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Analysis of Waste in the Production System with the Approach Lean Manufacturing Method

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Abstract

Improving the production process needs to be done continuously and continuously in order to minimize all activities that consume time but do not contribute directly to the value of the products produced. PT Cipta Oggi is a manufacturing company that makes furniture products which has a major problem, namely the low value of Process Cycle Efficiency, which the company should have a PCE value of at least 50%. The use of lean manufacturing methods with the help of VSM is used to reduce waste in order to increase the PCE value. There are 22 non-added value activities with a time range of 427 minutes that can be cut. Where the production time was originally 1353 minutes to 926 minutes which had an impact on increasing Process Cycle Efficiency which was originally 46.8% to 68.4%. Based on Failure Mode and Effect Analysis (FMEA), it is known that the main root cause that has the highest RPN value is the Overprocessing waste with a score of 420 and the proposed improvements in order to reduce this waste are the need for safe storage management that can reduce the risk of damage to goods which requires additional processes, namely rework and additional human resources are needed in the inspection process in order to reduce the number of rework.

Introduction

In the manufacturing industry, the production process is one of the main factors in creating a quality product that can compete in the market. Improving the production process needs to be done continuously to minimize all activities that consume time but do not directly contribute to the value of the products produced. PT Cipta Oggi Furindo is a manufacturing company that produces furniture products such as office desks, decorative cabinets, TV racks, etc. The company has problems related to the high time involved in the process that does not add value to a product, and it can be said that the production process in the company is still inefficient. Measurement of the efficiency of the production process can be seen by calculating the value of Process Cycle Efficiensi (PCE). A company can be said to be efficient if its PCE value is above 50% (Zulfikar & Rachman, 2020).

The low PCE value occurs because of the existence of waste during the production process such as Defects, Unnecessary Motion, Excessive Transportation, Waiting Time, Excess Inventory, Over Processing, Overproduction which results in high lead time in a production process (Khunaifi et al., 2022; Hidayati & Shalihin, 2020; Salunkhe & Shinge, 2018). The number of non-value added activities, extending lead times that make production targets unachievable (Larasati & Laksono, 2022). Lean Manufacturing is a strategy or way of thinking of company management, which aims to improve the efficiency of manufacturing and production (Lu & Aidil, 2024; Kumar et al., 2022; Javaid et al., 2022; Vlachos et al.,

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2023). So that the manufacturing company can maximize its value to customers and increase its profits. Problems related to high lead time occur because of the high value of non-value added activities that should be reduced or eliminated (Fatma et al., 2022; Balamurugan & Sudhakarapandian, 2024).

VSM is a visual tool used to map the value stream of the entire production process, from the supplier to the delivery of the final product to the customer. VSM is more suitable for identifying waste within the entire value stream, focusing on larger processes and waste occurring along the value chain (Reda & Dvivedi, 2022; Sultan et al., 2021; Sangwa & Sangwan, 2023). Based on these problems, an analysis is carried out which is used to reduce waste in the production process flow with a lean manufacturing approach with the help of the Value Stream Mapping (VSM) tool. The approach in solving the above problems is done by analyzing related production process activities presented in the form of Big Picture Mapping, observing waste presented in the Process Activity Mapping table, calculating the PCE value and percentage of each activity that contributes waste, and analyzing improvements to reduce waste with the FMEA method. This research was conducted in order to reduce waste so as to reduce the lead time in the production process. By reducing waste, speeding up process times, and creating a more efficient workflow (Baldah et al., 2021).

Production

Production is an effort to produce or improve the function of a product or service by utilizing available resources. In the modern industrial world full of global competition, this process is not only considered as converting raw materials into final products, but also as a way of creating added value. Therefore, understanding the concept of added value is crucial to optimize every creative step and minimize waste (Salmaa & Isnaini, 2022). In the manufacturing process, alead time that is too long can trigger waste in the company due to an increase in production costs (Nurwulan et al., 2021; Niekurzak et al., 2023; Parwani & Hu, 2021).

Lean Manufacture

Lean manufacturing is a business strategy that aims to reduce waste or production that does not contribute to economic growth (Sumasto et al., 2023; Kumaret al., 2022; García-Alcaraz et al., 2021). Pemborosan can occur in all production lines from hulu to hilir. Therefore, companies that are committed to implementing Lean Manufacturing in their production system must also be committed to reducing waste or waste from the beginning to the end (Nelfiyanti et al., 2023).

Waste

Waste can be defined as any work-related activity that does not contribute to the process of converting input into output through value stream mapping. According to the lean perspective, all types of pemborosan that exist that translate input into output must be avoided in order to increase the value of the product and, consequently, the value of the client. Here are the seven types of waste that exist in the production system: a) Overproduction; b) Overprocessin; c) Defect; d) Waiting; e) Uncessary Motion; f) Uncessary Inventory; g) Excessive Transportation (Fontana & Gaspersz, 2011).

