

# ANALYSIS OF WASTE IN THE WAREHOUSING FLOW PROCESS WITH LEAN WAREHOUSING METHOD AT PT. XYZ

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## ABSTRACT

*PT XYZ is a manufacturing company engaged in furniture such as wardrobes, computer desks, and others. The warehouse is one of the important elements to support the operational activities of an industry that functions as a storage area for goods that play a role in maintaining product quality before being sent to consumers. As a place to store finished products, warehousing activities at PT XYZ have not been carried out optimally due to waste. Waste that occurs such as delays in the process of making road letters, the length of the process of retrieving goods, the excessive amount of storage, and the time waiting for the delivery planning process which results in disruption of the smooth running of warehousing activities. With these problems, this study aims to determine the waste that often occurs and provide suggestions for improvements to reduce waste in the finished product warehousing flow process at PT XYZ. This research uses the Lean Warehousing method which consists of Value Stream Mapping, Process Activity Mapping, Questionnaire, and Fishbone Diagram. The results of this study are that there are 5 attributes of waste that often occur, namely furniture products placed on the warehousing floor (Inventory 3), the accumulation of inventory of furniture products in the warehouse is not sold out (inventory 2), the length of the process of searching for furniture products for order preparation (searching time 1), waiting time for the next process (waiting 4), and looking for empty shelves for product storage (searching time 3). The proposed improvements provided can reduce 9 activities and reduce activity time for 193 minutes. The proposed improvements also increase Process Cycle Efficiency (PCE) by 12.69% from 46.90% to 59.59%.*

**Keywords:** *Lean Warehousing, Fishbone Diagram, Process Activity Mapping, dan Value Stream Mapping.*

## **A. INTRODUCTION**

In the manufacturing industry, a warehouse is a place to store goods, both materials needed in the production process and finished goods that will be sent according to orders from consumers. Some common activities associated with storage in warehouses include receiving, inbound, put away, and storage. Many logistics activities in warehousing require a system that can organise the flow of warehousing so that it can run without any problems and does not harm the company or the customer (Pratiwi, 2023).

PT XYZ is a manufacturing company engaged in furniture since 2003. The company develops and produces quality furniture at affordable prices for local and international markets. The products produced and stored in the warehouse include kitchen sets, wardrobes, multipurpose racks, work desks, shoe racks, and others. As a place to store finished products, warehousing activities at PT XYZ have not been carried out optimally due to waste that reduces the efficiency and effectiveness of daily warehouse operations. Waste that occurs such as delays in the process of making road letters, the long process of picking goods, excessive amounts of storage, and the time waiting for the delivery planning process. Thus resulting in disruption of the smooth flow of warehousing activities.

Based on these problems, an analysis of waste in the warehousing flow process using the lean warehousing method at PT XYZ is carried out in the hope of identifying waste in warehousing activities and providing suggestions for improvements to eliminate waste that occurs so that the warehousing flow process becomes more effective and efficient.

## **B. LITERATURE**

### **D.1. Warehousing**

A warehouse is an important part of a company. A warehouse is a building that serves as a storage place for raw materials, semi-finished products, and finished products. A warehouse is a place where goods are distributed from suppliers to end-users (Puteri et al., 2023). The warehouse aims to coordinate supply and demand because market demand cannot always be accurately ascertained, so the warehouse can be used to store goods when production increases and demand decreases (Mayers in Fadhilah et al., 2022).

### **D.2. Lean Warehousing**

According to Wijaya, (2023), the Lean concept is a methodology that aims to improve the process by eliminating non-additive activities and making the work process more effective and efficient, which results in faster and better performance. According to Tapping in Dzulkifli & Ernawati, (2021) the use of lean principles can help businesses to become more competitive and more viable in the long term. According to Thangarajoo and Smith, in Dhika et al., (2023) the lean warehouse concept includes the application of lean concepts and techniques to all operations or activities in the warehouse. The main focus of this concept is to find and eliminate waste or activities that do not add value to the warehousing process or activities by making continuous and continuous improvements and evaluations. The goal of Lean Warehouse is to improve all warehouse operations by reducing waste in the finished product warehouse and raw material warehouse.

### **D.3. Waste**

According to Early, (2016) anything a company does that does not add value is waste. Therefore, the only action the company can take is to stop doing things that do not add value and eliminate them immediately. According to Suhartono in Fhadillah et al., (2020), stated that waste in lean is overproduction, waiting, transportation, excess processing, inventories, motion,

defects, non-utilised talent. According to Dzul kifli & Ernawati, (2021) the waste that occurs in warehousing is waste of waiting, waste of searching time, waste of overprocessing, waste of defects, waste of motion, waste of inventory, and waste of transportation. According to Albanna and Karningsih, (2018), each category of waste has several activities which will be weighted and ranked to determine the waste that often occurs.

