | | | | | | | | | | | | |
| Picking up a bucket in the raw material warehouse | | | | | | | 0,13 | | | | | | | | | | | | |
| Filling the bucket with water | | | | | | | 0,35 | | | | | | | | | | | | |
| The operator goes to the work station of the horizontal mixer machine | | | | | | 2 | 0,59 | | | | | | | | | | | | |
| Putting water and others material such as milk powder, sugar, and eggs in a bucket into a horizontal mixing machine | | | | | | | 0,06 | | | | | | | | | | | | |
| The process of stirring bread dough into coarse dough | | | | | | | 5,17 | | | | | | | | | | | | |
| Set up spiral mixing machine | | | | | | | 2,19 | | | | | | | | | | | | |
| Transfer of coarse dough to the working station of the spiral mixing machine | | | | | | 1 | 0,05 | | | | | | | | | | | | |
| Putting coarse dough into a spiral mixing machine | | | | | | | 0,06 | | | | | | | | | | | | |
| The operator goes to the raw material warehouse | | | | | | 3 | 0,45 | | | | | | | | | | | | |
| Searching for containers in the raw material warehouse | | | | | | | 0,12 | | | | | | | | | | | | |
| Picking up butter and salt in the raw material warehouse | | | | | | | 0,09 | | | | | | | | | | | | |

**Table 5.2** Flow Process Chart Before Implementation SOP and Work Instructions

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weighing butter and salt | | | | | | | 1,13 | | | | | | | | | | | | |
| Putting butter and salt in a container | | | | | | | 0,05 | | | | | | | | | | | | |
| The operator goes to the work station of the spiral mixing machine | | | | | | 3 | 0,45 | | | | | | | | | | | | |
| Putting butter in a container to a spiral mixing machine and last salt | | | | | | | 0,04 | | | | | | | | | | | | |
| The process of stirring bread dough | | | | | | | 6,51 | | | | | | | | | | | | |
| Transfer of dough to press machine | | | | | | 1,3 | 0,09 | | | | | | | | | | | | |
| Set up press machine | | | | | | | 1,25 | | | | | | | | | | | | |
| Dough in the press in the press machine | | | | | | | 5,44 | | | | | | | | | | | | |
| The dough is transferred to the bread formation work station | | | | | | 4,18 | 0,19 | | | | | | | | | | | | |
| Inspect bread dough | | | | | | | 1,47 | | | | | | | | | | | | |
| Rework bread dough | | | | | | | 29,31 | | | | | | | | | | | | |
| The operator goes to the storage area | | | | | | 2,51 | 0,27 | | | | | | | | | | | | |
| The operator takes a round baking sheet, rectangular baking sheet, scales and knife | | | | | | | 3,12 | | | | | | | | | | | | |
| The operator goes to the bread forming work station | | | | | | 2,51 | 0,57 | | | | | | | | | | | | |
| Weighing the dough | | | | | | | 1,14 | | | | | | | | | | | | |
| Reaching out to oil already in bread forming workstations | | | | | | | 0,05 | | | | | | | | | | | | |
| Grease a round baking sheet with oil | | | | | | | 2,08 | | | | | | | | | | | | |
| Inserting and jerking the round baking sheet-shaped dough | | | | | | | 2,11 | | | | | | | | | | | | |
| Transfer of a round baking sheet containing dough to a cutting work station | | | | | | 0,68 | 0,29 | | | | | | | | | | | | |
| Cutting the dough on a round baking sheet into pieces | | | | | | | 4,26 | | | | | | | | | | | | |
| Operator to bread forming workstation | | | | | | 0,68 | 0,29 | | | | | | | | | | | | |
| Laying the cut dough | | | | | | | 1,06 | | | | | | | | | | | | |
| Carrying out the process of forming and giving bread fillings | | | | | | | 18,31 | | | | | | | | | | | | |
| The formed dough is put into a baking sheet | | | | | | | 2,5 | | | | | | | | | | | | |
| Operator to proofing room | | | | | | 6,19 | 4,27 | | | | | | | | | | | | |
| Operator to storage area to pick up tarpaulin | | | | | | 11,1 | 1,08 | | | | | | | | | | | | |
| Operator to proofing room | | | | | | 11,1 | 1,12 | | | | | | | | | | | | |
| Covering the baking sheet with a tarp | | | | | | | 0,21 | | | | | | | | | | | | |
| The process of proofing | | | | | | | 120 | | | | | | | | | | | | |
| Inspection of the dough whether it rises or not | | | | | | | 9,05 | | | | | | | | | | | | |
| Transfer of dough that has risen to the fryer work station | | | | | | 14,52 | 4,13 | | | | | | | | | | | | |
| The dough is put in the frying machine | | | | | | | 2,13 | | | | | | | | | | | | |
| Frying Process | | | | | | | 18,11 | | | | | | | | | | | | |
| Putting cooked bread onto a baking sheet | | | | | | | 4,08 | | | | | | | | | | | | |

**Table 5.3** Flow Process Chart Before Implementation SOP and Work Instructions

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bakery cooling process | | | | | | | 9,21 | | | | | | | | | | | | |
| Bakery Inspection | | | | | | | 9 | | | | | | | | | | | | |
| Moving bakery to a packaging workstation | | | | | | 4,9 | 3,16 | | | | | | | | | | | | |
| Bread packing process | | | | | | | 12,08 | | | | | | | | | | | | |
| Putting packaged bread in the basket | | | | | | | 3,04 | | | | | | | | | | | | |
| Transfer of bakery baskets to the storage area of finished products | | | | | | 2,42 | 2,37 | | | | | | | | | | | | |
| Product storage | | | | | | | 3,18 | | | | | | | | | | | | |

Based on the Flow Process Chart (FPC) before the implementation of SOP and work instructions at **Table 5.1** to **Table 5.3**, it can be seen that there is waste such as waiting for bakery dough to be processed in horizontal mixer machine, spiral mixer machine, and pressing machine. Waste also occurs such as rework on bakery dough. Based on the fishbone diagram that can be seen in **Figure 4.2** rework occurs because over processing occurs in the process of mixing in horizontal mixer machine, mixing in spiral mixer machine, and pressing process. As a result, the bakery dough becomes overmixed, looks wet, sticky, mushy, and inelastic so it is necessary to rework the bakery dough which takes up to 29.31 min.