VALSAT

Value Stream Analysis Tools (VALSAT) is a tool used to determine tools in process flow mapping, which is then used as a guide to identify waste (Odi et al., 2019). There are 7 tools that can be used, namely: Process Activity Mapping. Supply Chain Response Matrix, Production Variety Funnel, Quality Filter Mapping, Demand Amplification Mapping. Decission Point Analysis, and Physical Structure (Pattiapon et al., 2020).

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Table 1. Matrix VALSAT

Waste / Structure	Mapping Tools						
	PAM	SCRM	PVF	QFM	DAM	DPA	PS
Transportation	H						L
Waiting	H	H	L	M	M		
Overproduction	L	M		L	M	M	
Defect	L			H			
Unnecessary Inventory	M	H	M		H	M	L
Unnecessary Motion	H	L					
Unappropriate Processing	H		M	L		L	

Source : Hines & Rich (1997)

Description :
H (High Correlation and Usefullness) = 9
M (Medium Correlation and Usefullness) = 3
L (Low Correlation and Usefullness) = 1

PAM

PAM is a tool that aims to identify the lead time of physical product and information flows by mapping each stage of activities, such as operations, transportation, inspection, delays, and storage (Fitriani & Rochmoeljati, 2023). Activities are then grouped into value added (VA), necessary non value added (NNVA), and non value added (NVA) categories to understand the process flow, identify waste, efficiency, and improvement opportunities (Zulfikar & Rachman, 2020). VA is an activity that produces added value to a product that must still be carried out (Graciella et al., 2020). NVA is an activity that does not produce added value and makes the length of the lead time (Pratiwi & Widjajati, 2023). NNVA is in the middle between VA and NVA, which are activities that although do not add value directly to the product, are still necessary to ensure the smooth running of the production process until completion (Ismail et al., 2023; Shou et al., 2020; Haekal, 2022).

Fishbone Diagram

Fishbone diagrams are useful for focusing attention on the main problem and providing a brief overview of the problem at hand (Putra & Rochmoeljati, 2024). One of the methods developed by Ishikawa is the cause-and-effect diagram, which is often called a fishbone diagram or Ishikawa diagram (Arif & Gunawan, 2023).

Pareto

A Pareto chart or Pareto analysis is a bar and line graph that shows the overall proportion of each type of information. In a Pareto chart, categories of occurrences are sorted by size, from largest to smallest on the right. The order indicates priority. Pareto charts are used to identify major product defects by classifying product defects and determining the defect rate from maximum to minimum (Oktavia, 2021; Erdhianto et al., 2021; Singh et al., 2023).

FMEA

FMEA is a tool to identify and prevent Product failure modes that disrupt the production process (Novitasari & Rochmoeljati, 2021). Quality problems can be traced to their root causes through FMEA analysis (Pamungkas & Irawan, 2020).

Methods

The research initiative analyzed waste in the manufacturing system at PT Cipta Oggi Furindo through an extensive lean manufacturing methodology. The primary objective concentrated

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on raising Process Cycle Efficiency (PCE) while removing all non-value-added (NVA) activities and shortening production lead duration. Multiple stages built the methodology which incorporated observational measures with analytical tools for developing a data-centered process improvement approach.

Observers conducted primary site observations during the early stage of the methodology at the production area. Research teams monitored operational workflow activities as they happened in different sections of the production area. The research team documented both operational steps as well as material movements together with operator interactions alongside machine usage and all delay occurrences during the observations. Employee interactions with production workers and supervisors enabled team members to define the main research problem as non-value-added processes generated excessive inefficiencies which produced PCE results under 50%.

Within the data collection phase the researchers deployed Value Stream Mapping (VSM) to represent the complete production pathway which started with raw materials and terminated with finished product delivery. The researchers deployed this tool to document operational conditions together with material and information movements. The VSM procedures helped detect operational delays together with waste sections and equilibrium issues in process sequencing. The production process lasted 1,353 minutes but only contributed 604 valuable minutes to the system and exposed vast potential for enhancing operational efficiency.

The study used Process Activity Mapping (PAM) as a VALSAT tool to analyze decided tasks through detailed operational activities during the VSM analysis. Staff categorized all activities into five distinct groups which included operations, transport, inspection, delays and storage. The evaluation process utilized Value-Added (VA) and Non-Value-Added (NVA) alongside Necessary but Non-Value-Added (NNVA) classifications for value assessment. The implementation of PAM generated accurate data showing NVA activities used 427 minutes that made up approximately 37% of the total production time. Through this step the analysis uncovered detailed inefficiencies that VSM analysis was unable to reveal completely by itself.