#### D.4. Value Stream Mapping

Value Stream Mapping (VSM) is an important part of any lean initiative, as it provides a framework that shows waste and its negative impact on performance and overall process flow (King and King, 2015). In value stream mapping, process cycle efficiency (PCE) will be calculated with the following formula:

$$PCE = \frac{VA}{\sum t} \times 100\% \dots\dots\dots(1)$$

Description:

- PCE = *Process cycle efficiency*
- VA = *Value Added*
- $\sum t$  = Total activity time (Dhika et al., 2023)

Value Stream Mapping consists of two types namely:

1. Current state map is the current configuration of the product value stream, using specific icons and terminology to identify waste and areas for improvement.
2. Future state map is a blueprint for the desired lean transformation in the future. Both types indicate all the important information related to the product value stream such as cycle time, inventory levels, etc. that will help to make tangible improvements (Tilak et al., in Nurdiansyah et al., 2022).

#### D.5. Process Activity Mapping

Process Activity Mapping (PAM) is the process of identifying all activities that occur and then dividing them by type of waste. The purpose of this tool is to eliminate unnecessary activities, determine whether the process can be further streamlined, and find solutions to reduce waste (Misbah et al., in Maulana, 2019). Process Activity Mapping is useful for knowing the proportion of each warehousing activity that includes Value Added (VA), Non-Value Added (NVA), and Necessary Non-Value Added (NNVA) (Dhika et al., 2023). In addition, activity types were also identified, which were divided into five categories: operation, transport, inspection, delay, and storage (Mahen et al., 2023).

#### D.6. Fishbone Diagram

The Fishbone Diagram is a small component of the ad method for improving quality. This diagram will explain the form of management problems and the factors that cause them (Suharto et al., 2022). problems that occur during business processes are usually grouped into main categories to identify the main causes of various types of problems. These categories include man, method, materials, machine, management, and environment (Liliana in Indah, 2020).

### C. METHOD

The methods used to collect data in this study are interviews, observations, and questionnaires. The population of this study are workers related to the warehousing of finished products of PT XYZ, which is 10 people. This research has several stages as shown below:

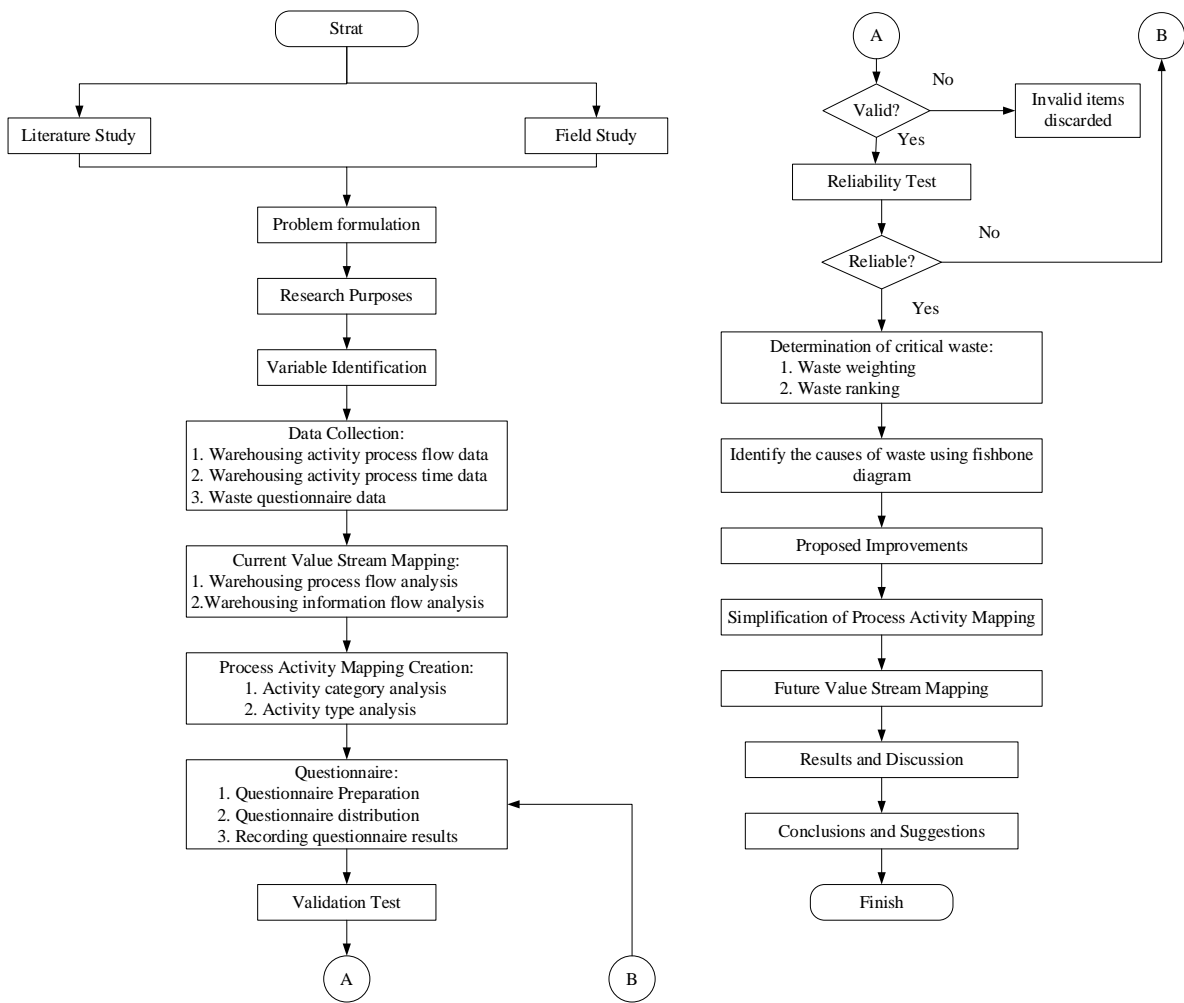
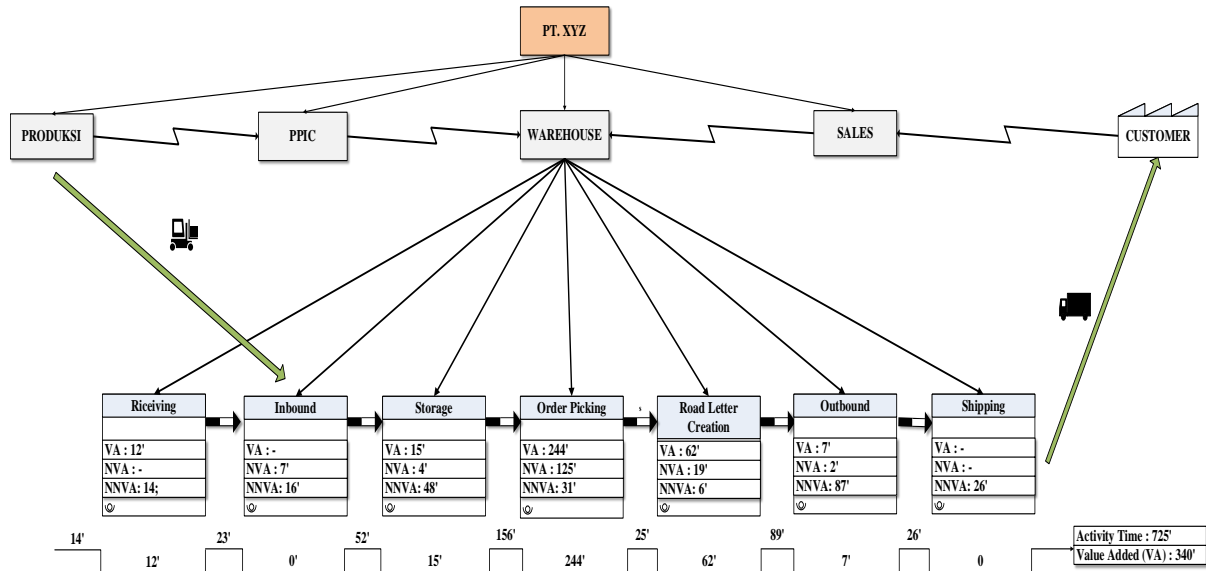


Figure 1. Flowchart

## D. RESULT AND DISCUSSION

### D.1. Current Value Stream Mapping

Initial mapping using the Current State VSM was carried out to show the flow of processes, information and materials in business and operational activities in PT XYZ's finished product warehousing. The results of mapping using Current State VSM will be used as a reference to identify waste that occurs in each activity or process carried out in finished product warehousing. The following is Figure 2. of the Current Value Stream Mapping:



**Figure 2. Current Value Stream Mapping**

Based on Figure 1. it can be obtained that the Process Cycle Efficiency value is 46.90%, so it can be said that there are still many activities or processes that do not provide added value to the products and business activities carried out by PT XYZ. This happens because there is still waste that occurs in the Main Warehouse so that further identification must be carried out to obtain the causes of waste in order to make improvements to the waste.