Rework on bakery dough also occurs due to the inappropriate fermentation process. This is due to wrong work sequences, such as weighing salt and yeast on the same base, mixing all ingredients in one mixing process, mixing salt in predough, and inappropriate dosage. As a result, the dough has a rough, inelastic, and difficult to process at forming and filling bakery. Based on **Table 5.1** to **Table 5.3** It can also be seen that the work sequence is not effective such as taking raw materials from the warehouse repeatedly, so that the transportation time is getting longer which causes the production leadtime to be longer. Redesign of the Flow Process Chart (FPC) was carried out after the implementation of SOP and work instruction which can be seen in **Table 5.4** to **Table 5.5.**

**Table 5.4** Flow Process Chart After Implementation SOP and Work Instructions

FLOW PROCESS CHART

| SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| ACTIVITIES | NOW | | PROPOSED | | DIFFERENT | |
| | Total | Time | Total | Time | Total | Time |
| ○ OPERATION | 29 | 233,57 | | | | |
| □ INSPECTION | 3 | 19,52 | | | | |
| ⇨ TRANSPORTATION | 15 | 21,20 | | | | |
| D DELAY | 1 | 2,34 | | | | |
| ▽ STORAGE | 1 | 3,18 | | | | |
| TOTAL DISTANCE | 66,09 | | | | | |

ACTIVITIES : Bakery Production at Yanna Bakery
MAP NUMBER : 01
PERSON [V] MATERIAL [ ]
NOW [V] PROPOSED [ ]
MAPPED BY : Muhammad Fauzan Syahputra
MAPPED DATE : 17 February 2023

| DESCRIPTION OF ACTIVITIES | SYMBOL | DISTANCE (m) | TIME (min) | ANALYZES | | | | | NOTE | ACTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WHAT | WHERE | WHEN | WHO | HOW | | ROOM | MERGE | UBAH | | | REPAIR |
| | | | | | | | | | | | | ORDER | PLACE | PERSO | |
| Taking scales and containers | | | 1,32 | | | | | | | | | | | | |
| Picking up raw materials to weighing materials work station | | 1 | 2,05 | | | | | | | | | | | | |
| Weighing materials | | | 9,36 | | | | | | | | | | | | |
| Putting the weighing material in the container | | | 2,02 | | | | | | | | | | | | |
| The materials are transferred to the horizontal mixer machine work station | | 2 | 1,28 | | | | | | | | | | | | |
| Set up horizontal mixer machine | | | 2,01 | | | | | | | | | | | | |
| The material is waiting to be stirred in the horizontal mixer machine | | | 2,34 | | | | | | | | | | | | |
| The material is put into the horizontal mixing machine | | | 0,07 | | | | | | | | | | | | |
| Stirring bread dough ingredients | | | 5,32 | | | | | | | | | | | | |
| Putting water and others material such as milk powder, sugar, and eggs in a bucket into a horizontal mixing machine | | | 0,06 | | | | | | | | | | | | |
| The process of stirring bread dough into coarse dough | | | 4,17 | | | | | | | | | | | | |
| Transfer of coarse dough to the working station of the spiral mixing machine | | 1 | 0,046 | | | | | | | | | | | | |
| Putting coarse dough into a spiral mixing machine | | | 0,06 | | | | | | | | | | | | |
| Putting butter in a container to a spiral mixing machine and last salt | | | 0,04 | | | | | | | | | | | | |
| The process of stirring bread dough | | | 5,11 | | | | | | | | | | | | |
| Transfer of dough to press machine | | 1,3 | 0,09 | | | | | | | | | | | | |
| Dough in the press in the press machine | | | 4,21 | | | | | | | | | | | | |
| The dough is transferred to the cutting dough work station | | 4,18 | 0,1885 | | | | | | | | | | | | |
| Inspect bread dough | | | 1,47 | | | | | | | | | | | | |
| The operator goes to the storage area | | 2,51 | 0,27 | | | | | | | | | | | | |
| The operator takes a round baking sheet, rectangular baking sheet, | | | 3,12 | | | | | | | | | | | | |
| The operator goes to the bread | | 2,51 | 0,57 | | | | | | | | | | | | |
| Weighing the dough | | | 1,14 | | | | | | | | | | | | |
| Reaching out to oil already in bread forming workstations | | | 0,05 | | | | | | | | | | | | |
| Grease a round baking sheet with oil | | | 2,08 | | | | | | | | | | | | |
| Inserting and jerking the round baking | | | 2,11 | | | | | | | | | | | | |
| Transfer of a round baking sheet | | 0,68 | 0,29 | | | | | | | | | | | | |
| Cutting the dough on a round baking | | | 4,26 | | | | | | | | | | | | |

**Table 5.5** Flow Process Chart Afer Implementation SOP and Work Instructions

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Operator to bread forming workstation | | | | | | 0,68 | 0,29 | | | | | | | | | | | |
| Laying the cut dough | | | | | | | 1,06 | | | | | | | | | | | |
| Carrying out the process of forming and giving bread fillings | | | | | | | 16,2 | | | | | | | | | | | |
| The formed dough is put into a baking sheet | | | | | | | 2,5 | | | | | | | | | | | |
| Operator to proofing room | | | | | | 6,19 | 4,27 | | | | | | | | | | | |
| Operator to storage area to pick up tarpaulin | | | | | | 11,1 | 1,08 | | | | | | | | | | | |
| Operator to proofing room | | | | | | 11,1 | 1,12 | | | | | | | | | | | |
| Covering the baking sheet with a tarp | | | | | | | 0,21 | | | | | | | | | | | |
| The process of proofing | | | | | | | 120 | | | | | | | | | | | |
| Inspection of the dough whether it | | | | | | | 9,05 | | | | | | | | | | | |
| Transfer of dough that has risen to the fryer work station | | | | | | 14,52 | 4,126 | | | | | | | | | | | |
| The dough is put in the frying machine | | | | | | | 2,13 | | | | | | | | | | | |
| Frying Process | | | | | | | 17,08 | | | | | | | | | | | |
| Putting cooked bread onto a baking sheet | | | | | | | 4,08 | | | | | | | | | | | |
| Bread cooling process | | | | | | | 9,294 | | | | | | | | | | | |
| Bakery Inspection | | | | | | | 9,00 | | | | | | | | | | | |
| Moving bread to a packaging workstation | | | | | | 4,9 | 3,16 | | | | | | | | | | | |
| Bread packing process | | | | | | | 11,46 | | | | | | | | | | | |
| Putting packaged bread in the basket | | | | | | | 3,04 | | | | | | | | | | | |
| Transfer of bakery baskets to the | | | | | | 2,42 | 2,37 | | | | | | | | | | | |
| Product storage | | | | | | | 3,18 | | | | | | | | | | | |