Fishbone Diagrams allowed the study to conduct diagnostic work during which they analyzed activities with waste problems. The research team established these diagrams to represent each waste type which workers defined through surveys and factory records. The diagrams divided probable causes into the five categories of People, Methods, Machines, Materials along with Environment. The evaluation of overprocessing revealed its source stemmed from inadequate storage organization and absent standard testing protocols. The organized root cause investigation method helped the proposed remedies focus on correcting fundamental issues instead of resolving symptoms alone.

The study used Failure Mode and Effects Analysis (FMEA) to determine improvement priorities before identifying root causes. Through FMEA the current system examines possible failure modes by assessing their impact severity along with the chance of occurrence and how easily the issue can be spotted. Success risk numbers (RPN) were generated by multiplying evaluations from three key criteria assigned to each detected failure condition. The analysis revealed a critical situation because overprocessing waste achieved the highest RPN score of 420. Following overprocessing waste came unnecessary motion (RPN 250) and defects (RPN 240) and waiting time (RPN 210). The analysis gave lower RPN ratings to provisions of excessive transportation services and holding extra inventory and making too much production. The organization distinguished important project areas so resources could efficiently target their most effective improvement efforts.

The assessment results from FMEA were used to create specific enhancement proposals. The company carried out safer storage systems combined with organized layouts to decrease product damage and rework and added staff for quality checks along with scheduled machine

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maintenance for defect reduction. Ergonomic layout upgrades and dedicated personnel to prevent delays contributed to decreased unnecessary motion. Certain tasks were identified as repetitive duplications which researchers proposed eliminating from the process such as confirmation validations alongside redundant labeling actions that duplicated existing documentation formats.

Results and Discussion

Production Aktivity Time Data

Table 2. Production Aktivity Time Data

Activities	Tine (Minutes)
Transferring components to the Lamination Workstation	15
Lamination	
Waiting for confirmation of component inspection results	9
Start work order confirmation in ERP	2
Cleaning the lamination machine	5
Activities	**Tine (Minutes)**
Apply glue to the lamination machine	5
Installation of PVC on the ParticleBoard surface and cutting the edges of the laminate	17
Rework on lamination that is less attached and not neat	15
Inspection of the number of components that have been produced	5
Waiting for the laminate to dry	30
Panel Saw	
Transferring components to the panel saw workstation	20
Operator receiving components	2
Waiting for cutting machine for CHR work	10
Resetting the machine	10
Start work order confirmation in ERP	2
Particle board cutting process	40
Waiting for inspection confirmation on several component samples that have been processed	10
Rework on cutting processes that are not up to standard	15
Inspection of the number of components that have been produced	5
Arranging components onto pallets	10
Radial Arm Saw	
Transfer of components to radial arm saw workstation	20
Operator receiving components	2
Start work order confirmation in ERP	2
Checking/replacement of machine cutting blades	7
Particle board cutting process	23
Waiting for inspection confirmation on several samples of components that have been processed	10
Rework on cutting processes that are not up to standard	15
Inspection of the number of components that have been produced	5
Arranging components onto pallets	10
Auto Edgeband	

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Moving components to Auto Edgeband workstation	20
Operator receiving components	2
Start work order confirmation in ERP	2
PVC installation on the machine	10
Edgeband coating process on particle board	237
Waiting for inspection confirmation on several samples of components that have been processed	10
Rework on components that do not meet the standards	28
Inspection of the number of components that have been produced	5
Arranging components onto pallets	10
Drilling	
Moving components to the drilling workstation	20
Operator receiving components	2
Activities	**Tine (Minutes)**
Start work order confirmation in ERP	2
Installation / change of drill bit	13
Matching mall with shop drawing	3
Drilling process	170
Waiting for the inspection process on several samples of components that have been processed	10
Rework on components that do not meet standards	15
Inspection of the number of components that have been produced	5
Arranging components onto pallets	10
CCTU	
Transferring components to the CCTU workstation	20
Operator receiving components	2
Start work order confirmation in ERP	2
Perform physical checks on product components	30
Perform cleaning on product components	32
Perform touch up on product components	15
sticking number labels on components	10
Data collection of reworked items	7
Returning items that were reworked in the previous process	8
Inspection of the number of components that have been produced	5
Arranging components onto pallets	10
Assembling	
Testing product samples for drafting	115
Waiting for SPV orders to move to the packing process	10
Operator receiving material	2
Start work order confirmation in ERP	2
Waiting for packing box preparation to the packing workstation	7
Packing	
Packing process	92
Checking the completeness of the components after packing	32
Inspection of the number of components that have been produced	5
Perform Good Receipt PRO by ERP with Warehouse Dept.	3
Waiting for SPV orders to move to the warehouse	21

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Transferring Finish Product to the warehouse	30
Total	**1355**

Source: PT Cipta Oggi Furindo

The following are the 9 main activities in the production process which are further broken down into several sub-activities. Total production employees are 17 people. The lamination process consists of 3 employees, panel saw process consists of 2 employees, radial arm saw process consists of 2 employees, auto edgeband consists of 2 employees, drilling consists of 3 employees, CCTU consists of 2 people, assembling 1 person, and packing 2 people. Each workstation has its own problems that reduce the efficiency of the production process. One example of waste in the edgeband process so that it has the longest process time because this process requires a level of accuracy so that defects often occur in this process so that there is a repetition of the process which makes this process have the highest lead time.