#### D.2. Process Activity Mapping Creation

Furthermore, mapping is carried out on each activity or process using PAM to identify operational activities in the PT XYZ Finished Product Warehousing in more detail by classifying activities or processes that occur into VA, NVA, and NNVA activity categories. The activities or processes that occur are also classified into five types, namely Operations, Transportation, Inspection, Storage and Waiting Time which will then also identify the waste that occurs in each activity carried out. The following is a summary table of the PAM mapping results:

**Table 1. Summary of PAM Mapping Results**

Description	Total Activity	Total Time (minutes)	Percentage Activity	Percentage Time
Activity Categories				
VA	18	340	37,50%	46,90%
NVA	8	157	16,67%	21,66%
NNVA	22	288	45,83%	31,44%
Activity Type				
Operation	31	453	64,58%	62,48%
Transportation	4	44	8,34%	6,07%
Inspection	6	54	12,50%	7,45%
Storage	1	23	2,08%	3,17%
Waiting Time	6	151	12,50%	20,83%

#### D.3. Determination of Critical Waste

Determination of critical waste is done by weighting or averaging the results of respondents' answers on each waste attribute. After calculating the weights for all waste attributes, ranking will then be carried out from the largest weight to the smallest weight, with the following results:

**Table 2. Weighting Ranking Questionnaire Results**

No	Waste	Waste Attributes	Respondent's Result Score										Total	Wieght	Rank
			1	2	3	4	5	6	7	8	9	10			
1	Searcing Time 1	Long process in finding PT XYZ furniture products for order preparation	4	4	3	4	5	4	4	3	4	4	39	3,9	3
2	Searcing Time 2	Product search due to lack of labelling/coding on PT XYZ furniture products	1	2	2	2	2	1	2	2	1	1	16	1,6	23
3	Searcing Time 3	Looking for empty shelves for storage of PT XYZ furniture products	3	4	4	5	3	3	4	4	4	3	37	3,7	5
4	Motion 1	Back and forth movement caused by the arrangement of furniture products that change every day at PT XYZ	3	4	4	4	3	3	3	2	4	3	33	3,3	10
5	Motion 2	Picking up furniture products on high shelves without tools at PT XYZ	4	4	3	4	3	3	4	2	4	2	33	3,3	11
6	Defect 1	Quality decline in PT XYZ's furniture products caused by the buildup of product inventory	3	4	3	3	4	3	4	3	3	4	34	3,4	7
7	Defect 2	Handling of furniture products that are carried out arbitrarily and manually at PT XYZ	3	2	3	4	2	3	3	3	4	2	29	2,9	16
8	Transportation 1	Long furniture product movement distance in order preparation at PT XYZ	4	3	3	3	4	4	3	3	3	4	34	3,4	8
9	Transportation 2	Manual movement of goods at PT XYZ	2	3	3	3	2	2	3	3	3	2	26	2,6	19
10	Waiting 1	Lack of coordination between workers at PT XYZ	3	4	3	3	4	3	4	3	3	4	34	3,4	9
11	Waiting 2	Workers are less dexterous and tend to be slow in carrying out their work at PT XYZ	2	2	3	2	2	2	2	3	2	2	22	2,2	21
12	Waiting 3	The large quantity of furniture products to be processed and the very diverse types of furniture products that require a long process time at PT XYZ	2	3	4	4	3	2	3	4	5	2	32	3,2	13
13	Waiting 4	Waiting time for the next process at PT XYZ	4	4	3	4	4	4	4	3	4	4	38	3,8	4
14	Inventory 1	The various types and quantities of furniture products sold have limited and different product storage places for each product at PT XYZ.	4	2	2	4	4	4	2	2	4	4	32	3,2	14
15	Inventory 2	Accumulation of furniture product inventory in PT XYZ's warehouse that is not sold out so that it becomes unnecessary inventory.	4	5	4	5	4	4	5	4	5	4	44	4,4	2