Based on **Table 5.4** to **Table 5.5** the difference between Flow Process Chart (FPC) before and after implementing SOP and work instructions can be seen. The process of weighing materials was previously 7.48 min to 9.36 min. Increased processing time on weighing materials based on work instructions that have been made before, all raw materials are weighed as a whole first. Whereas before the work instructions, work sequences such as weighing margarine and salt were carried out after the dough course arrived at the spiral mixer machine work station. The incorporation of these work sequence saves transportation time and total operating time. The difference in work sequence can also be seen in the set up spiral and press machine. With the application of work instructions, the spiral machine set up is carried out during the mixing process in the horizontal mixer machine, and the press machine set up is carried out during the mixing process in the spiral machine. With the application of work instructions, it can minimize production lead time by

eliminating machine set up time so that there is no waiting for the mixing process in the spiral and press machine. The difference can also be seen in the absence of rework on the dough. This is because rework on the dough occurs due to the weighing of salt and yeast in one base so that the performance of the yeast will decrease as the dough does not produce a distinctive smell and the bakery dough becomes coarse. Rework also occurs when excess salt is done in the dough, because excess salt of more than 1% will inhibits the fermentation process. Rework also occurs due to over processing in the mixing process in the horizontal and spiral machines and also the pressing process so that the dough becomes over mixed. With the implementation of SOPs and good work instructions, it is assumed that there is no rework on the dough so that it can save production time up to 29.31 min.

With SOPs and work instructions, the bakery production process at Yanna bakery can run smoothly and maintain the consistency of the quality of the bakery products produced. The design and implementation of good SOPs and work instructions increases the efficiency of the production process by eliminating or minimizing waste over processing. Hence, the leadtime of bakery production in the initial condition of 312.79 min became 280.20 min, resulting a reduction of leadtime by 9.91%. The next waste that must be immediately eliminated and prioritized to immediately get recommendations for improvement is waste transportation which occupies the second position as waste with the highest percentage after waste over processing, which is 24%. Based on the results of Process Activity Mapping (PAM), there are 19 transportation activities with a percentage of 31.15% of the total activities in production. Therefore, due to the large number of transportation activities in the bakery production process, the distance between interrelated work stations should be close together to minimize transportation time and also eliminate or minimize unnecessary transportation activities.

Based on the fishbone diagram that can be seen in **Figure 4.3** the cause of waste transportation is the layout of the production floor at Yanna Bakery does not pay attention to the relationship between work stations, so there is a lot of bypassing

and backtracking movement, especially, forming, proofing, frying, and packaging work stations. Hence, that distance and transportation time are getting longer which causes the production lead time also be longer. Layout design is known to have a major influence on leadtime and productivity (Drira et al., 2007). For this reason, it is necessary to re-layout the production floor so that the production layout pays attention to the relationship between facilities so that waste transportation can be minimized. One method that can be used to carry out the process of designing factory facilities is the BLOCPLAN method.

Layout design with the BLOCPLAN method that uses a certain scale can represent buildings with space constraints owned. The data input needed in layout design is facility data in the form of the number of units, floor area, and degree of proximity through the Activity Relationship Chart (ARC) map (Putri & Dona, 2019). Determination of the best design results based on iterations carried out through the BLOCPLAN algorithm which involves close relationships between work stations and land area used. In the final stage after getting a layout design in block view, design is carried out using actual dimensions for each work station. The first step in re-layout is to create an Activity Relationship Chart (ARC). ARC is a simple technique in planning the layout of facilities or departments based on the degree of activity relations that is often expressed in qualitative assessments and tends to be based on subjective considerations. ARC is one of the techniques to plan the linkage between each group of interrelated activities (Sugiyono, 2018). Yanna Bakery's Activity Relationship Chart (ARC) can be seen at **Figure 5.8.**