Initial Big Picture Mapping

Big Picture Mapping obtained lead time in the production process of 1353 minutes or equivalent to 81180 seconds with value added time obtained of 604 minutes or equivalent to 36240 second.

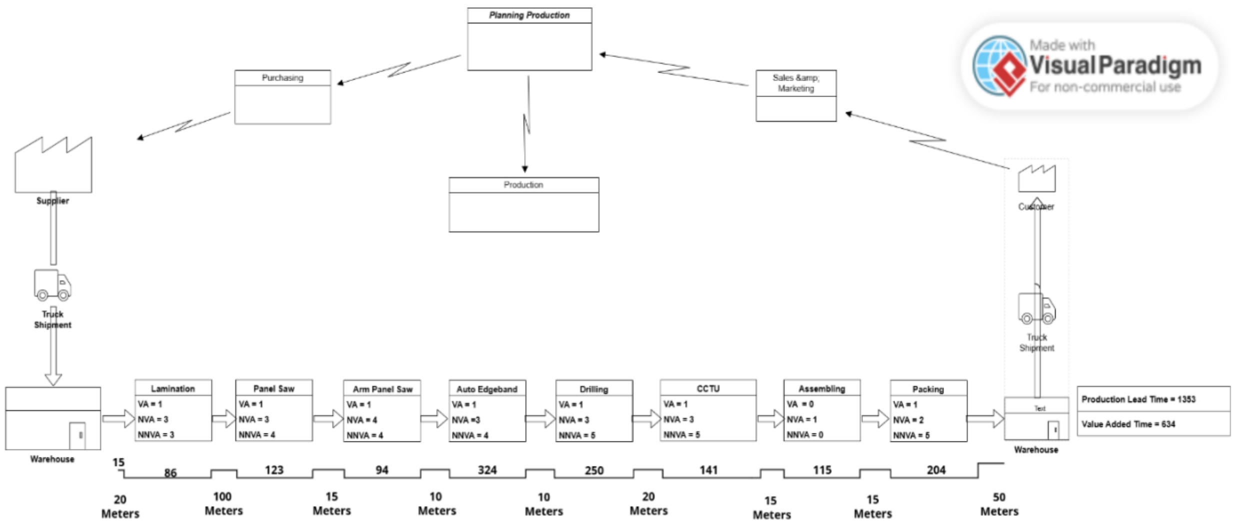

Figure 1. Initial Big Picture Mapping

Questionnaire

This questionnaire contains several statements presented in the form of a Likert scale with a range of 1-5. The distribution of questionnaires is devoted to 17 employees of the Production Department. A questionnaire is conducted to find out which waste has a large weight or impact on the production process.

Table. 3 Questionnaire calculation results

Activities	Respondents												Average	Rangking
	1	2	3	4	5	6	7	8	9	10	11	12		
Over Processing	5	5	5	5	4	5	5	5	5	5	4	4	4,47	1
Unnecessary Motion	4	5	4	5	5	5	3	3	4	5	4	4	4,29	2
Defect	4	5	3	5	4	5	5	5	4	4	4	4	4,12	3
Waiting	4	5	4	3	4	4	4	5	3	5	5	4	4,06	4
Excessive Transportation	4	3	3	4	4	5	3	3	3	5	5	5	3,59	5
Excess Inventory	5	5	5	5	4	4	2	2	2	3	4	4	3,53	6
Overproduction	4	2	2	3	2	2	2	5	3	3	2	3	2,82	7

Source : Processed Data, 2025

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The distribution of questionnaires is used to find out which type of waste has the most severe level by looking at the average value or what is commonly called the weight of the type of waste, in this study the waste that has the highest weight is overprocessing because this waste is proven to contribute to the highest lead time and is followed by unnecessary motion type waste.