**Table Continuation Weighting Ranking Questionnaire Results**

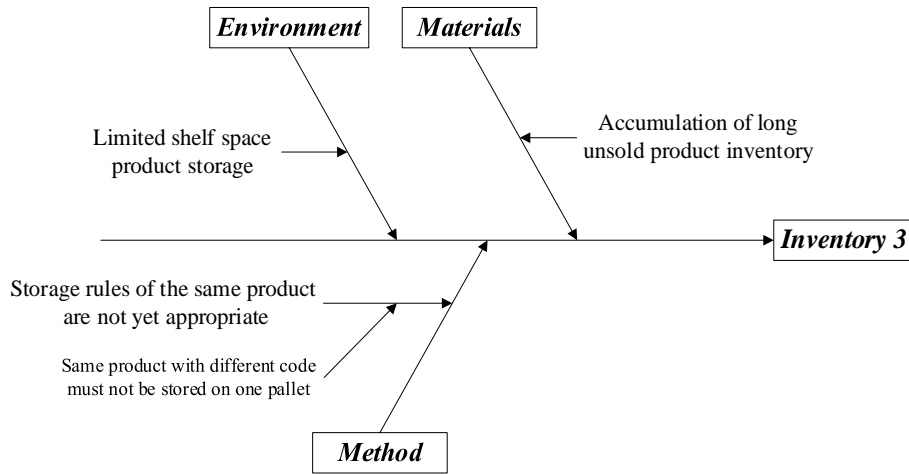
No	Waste	Waste Attributes	Respondent's Result Score										Total	Wieght	Rank
			1	2	3	4	5	6	7	8	9	10			
16	Inventory 3	Furniture products placed on the warehousing floor of PT XYZ	4	5	5	5	4	4	5	5	5	4	46	4,6	1
17	Inventory 4	Irregular placement of furniture products at PT XYZ	4	4	4	4	3	4	4	3	4	2	36	3,6	6
18	Processing 1	Workers who are not good at implementing company procedures PT XYZ	3	2	3	4	2	2	2	2	4	2	26	2,6	20
19	Processing 2	Rechecking the prepared furniture products of PT XYZ	4	2	3	4	1	3	4	3	4	1	29	2,9	17
20	Processing 3	Improvement of packaging due to defective furniture products stored in PT XYZ's warehouse.	2	2	3	2	2	2	2	3	2	2	22	2,2	22
21	Employee 1	Lack of concentration and focus of workers caused by less conducive and comfortable working environment conditions at PT XYZ.	3	3	3	4	3	3	3	3	4	2	31	3,1	15
22	Employee 2	There are workers who lack expertise or experience in carrying out their duties at PT XYZ.	1	2	2	2	1	1	2	2	2	1	16	1,6	24
23	Employee 3	The minimum number of workers on duty in one shift so that the activities carried out are not optimal at PT XYZ.	3	3	3	4	3	3	4	3	4	3	33	3,3	12
24	Employee 4	Worker negligence caused by a lack of understanding of workers in handling and picking up PT XYZ furniture products.	2	3	4	2	3	2	3	4	2	3	28	2,8	18

The results of ranking and weighting, where the five most frequent waste attributes are inventory 3, inventory 2, searching time 1, waiting 4, and searching time 3. These five attributes will be further identified to find out the causes and proposed improvements.

#### D.4. Identify The Causes of Waste Using Fishbone Diagram

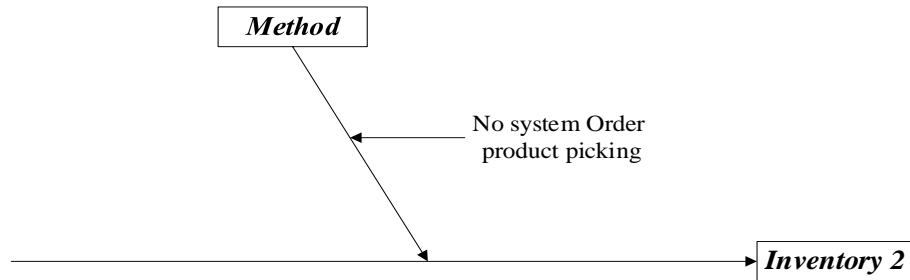
Fishbone diagram analysis is used to show what are the causes and consequences of waste in the warehousing flow process, so that recommendations for improvement can be determined. The following are the causes of five frequent wastes, namely inventory 3, inventory 2, searching time 1, waiting 4, and searching time 3 using Fishbone Diagram:

- a. Furniture products are placed on the warehousing floor (Inventory3)



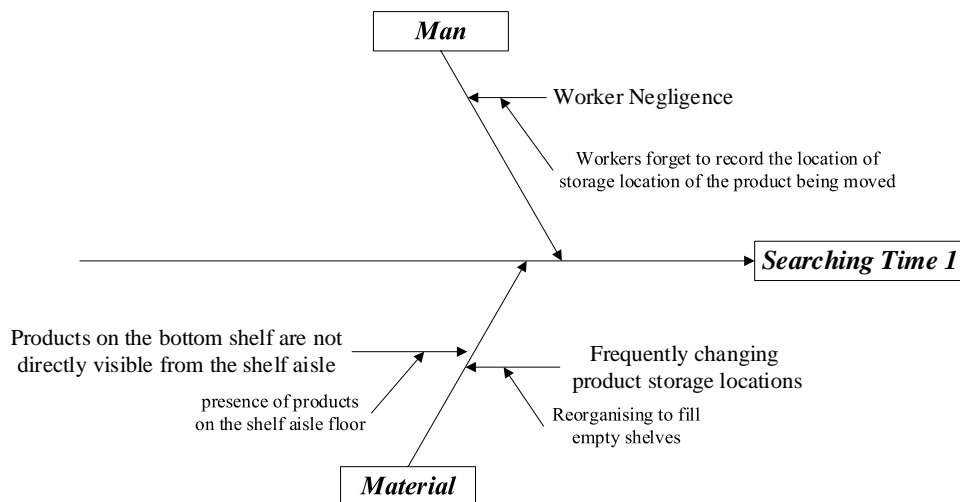
**Figure 3. Fishbone Diagram Inventory 3**