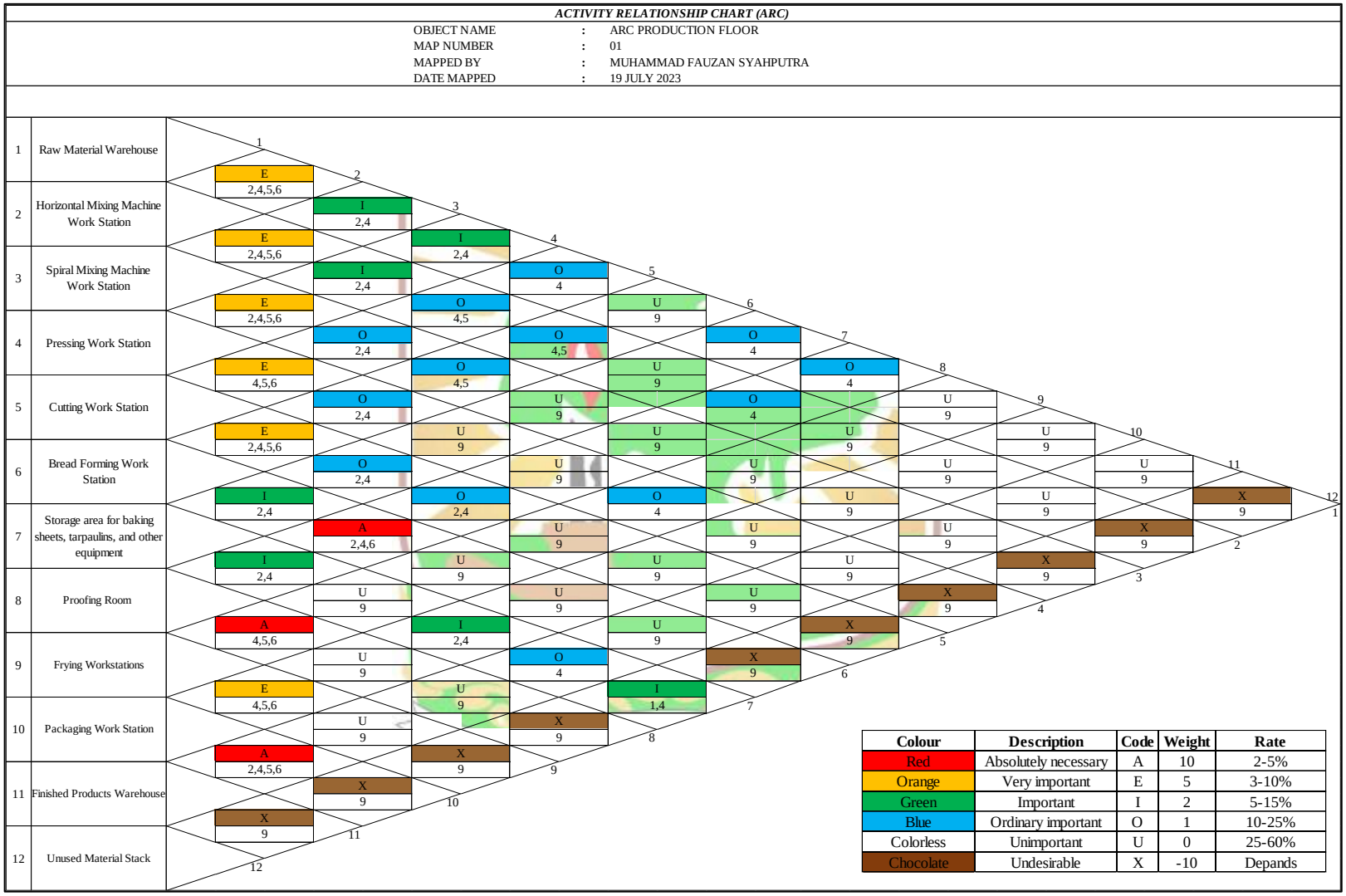


**Figure 5.8** Activity Relationship Chart (ARC) Yanna Bakery

Based on **Figure 5.8**, we can see the relationship of each work station. The relationship of each work station consists of 5 categories, namely absolutely necessary, very important, important, ordinary important, unimportant, and undesirable. Where the reason for the relationship of each work station can be seen in **Table 5.6**

**Table 5.6** Description the Reasons of the Relationship

| Reasons Code | Description of the Reasons |
|---|---|
| 1 | Concurrent use of notes |
| 2 | Using the same workforce |
| 3 | Using the same space area |
| 4 | Degree of frequent personnel contact |
| 5 | Degree of frequent performed work paper contact |
| 6 | Work flow sequence |
| 7 | Carry out the same work activities |
| 8 | Using the same work equipment |
| 9 | The possibility of unpleasant odors, crowded, and others |

Based on **Table 5.6** can be seen the reasons of the relationship of each work station. For example, proofing room and frying work station have a completely necessary relationship with the reason of degree of frequent personnel contact, degree of frequent performed work paper contact, and work flow sequence. The determination of each relationship should not exceed the rate of each relationship. The results of Yanna Bakery's Activity Relationship Chart (ARC) can be seen at **Table 5.7**.

**Table 5.7** Yanna Bakery's Activity Relationship Chart (ARC) Recap Results

| Work Station | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Degree of Relationship | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | A | E | I | O | U | X |
| Raw Material Warehouse | | E | I | I | O | U | O | O | U | U | U | X | 0 | 1 | 2 | 3 | 4 | 1 |
| Horizontal Mixing Machine Work Station | E | | E | I | O | O | U | O | U | U | U | X | 0 | 2 | 1 | 3 | 4 | 1 |
| Spiral Mixing Machine Work Station | I | E | | E | O | O | U | U | U | U | U | X | 0 | 2 | 1 | 2 | 5 | 1 |
| Pressing Work Station | I | I | E | | E | O | U | U | O | U | U | X | 0 | 2 | 2 | 2 | 4 | 1 |
| Cutting Work Station | O | O | O | E | | E | O | O | U | U | U | X | 0 | 2 | 0 | 5 | 3 | 1 |
| Bread Forming Work Station | U | O | O | O | E | | I | A | U | U | U | X | 1 | 1 | 1 | 3 | 4 | 1 |
| Storage area for baking sheets, tarpaulins, and other equipment | O | U | U | U | O | I | | I | U | I | O | I | 0 | 0 | 4 | 3 | 4 | 0 |
| Proofing Room | O | O | U | U | O | A | I | | A | U | U | X | 2 | 0 | 1 | 3 | 4 | 1 |
| Frying Workstations | U | U | U | O | U | U | U | A | | E | U | X | 1 | 1 | 0 | 1 | 7 | 1 |
| Packaging Work Station | U | U | U | U | U | U | I | U | E | | A | X | 1 | 1 | 1 | 0 | 7 | 1 |
| *Finished Products Warehouse* | U | U | U | U | U | U | O | U | U | A | | X | 1 | 0 | 0 | 1 | 8 | 1 |
| Unused Material Stack | X | X | X | X | X | X | I | X | X | X | X | | 0 | 0 | 1 | 0 | 0 | 10 |
| | | | | | | | | | | | | | 6 | 12 | 13 | 26 | 54 | 10 |
| | | | | | | | | | | | | | 5% | 10% | 11% | 21% | 45% | 8% |

After the data on the number of work stations on the production floor and the area of each work station can be seen in **Figure 1.2** production floor at Yanna Bakery and the Activity Relationship Chart (ARC) data that has been obtained, then input it in BLOCPLAN Software. Layout selection is based on the score of each available layout alternative. This score serves to be a consideration in choosing the best layout. The results of alternative layouts in BLOCPLAN Software can be seen at **Figure 5.9**.