VALSAT

After summarizing the results of the questionnaire, data processing is carried out by multiplying the average score on each waste with the size of the column contained in the VALSATTable 4. Mapping Tools VALSAT

Mapping Tools									
No	**Waste**	**Avg (Waste)**	**VALSAT**						
			PAM	**SCRM**	**PVF**	**QFM**	**DAM**	**DPA**	**PS**
1	Over Processing	4,47	40,24	-	13,41	4,47	-	4,47	-
2	Unnecessary Motion	4,29	38,65	4,29	-	-	-	-	-
3	Defect	4,12	4,12	-	-	37,06	-	-	-
4	Waiting	4,06	36,53	36,53	4,06	12,18	12,18	-	-
5	Excessive Transportation	3,59	32,29	-	-	-	-	-	3,59
6	Excess Inventory	3,53	10,59	31,76	10,59	-	31,76	10,59	3,53
7	Overproduction	2,82	2,82	8,47	-	2,82	8,47	8,47	-
Total			**165,24**	**81,06**	**28,06**	**56,53**	**52,41**	**23,53**	**7,12**

Source : Processed Data, 2025

After obtaining the weight of each waste, the value is used to calculate VALSAT with the formula

Tools VALSAT = Weight x Correlation Between Tools and Type of Waste

If High Correlation (H) the value is 9. If Medium Correlation (M) the value is 3. If Low. Correlation (L) the value is 1. VALSAT tool that has the highest value is PAM with the highest total value of 165.24

Process Aktivity Mapping (PAM)

The PAM method emphasizes eliminating, simplifying, or changing a series of activities that do not add value to a production process.

Table 5. Process Activity Mapping

Activities	**Time (Minute)**	**Activities Type**	**Activities Category**		
			VA	**NVA**	**NNVA**
Component transfer to Lamination Workstation	15	T			V
Lamination					
Waiting for confirmation of component inspection results	7	I		V	
Start work order confirmation in ERP	2	O			V
Cleaning the lamination machine	5	O			V
Gluing the lamination machine	5	O			V
Installation of PVC on the ParticleBoard surface and cutting the edges of the laminate	17	O	V		
Rework on lamination that is less attached and not neat	15	O		V	
Inspection of the number of components that have been produced	5	I			V
Waiting for the drying of lamination results	30	D		V	
Panel Saw					

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Transferring parts to the panel saw workstation	20	T			V
Operator receiving components	2	S			V
Waiting for cutting machine to work on CHR	10	D		V	
Resetting the machine	10	O		V	
Start work order confirmation in ERP	2	O			V
Particle board cutting process	40	O	V		
Waiting for inspection confirmation on several samples of components that have been processed	10	D		V	
Rework on cutting processes that are not up to standard	15	O		V	
Inspection of the number of components that have been produced	5	I			V
Arranging components onto pallets	10	O			V
Radil Arm Saw					
Transferring parts to radial arm saw workstation	20	T			V
Operator receives the component	2	S			V
Start work order confirmation in ERP	2	O			V
Checking/replacement of machine cutting blades	7	I			V
Particle board cutting process	23	O	V		
Waiting for inspection confirmation on several samples of components that have been processed	10	D		V	
Rework on cutting processes that are not up to standard	15	O		V	
Inspection of the number of components that have been produced	5	I			V
Arranging components onto pallets	10	O			V
Auto Edgeband					
Moving parts to Auto Edgeband workstation	20	T			V
Operator receives the component	2	S			V
Start work order confirmation in ERP	2	O			V
PVC installation on the machine	10	O	V		
Edgeband coating process on particle board	237	O	V		
Waiting for inspection confirmation on several samples of components that have been processed	10	D		V	
Rework on components that do not meet the standards	28	O		V	
Inspection of the number of components that have been produced	5	I			V
Arranging components onto pallets	10	O			V
Drilling					
Transferring parts to the drilling workstation	20	T			V
Operator receives the component	2	S			V
Start work order confirmation in ERP	2	O			V
Installation / change of drill bit	13	O			V
Matching mall with shop drawing	3	I			V
Drilling process	170	O	V		
Waiting for the inspection process on several samples of components that have been processed	10	D		V	
Rework on components that do not meet standards	15	O		V	
Inspection of the number of components that have been produced	5	I			V
Arranging components onto pallets	10	O			V
CCTU					
Component transfer to CCTU workstation	20	T			V
Operator receives the component	2	S			V
Start work order confirmation in ERP	2	O			V

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Perform physical checks on product components	30	I			V
Perform cleaning on product components	32	O		V	
Performing touch up on product components	15	O	V		
Putting the number label on the component	10	O		V	
Data collection of reworked items	7	I		V	
Returning items that were reworked in the previous process	8	O		V	
Inspection of the number of components that have been produced	5	I			V
Arranging components onto pallets	10	O			V
Assembling					
Testing of product samples to be compiled	115	I		V	
Packing					
Waiting for SPV order to move to packing process	10	D		V	
Operator receiving material	2	S			V
Start work order confirmation in ERP	2	O			V
Waiting for packing box preparation to the packing workstation	7	D		V	
Packing process	92	O	V		
Checking the completeness of the components after packing	32	I		V	
Inspection of the number of components that have been produced	5	I			V
Perform Good Receipt PRO by ERP with Warehouse Dept.	3	S			V
Waiting for SPV order to move to warehouse	21	D		V	
Transferring Finish Product to the warehouse	30				
Total Time	**1353**				

Source : Processed Data, 2025

PAM classifies activities into five main categories, namely value-added activities, non-value-added but necessary activities, non-value-added activities, By using PAM, non-value-added activities can be identified and subsequently minimized or eliminated to improve operational efficiency.