- b. Inventory of furniture products in the warehouse that are not sold out (Inventory 2).



**Figure 4. Fishbone Diagram Inventory 2**

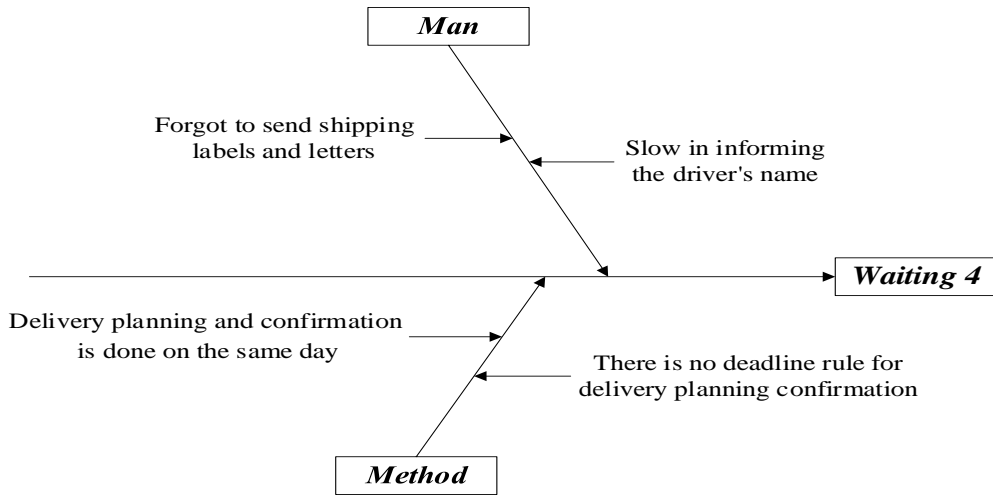
- c. Long process of sourcing products for order preparation (Searching Time 1)



**Figure 5. Fishbone Diagram Searching Time 1**

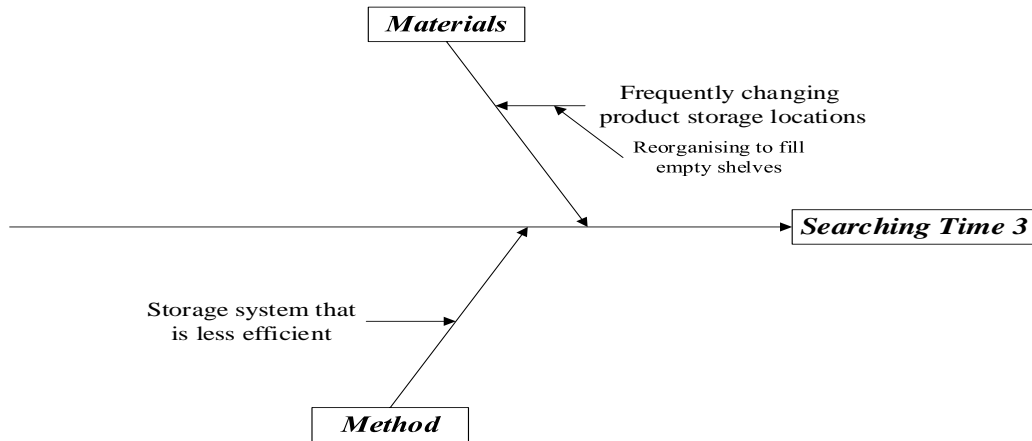


d. Waiting time for the next process (Waiting 4)



**Figure 6. Fishbone Diagram Waiting 4**

e. Finding empty shelves for storage (Searching Time 3)



**Figure 7. Fishbone Diagram Searching Time 3**

**D.5. Proposed Improvements**

The proposed improvements given to eliminate the occurrence of waste that often occurs in PT XYZ's Finished Product Warehousing are based on the results of identification and analysis that have been carried out previously:

a. Furniture products are placed on the warehousing floor (Inventory3)

**Table 3. Proposed Improvements Inventory 3**

No.	Factors	cause	Proposed Improvement
1	Materials	Accumulation of long unsold product inventory	Create a First In First Out rule for the sales system and order product collection and monitor products that have not been sold for a long time by storing these products on the warehouse floor by maximising shelf capacity for products with high sales. Where products that have not been sold for a long time should be exposed through social media promotions in order to increase sales of these products.
2	Method	Limited shelf space product storage	Create an SOP for storing the same product. Where the same product with different codes can be placed on one storage pallet where the old product is placed on top of the new product.