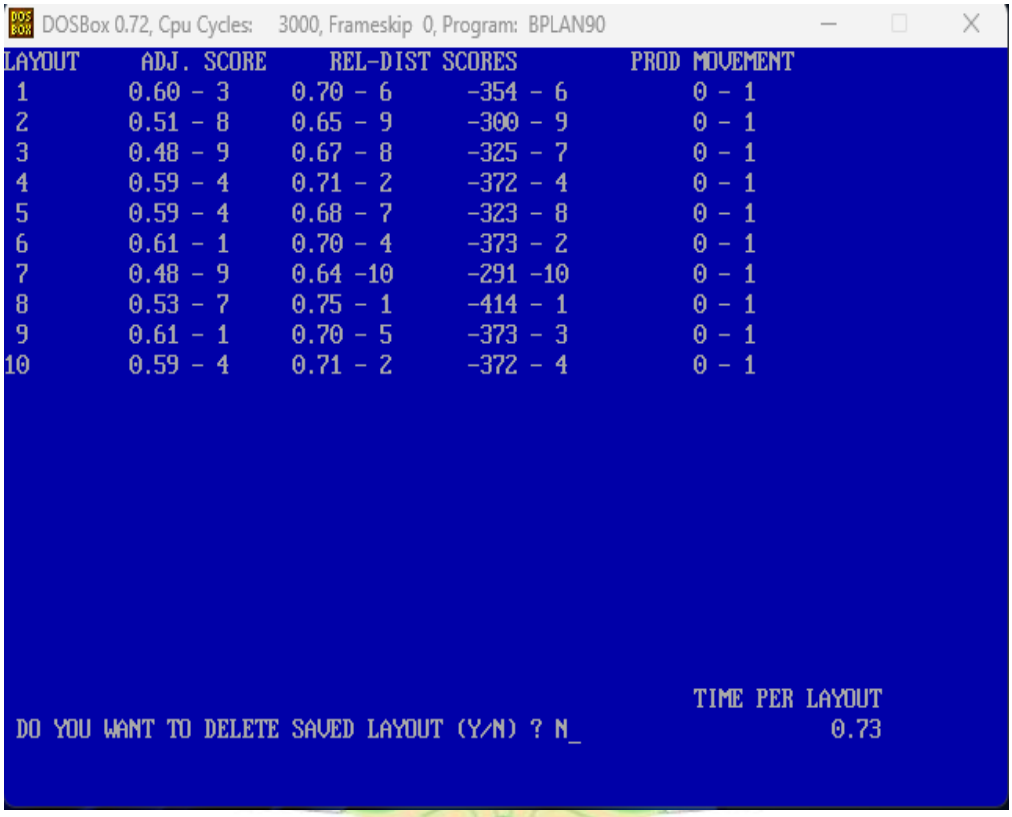


**Figure 5.9** BLOCPLAN Layout Alternatives

Based on **Figure 5.9** Each value will be analyzed so that the best value can be selected. Then, the selection is also seen based on the shape of the layout. In the table there are Adj-scores, the closer to 1, the closer between departments. The R-score displays the efficiency of the resulting layout. So that the more the R-score value (closer) 1, the more efficient the layout will be. While the Rel-dist score displays the total amount of distance between departments, the smaller the score, the better. Based on **Figure 5.9**, it can be seen that the best layout is in alternative

6 with Adj-scores of 0.61, R-scores of 0.70, and Rel-dist scores of -373. Proposed alternative layouts 6 can be seen in **Figure 5.10.**

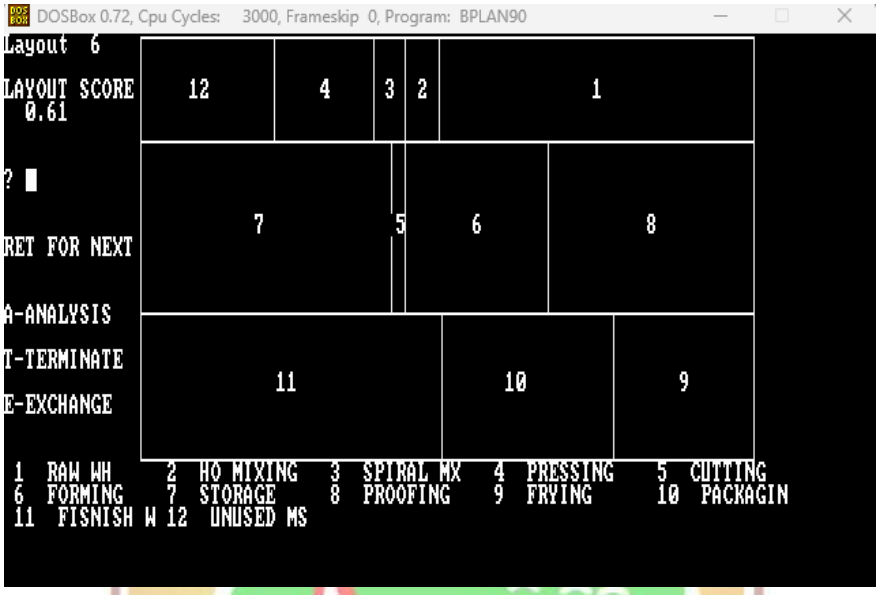


**Figure 5.10** Selected Alternative Layouts

At the final stage after getting the layout design in block view, design is carried out using the actual dimensions for each work station which can be seen in **Figure 5.11.**