Table 6. Percentage of warehouse activity frequency and time

No	Type Activities	Time (Minute)	Persentase	Frekuensi	Persentase
1	Inspection	236	33%	14	23%
2	Operation	235	33%	24	40%
3	Delay	118	16%	9	15%
4	Transportation	115	16%	6	10%
5	Storage	15	2%	7	12%
Total		**719**	**100%**	**60**	**100%**

Source : Processed Data, 2025

After knowing the number of activities and the time required for each activity, it is continued by grouping into activities that fall into the category of Value Added Activity, Non Value Added Activity, and Necessary but Non Value Added Activity.

Table 7. Percentage of frequency and time of each activity type

No	Type Activities	Time (Minute)	Persentase	Frekuensi	Persentase
1	Non Value Added Activities	427	37%	22	32%
2	Value Added Activities	634	42%	8	12%
3	Necessary but Non Value Added Activities	292	21	38	56%

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Total	**1353**	**100%**	**68**	**100%**

Source : Processed Data, 2025

Fishbone Diagram

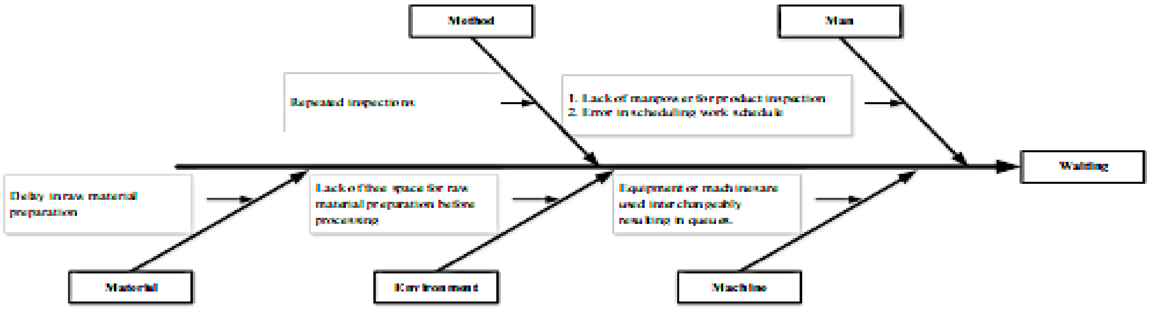

Figure 2. Fishbone Diagram Waste of Waiting