**Table Continuation Proposed Improvements Inventory 3**

No.	Factors	cause	Proposed Improvement
3	<i>Environment</i>	Storage rules of the same product are not yet appropriate	Maximise storage space by prioritising storing products that have high sales and storing products that have not been sold for a long time on the warehouse floor. Where products that have not been sold for a long time should be exposed through social media promotions in order to increase sales of these products.

b. Inventory of furniture products in the warehouse that are not sold out (Inventory 2).

**Table 4. Proposed Improvements Inventory 2**

No.	Factors	cause	Proposed Improvement
1	<i>Method</i>	No system Order product picking	Create a First In First Out rule for the product sales and picking system. Where to prioritise older products for orders on products that have multiple codes.

c. Long process of sourcing products for order preparation (Searching Time 1)

**Table 5. Proposed Improvements Searching Time 1**

No.	Factors	cause	Proposed Improvement
1	<i>Man</i>	Worker negligence where workers forget to record the storage location of the product being moved Products on the bottom shelf are not directly visible from the shelf aisle	Make it a rule that each product has a designated shelf space. This will minimise worker negligence due to the unchanging location of product storage.  Create an SOP to prohibit placing items in the aisles of storage shelves.
2	<i>Materials</i>	Frequently changing product storage locations	Determining the location for each product has a fixed shelf place by prioritising products with high weight and volume placed on shelves that are easily accessible and products that are not sold for a long time can be moved to the warehouse floor. Where products that have not been sold for a long time should be exposed through social media promotions in order to increase sales of these products.

d. Waiting time for the next process (Waiting 4)

**Table 6. Proposed Improvements Waiting 4**

No.	Factors	cause	Proposed Improvement
1	<i>Man</i>	Forgot to send shipping labels and letters. Slow in informing the driver's name	Make it a rule that shipping labels and shipping letters are sent right after confirmation of the shipping plan. Briefed to provide delivery driver name information after delivery planning confirmation.
2	<i>Method</i>	Delivery planning and confirmation is done on the same day There is no deadline rule for delivery planning confirmation	Make a rule for the creation of the delivery plan to be finalised on H-2 of the delivery and confirm the delivery plan on the morning of H-1 of the delivery. Make a dead line delivery planning confirmation rule in the morning at a maximum of 09.30 WIB H-1 delivery.

e. Finding empty shelves for storage (Searching Time 3)

**Table 7. Proposed Improvements Searching Time 3**

No.	Factors	cause	Proposed Improvement
1	<i>Materials</i>	Frequently changing product storage locations	Determining the location for each product has a fixed shelf place by prioritising products with high weight and volume placed on shelves that are easily accessible and products that are not sold for a long time can be moved to the warehouse floor. Where products that have not been sold for a long time should be exposed through social media promotions in order to increase sales of these products.

**Table Continuation Proposed Improvements Searching Time 3**

No.	Factors	cause	Proposed Improvement
2	Method	Storage system that is less efficient	Create a storage system where each product has a fixed shelf place by prioritising products with high weight and volume placed on shelves that are easily accessible and products that have not been sold for a long time can be moved to the warehouse floor. Where products that have not been sold for a long time should be exposed through social media promotions in order to increase sales of these products.

**D.6. Simplification of Process Activity Mapping**

The proposed improvements that have been given to reduce the waste that occurs in PT XYZ's Finished Product Warehousing, will affect the results of remapping using PAM. PAM simplification is carried out based on the prediction results after the application or implementation of the improvement proposals given. The following is a comparison of PAM before and after the proposed improvements:

**Table 8. PAM Comparison Results Before and After Proposed Improvements**

Description	Total Activity	Total Time (minutes)	Percentage Activity	Percentage Time
Activity Category Before Proposed Improvement				
VA	18	340	37,50%	46,90%
NVA	8	157	16,67%	21,66%
NNVA	22	288	45,83%	31,44%
Activity Category After Proposed Improvement				
VA	18	321	46,16%	59,59%
NVA	1	7	1,23%	1,30%
NNVA	20	210	51,28%	39,11%
Activity Type Before Proposed Improvement				
Operation	31	453	64,58%	62,48%
Transportation	4	44	8,34%	6,07%
Inspection	6	54	12,50%	7,45%
Storage	1	23	2,08%	3,17%
Waiting Time	6	151	12,50%	20,83%
Activity Type After Proposed Improvement				
Operation	28	421	71,80%	78,40%
Transportation	3	40	7,70%	7,45%
Inspection	6	54	15,38%	10,06%
Storage	1	15	2,56%	2,79%
Waiting Time	1	7	2,56%	1,30%