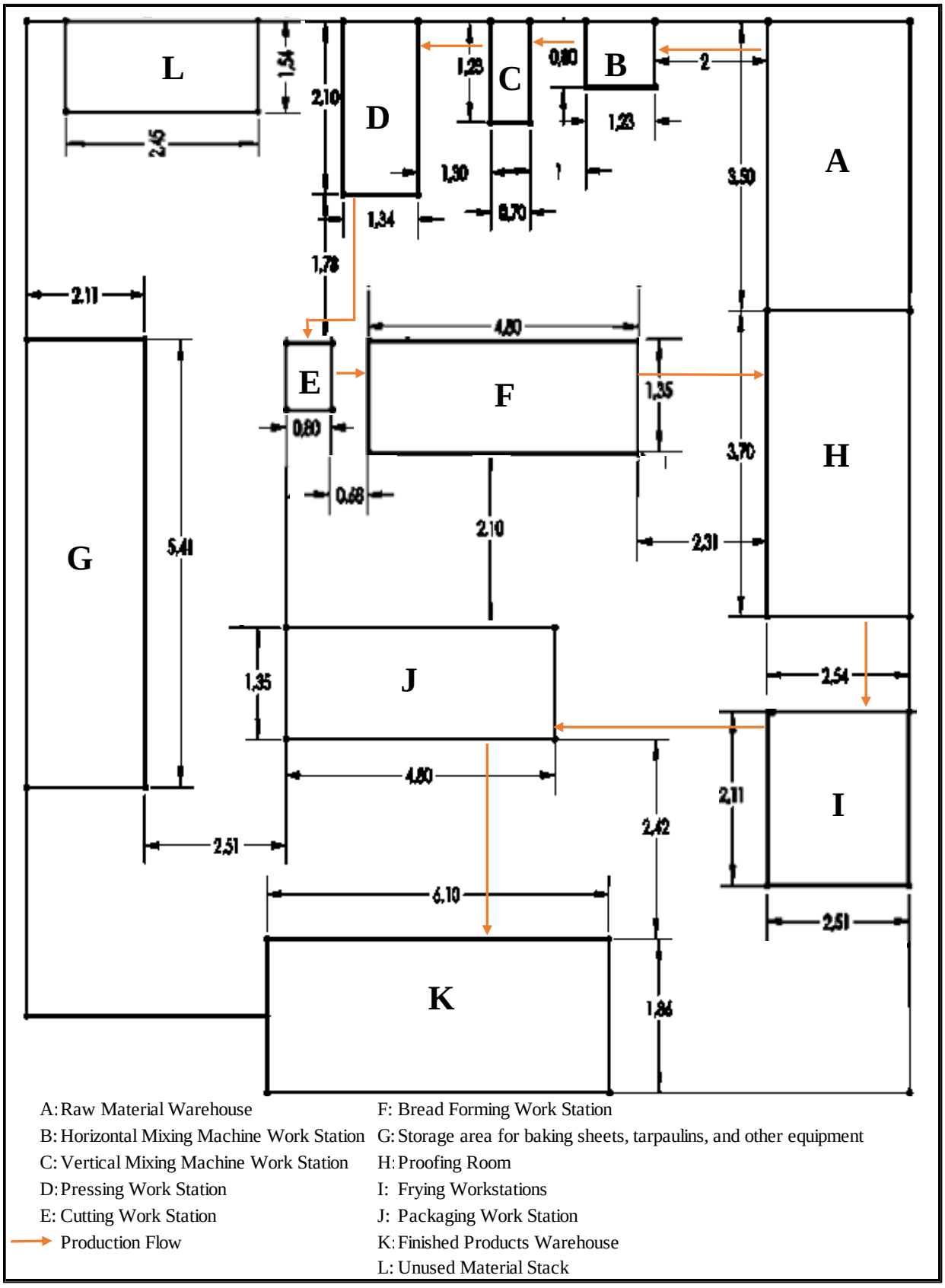


**Figure 5.11.** Proposed Improvement of Production Layout at Yanna Bakery

Based on **Figure 5.11,** it can be seen the difference in the production layout at Yanna Bakery in **Figure 1.2** with the layout of the proposed improvements. A comparison of the distance and time before and after implementation of proposed improvement can be seen at **Table 5.8**

**Table 5.8** Distance and Time Comparison Before and After Implementation of Proposed Improvement

| No | Work Station | | Before Implementation of Proposed Improvement | | After Implementation of Proposed Improvement | |
|---|---|---|---|---|---|---|
| | From | to | Distance (m) | Average time (sec) | Distance (m) | Average time (sec) |
| 1 | Raw Material Warehouse | Material Weighing Work Station | 1 | 120 | 1 | 120 |
| 2 | Material Weighing Work Station | Horizontal Mixing Machine Work Station | 2 | 88 | 2 | 88 |
| 3 | Horizontal Mixer Machine Work Station | Spiral Mixer Machine Work Station | 1 | 5 | 1 | 5 |
| 4 | Spiral Mixer Machine Work Station | Pressing Work Station | 1,3 | 9 | 1,3 | 9 |
| 5 | Pressing Work Station | Cutting Work Station | 4,18 | 19 | 1,78 | 8 |
| 6 | Cutting Work Station | Bread Forming Work Station | 0,68 | 29 | 0,68 | 29 |
| 7 | Bread Forming Work Station | Proofing Room | 6,19 | 267 | 2,31 | 100 |
| 8 | Proofing Room | Frying Work Stations | 14,52 | 253 | 2 | 35 |
| 9 | Frying Work Stations | Cooling Process | 1 | 29 | 1 | 29 |
| 10 | Cooling Process | Packaging Work Station | 4,9 | 196 | 2,82 | 113 |
| 11 | Packaging Work Station | Finished Products Warehouse | 2,42 | 157 | 2,42 | 157 |

Calculation example of average time after implementation of proposed improvement from pressing work station to cutting work station are as follows:

$$v = \frac{S1}{t1}$$

$$v = \frac{4.18\ m}{19\ s}$$

$$v = 0.22\ m/s$$

$$t2 = \frac{S2}{v}$$

$$t2 = \frac{1.78\ m}{0.22\ m/s}$$

$$t2 = 8\ s$$

Information:

t1 = Average time before implementation of proposed improvement (s)

t2 = Average time after implementation of proposed improvement (s)

S1 = Distance before implementation of proposed improvement (m)

S2 = Distance after implementation of proposed improvement (m)

v = Operator velocity (m/s)

From the proposed improvement of the production layout at Yanna Bakery, a reduction in transportation time of up to 40.92% for 1 batch production was obtained, from 1172 sec to 692 sec. Process Activity Mapping (PAM) after recommendations for improvements to minimize or eliminate waste overprocessing and transportation can be seen in **Table 5.9** to **Table 5.11.**