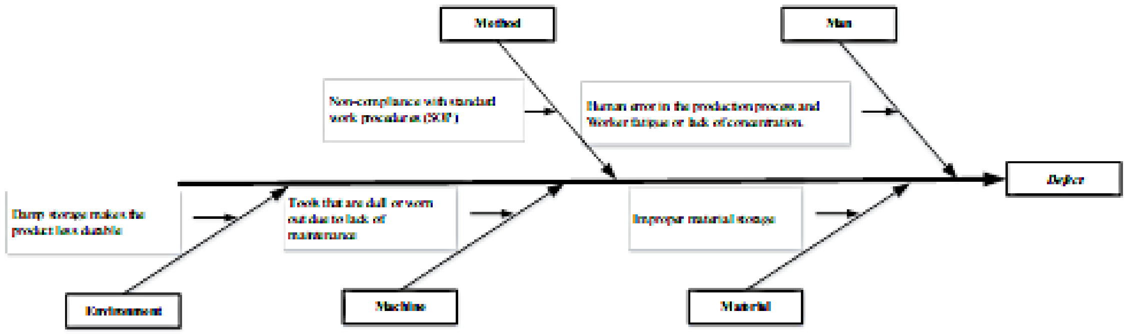

Figure 3. Fishbone Diagram Waste of Defect

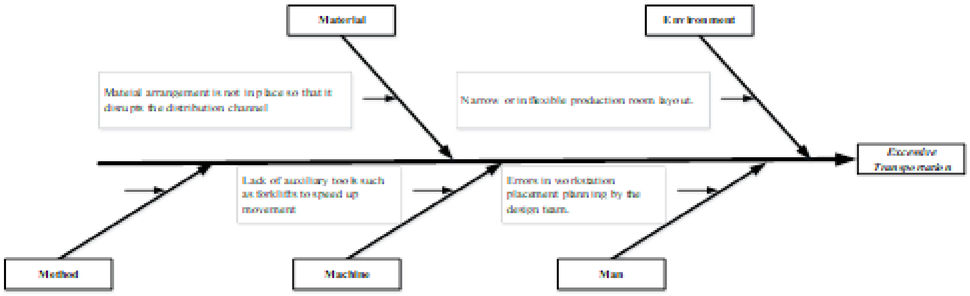

Figure 4. Fishbone Diagram Waste Excisive Transportation

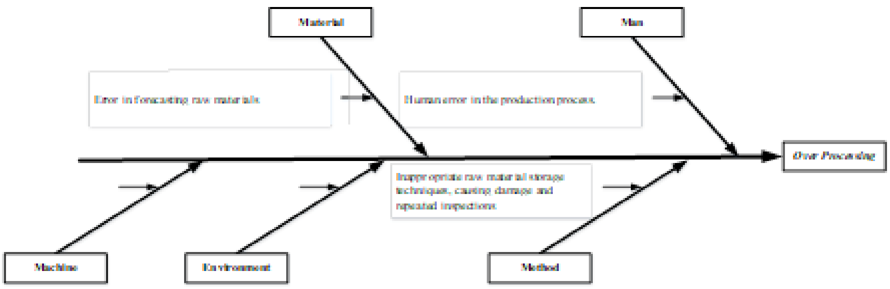

Figure 5. Fishbone Diagram Waste of Overprocessing

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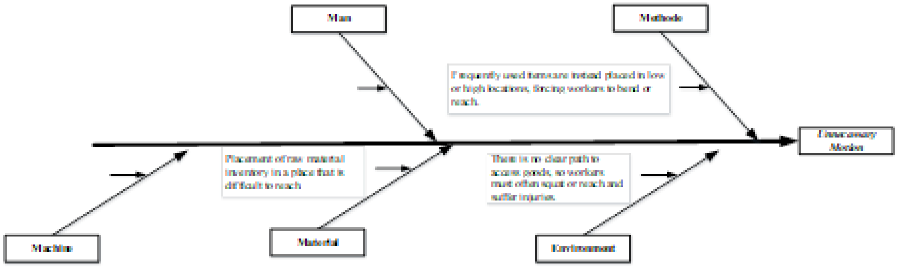

Figure 6. Fishbone Diagram Waste of Unecessary Motion

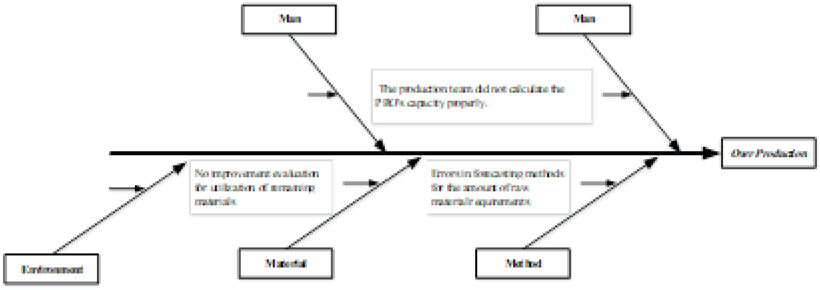

Figure 7. Fishbone Diagram Waste of Overproduction

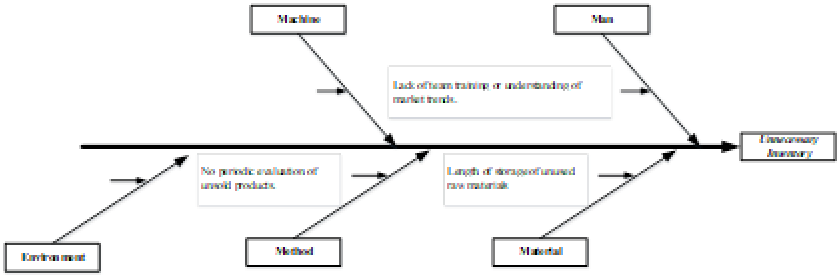

Figure 8. Fishbone Diagram Waste of Unnecessary Inventory

Next, the Fishbone Diagram is used to analyze the root causes of the problems found through VSM and PAM. This diagram helps identify the main factors that cause production inefficiencies, which are usually grouped into five main categories, namely people, machines, materials, methods, and environment. With this approach, problems can be mapped more systematically so that the solutions applied are more targeted.