**D.7. Future Value Stream Mapping**

Future value stream mapping is used to map the flow process of PT XYZ's Finished Product Warehousing after the proposed improvements. Mapping on the Future State VSM results in a Process Cycle Efficiency (PCE) value of 59.59% which means an increase of 12.69% from the previous value of 46.90%. This increase shows an increase in the effectiveness of the PT XYZ finished product warehousing process after the proposed improvements are given. The future value stream mapping can be seen in the following figure:

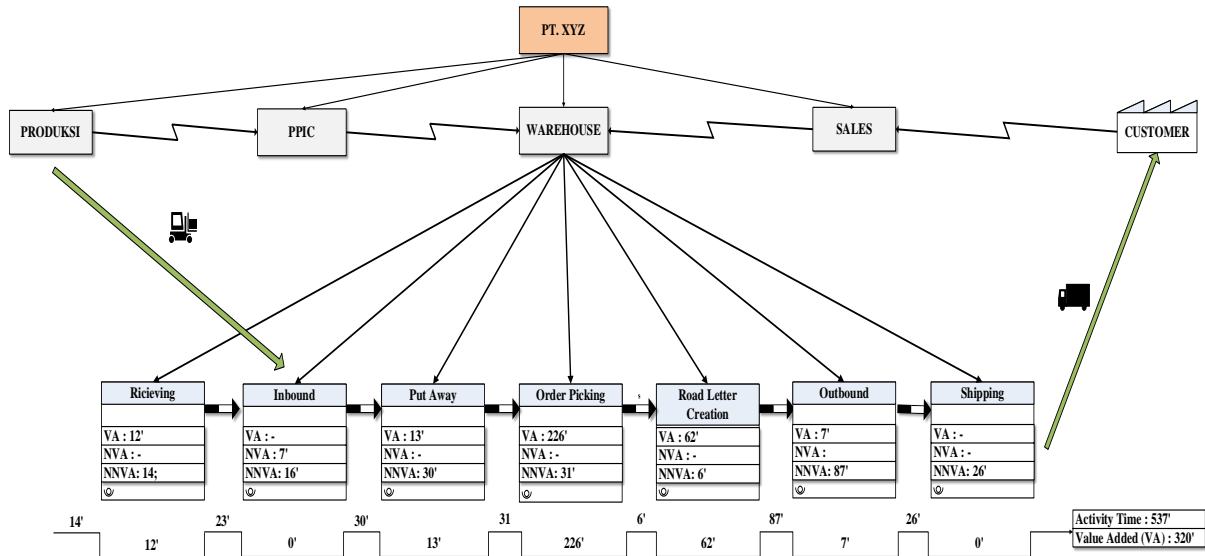


Figure 8. Future Value Stream Mapping

## E. CONCLUSION

Based on the results and discussion above, it can be seen that five attributes of waste that often occur in the PT XYZ finished product warehousing process, namely furniture products placed on the warehousing floor (Inventory 3) with a weight of 4.6; accumulation of unsold furniture product inventory (inventory 2) with a weight of 4.4; the long process of searching for products for order preparation (searching time 1) with a weight of 3.9; waiting time for the next process (waiting 4) with a weight of 3.8; and looking for empty shelves for storage of PT XYZ furniture products (searching time 3) with a weight of 3.7. Based on the proposed improvements, it is known that there is a reduction in the time and number of activities in several operational activities carried out at the PT XYZ Finished Product Warehousing. The reduction can reduce 9 activities from 48 activities to 39 activities and reduce activity time for 193 minutes from 725 minutes to 537 minutes. The proposed improvements also increase Process Cycle Efficiency (PCE) by 12.69% from 46.90% to 59.59%, which means there is an increase in effectiveness in the PT XYZ finished product warehousing process after the proposed improvements. The reduction is predicted to occur because the proposed improvements provided will help minimise waste in operational activities at PT XYZ's Finished Product Warehousing if implemented optimally and optimally. It is hoped that this research can be used or developed as the main idea for further research related to reducing waste in the Finished Product Warehousing of PT XYZ and further research needs to be carried out regarding the costs required in implementing each of the proposed improvements that have been given.

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