**Table 5.9** Process Activity Mapping After Recommendation

| No. | Process | Description of Activities | Machine/ Tool | Distance (m) | Time (min) | Types of Activities | | | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | O | I | T | D | S | |
| 1 | Material Weighing | Taking scales and containers | | | 1,32 | O | | | | | VA |
| 2 | | Transfer raw materials to weighing materials work station | | 1 | 2,27 | | | T | | | NNVA |
| 3 | | Weighing materials | Scales | | 9,36 | O | | | | | VA |
| 4 | | Putting the weighing material in the container | Container | | 2,02 | O | | | | | VA |
| 5 | | The materials are transferred to the horizontal mixer machine work station | | 2 | 1,28 | | | T | | | NNVA |
| 6 | Stirring of materials in horizontal mixer | Set up horizontal mixer machine | | | 2,01 | O | | | | | NNVA |
| 7 | | The material is waiting to be stirred in the horizontal mixer machine | | | 2,34 | | | | D | | NVA |
| 8 | | The material is put into the horizontal mixing machine | | | 0,07 | O | | | | | VA |
| 9 | | Stirring bread dough ingredients | Horizontal mixer | | 5,32 | O | | | | | VA |
| 10 | | Putting water and others material such as milk powder, sugar, and eggs in a bucket into a horizontal mixing machine | | | 0,06 | O | | | | | VA |
| 11 | | The process of stirring bread dough into coarse dough | Horizontal mixer | | 4,17 | O | | | | | VA |
| 12 | Stirring of materials in spiral mixer | Transfer of coarse dough to the working station of the spiral mixing machine | | 1 | 0,05 | | | T | | | NNVA |
| 13 | | Putting coarse dough into a spiral mixing machine | | | 0,06 | O | | | | | VA |
| 14 | | Putting butter in a container to a spiral mixing machine and last salt | | | 0,04 | O | | | | | VA |

**Table 5.10** Process Activity Mapping After Recommendation (cont.)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | | The process of stirring bread dough | Spiral mixer | | 5,11 | O | | | | | VA |
| 16 | | Transfer of dough to press machine | | 1,3 | 0,09 | | | T | | | NNVA |
| 17 | Press | Dough in the press in the press machine | Press Machine | | 4,21 | O | | | | | VA |
| 18 | | The dough is transferred to the cutting dough work station | | 1,78 | 0,08 | | | T | | | NNVA |
| 19 | forming dan filling bakery | Inspect bread dough | | | 1,47 | | I | | | | NNVA |
| 20 | | The operator goes to the storage area | | 2,51 | 0,27 | | | T | | | NNVA |
| 21 | | The operator takes a round baking sheet, rectangular baking sheet, scales and knife | | | 3,12 | O | | | | | VA |
| 22 | | The operator goes to the bread forming work station | | 2,51 | 0,57 | | | T | | | NNVA |
| 23 | | Weighing the dough | Scales | | 1,14 | O | | | | | VA |
| 24 | | Reaching out to oil already in bread forming workstations | | | 0,05 | O | | | | | VA |
| 25 | | Grease a round baking sheet with oil | | | 2,08 | O | | | | | VA |
| 26 | | Inserting and jerking the round baking sheet-shaped dough | | | 2,11 | O | | | | | VA |
| 27 | | Transfer of a round baking sheet containing dough to a cutting work station | | 0,68 | 0,29 | | | T | | | NNVA |
| 28 | | Cutting the dough on a round baking sheet into pieces | dough cutter | | 4,26 | O | | | | | VA |
| 29 | | Operator to bread forming workstation | | 0,68 | 0,29 | | | T | | | NNVA |
| 30 | | Laying the cut dough | | | 1,06 | O | | | | | VA |
| 31 | | Carrying out the process of forming and giving bread fillings | | | 16,20 | O | | | | | VA |
| 32 | | The formed dough is put into a baking sheet | Baking sheet | | 2,5 | O | | | | | VA |
| 33 | Proofing | Operator to proofing room | | 2,31 | 1,40 | | | T | | | NNVA |
| 34 | | Operator to storage area to pick up tarpaulin | | 11,1 | 1,08 | | | T | | | NNVA |
| 35 | | Operator to proofing room | | 11,1 | 1,12 | | | T | | | NNVA |
| 36 | | Covering the baking sheet with a tarp | Tarpaulin | | 0,21 | O | | | | | VA |
| 37 | | The process of proofing | | | 120 | O | | | | | VA |
| 38 | | Inspection of the dough whether it rises or not | | | 9,05 | | I | | | | NNVA |
| 39 | | Transfer of dough that has risen to the fryer work station | Baking sheet | 2,00 | 0,35 | | | T | | | NNVA |
| 40 | Frying process | The dough is put in the frying machine | | | 2,13 | O | | | | | VA |
| 41 | | Frying Process | Frying machine | | 17,08 | O | | | | | VA |
| 42 | | Putting cooked bread onto a baking sheet | Baking sheet | | 4,08 | O | | | | | VA |
| 43 | Cooling process | Bread cooling process | | | 9,29 | O | | | | | VA |
| 44 | | Bakery Inspection | | | 9 | | I | | | | NNVA |

**Table 5.11** Process Activity Mapping After Recommendation (cont.)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Packaging the bakery | Moving bread to a packaging workstation | Baking sheet | 2,82 | 1,53 | | | T | | | NNVA |
| 46 | | Bread packing process | Bread packaging | | 11,46 | O | | | | | VA |
| 47 | | Transfer of bakery baskets to the storage area of finished products | | 2,42 | 2,37 | | | T | | | NNVA |
| 48 | | Product storage | | | 3,18 | | | | | S | NNVA |

Based on **Table 5.9** to **Table 5.11**, it can be seen that non-value added (NVA) activities and necessary non-value added (NNVA) activities can be eliminated or minimized in the bakery production process at Yanna Bakery. The percentage of activities by category and type after improvement recommendations can be seen in **Table 5.12.**

**Table 5.12** Percentage Recapitulation for Each Activity Category After Proposed Improvement

| Activities | Before Improvement | | After Improvement | |
|---|---|---|---|---|
| | Total | Percentage | Total | Percentage |
| Operation | 37 | 60,66% | 28 | 58,33% |
| Transportatic | 19 | 31,15% | 15 | 31,25% |
| Inspection | 3 | 4,92% | 3 | 6,25% |
| Storage | 1 | 1,64% | 1 | 2,08% |
| Delay | 1 | 1,64% | 1 | 2,08% |
| **Total** | **61** | 100,00% | **48** | 100,00% |
| VA | 32 | 52,46% | 27 | 56,25% |
| NVA | 7 | 11,48% | 1 | 2,08% |
| NNVA | 22 | 36,07% | 20 | 41,67% |
| **Total** | **61** | 100,00% | **48** | 100,00% |

Based on **Table 5.12** can be seen the recap of Process Activity Mapping (PAM) after improvement with a total of 61 activities that took place during the bakery production process with 37 activities being operations with a percentage of 60.66% become 28 activities with percentages of 58.33%, 19 transportation activities with a percentage of 31.15% become 15 activities with a percentages 31.25%, 3 inspection activities with a percentage of 6.25%, 1 storage activity with a percentage of 2.08%, and 1 activity delay with a percentage of 2.08%. Furthermore, there are 27 activities classified as value added activities with a percentage of 56.25% of total production activities, 1 activities classified as non-

value added activities with a percentage of 2.08, and 20 activities classified as necessary but non value added activities with a percentage of 41.67%.

## 5.5 Future Value Stream Mapping Analysis

Future Value Stream Mapping (FVSM) can be used to characterise the state of the production process following the improvement recommendation, which is based on the recommendations provided for improving the waste that happens in the bakery manufacturing process at Yanna baking. For one production batch, the total Value Added (VA) time is 222.31 minutes, while the total Non-Value Added (NVA) time following a recommendation for improvement is 40.09 minutes. From FVSM can also be seen the leadtime for 1 batch production after the proposed improvement to 262.39 min. After mapping the flow of information and materials in FVSM, Process Cycle Efficiency (PCE) can be calculated using the equation **5.1.**

$$\text{Process Cycle Efficiency} = \frac{\text{Value Added (VA)}}{\text{Lead time}} \times 100\% \quad \textbf{5.1}$$

$$\text{Process Cycle Efficiency} = \frac{222.31}{262.39} \times 100\%$$

$$= 0.8472 \times 100\%$$

$$= 84.72\%$$

Based on PCE calculations on FVSM, it can be seen that there was an increase of 11.67% from CVSM. This value indicates an increase in efficiency in the bakery production process after the implementation of improvement recommendations is carried out. FVSM for the bakery production process at Yanna Bakery can be seen at **Figure 5.12.**

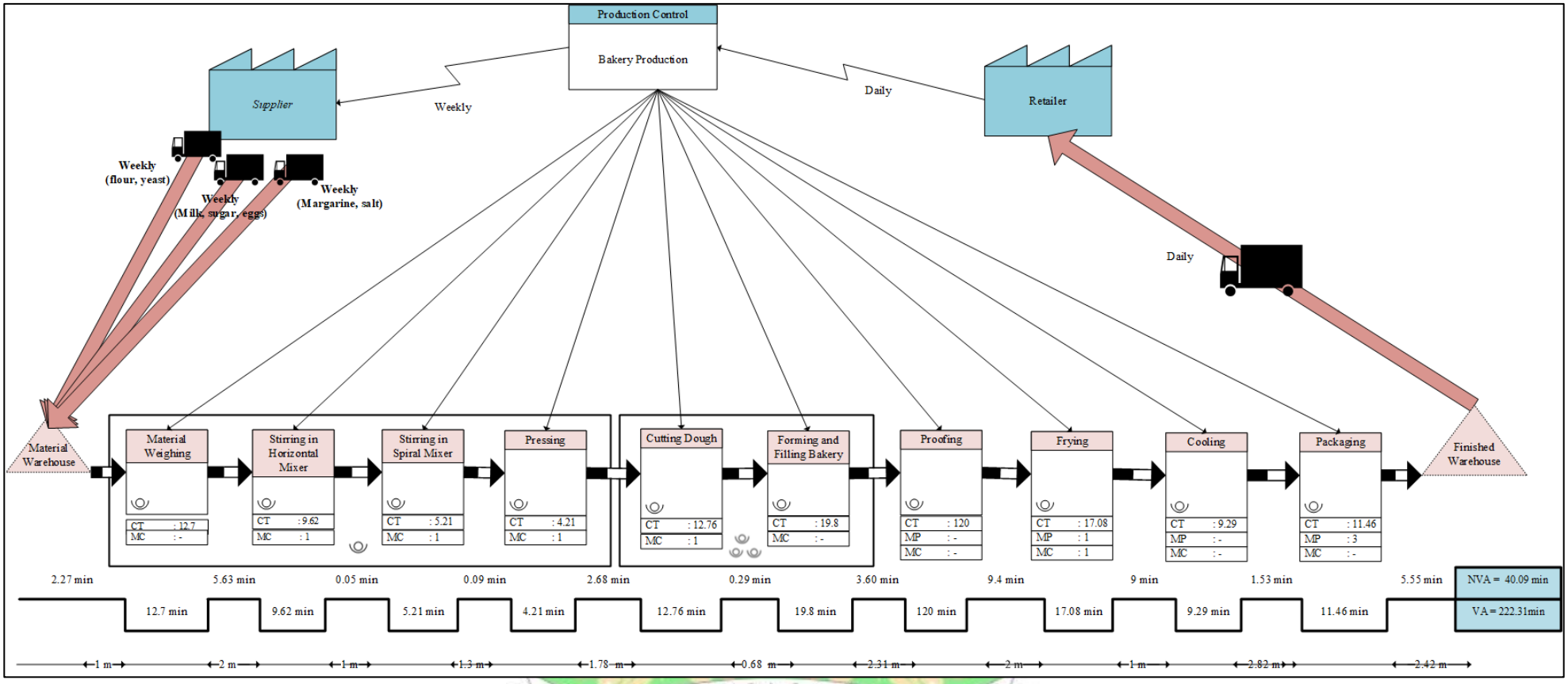


**Figure 5.12** Future Value Stream Mapping Bakery Production Process at Yanna Bakery