Analysis of Improvement Recommendations with Failure Mode and Effect Analysis

After data processing, it can be seen which type of waste needs to be improved first by looking at the highest RPN value. Waste handling is done based on the highest RPN value to the lowest value. Table 8. Proposed Improvement Plan Data

Waste	***Subwate***	**RPN**	**Recommendation for Improvement**	***Calculation Level***
Over Processing	Undetected production process errors that result in repetition of the production process	420	Safe storage management is needed that can reduce the risk of damaged goods that require additional processes, namely rework and additional resources are needed for the inspection process in order to reduce the number of reworks.	***Very High***
Unnecesarry Motion	Unergonomic or hard-to-reach placement of goods and poorly organized storage systems.	250	Rearrangement is needed for product / raw material storage by considering the weight, shelf height, and speed of movement of goods so that operators do not have difficulty in reaching these	***Very High***

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			items which have an impact on work accidents.	
Defect	Production processes that are not standardized or not well controlled.	240	Scheduling is needed for service machines, especially on knife sharpness, auto adgeband, and drilling, this is done in order to maximize the quality of the final component and an additional person is also needed who is devoted to the process inspection section to focus more on handling defects.	***Very High***
Waiting	Potential delays in the production process that disrupt other production processes.	210	A clear SOP related to inspection is needed so that there are not too many inspection processes that can be done is to eliminate the CCTU process but additional human resources are needed for the inpection process.	***Very High***
Excessive Transportation	Inefficient production space layout and lack of material transportation system.	175	The need for additional Helli or Forklif because the company only has 1 conveyance which makes the distribution process hampered.	***Medium***
Unnecassary Inventory	Poorly organized product management	96	The company must re-evaluate the utilization of unused materials into furniture products that have a smaller size in order to produce added value.	*Low*

Proposed Big Picture Mapping Analysis

The following table shows the reduction of time in the production process. Non-value added and necessary but non-value added activities can be reduced and even eliminated to increase process cycle efficiency (PCE).

Table 9. Process Cycle Efficiency (PCE)

Activity Description	Process time Before Improvement	Process time After Improvement	Repair Description
Waiting for confirmation of component inspection results	7	0	An operator is needed who is specialized for process inspection so that there is no waiting process that hinders the production process.
Rework on lamination that is less attached and not neat	15	0	Before use, inspection is required for the material whether to make improvements to the lamination process with stricter quality control of raw materials in the early stages to reduce the possibility of rework.
Waiting for drying lamination results	30	0	Selection of glue material with Grade B in order to speed up the drying process and minimize the results of lamination peeling.
Waiting for cutting machine for CHR work	10	0	It is necessary to make a clear SOP related to the schedule of machine use so that it does not collide with the ongoing production process.

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Resetting the machine	10	0	Standardize and document the machine settings for each process so that the setting time is shorter.
Waiting for inspection confirmation on several samples of components that have been processed	10	0	An operator is needed who is specialized for the inpection process so that there is no waiting process that hinders the production process.
Rework on the cutting process that is not according to standard	15	0	Rework in the cutting process is caused by blunt knives which result in less neat results, it is necessary to schedule machine maintenance before use in order to minimize rework in the cutting process.
Waiting for inspection confirmation on several samples of components that have been processed	10	0	An operator is needed who is devoted to the inpection process so that there is no waiting process that hinders the production process.
Rework on drilling process that does not meet the standard	15	0	Making malls (molds) to minimize errors during the drilling process
Waiting for inspection confirmation on several samples of components that have been processed	10	0	An operator is needed who is specialized for the process inpection so that there is no waiting process that hampers the production process.
Rework on auto edgeband process that does not meet the standard	28	0	Perform routine calibration on the auto edgeband machine to ensure the cutting and pasting results are in accordance with the standards.
Waiting for inspection on several samples of components that have been processed	10	0	An operator is needed who is devoted to the inpection process so that there is no waiting process that hampers the production process.
Rework on components that do not meet the standard	15	0	Perform routine calibration on the radil arm machine to get precise cutting results.
Perform cleaning on product components	32	0	This process can be eliminated because there is already a touch up process where it is sufficient.
sticking the number label on the component	10	0	This process should be eliminated because there is already a shop drawing used for product assembly steps.
Data collection of reworked goods	7	0	Maximize the inspection process so that no rework is found when packing.
Returning goods that were reworked in the previous process	8	0	Maximize the inspection process so that no rework is found when packing.
Testing product samples for compilation	115	0	This process can be eliminated because the process is sufficiently performed on new products
Waiting for SPV orders to move to the packing process	10	0	Create a standard work procedure (SOP) that allows operators to make decisions without having to wait for direct orders.
Waiting for packing box preparation to the packing workstation	7	0	Create SOPs for materials to be used so that they are available H-1 of the work.

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Checking the completeness of the components after packing	32	0	This process needs to be eliminated because the completeness of the components is already done during the packing process.
Waiting for SPV orders for transfer to the warehouse	21	0	Products that have finished packing should be placed directly in the warehouse without having to confirm from the production SPV because when the warehouse receives the goods, it must go through the Good Receipt process by ERP to monitor that the goods have been received by the warehouse.
Total Time	**427**	**0**	

There are 22 non-value added activities or about 427 minutes of time that can be eliminated. This can reduce the lead time of the production process which has an impact on the efficiency of the production process

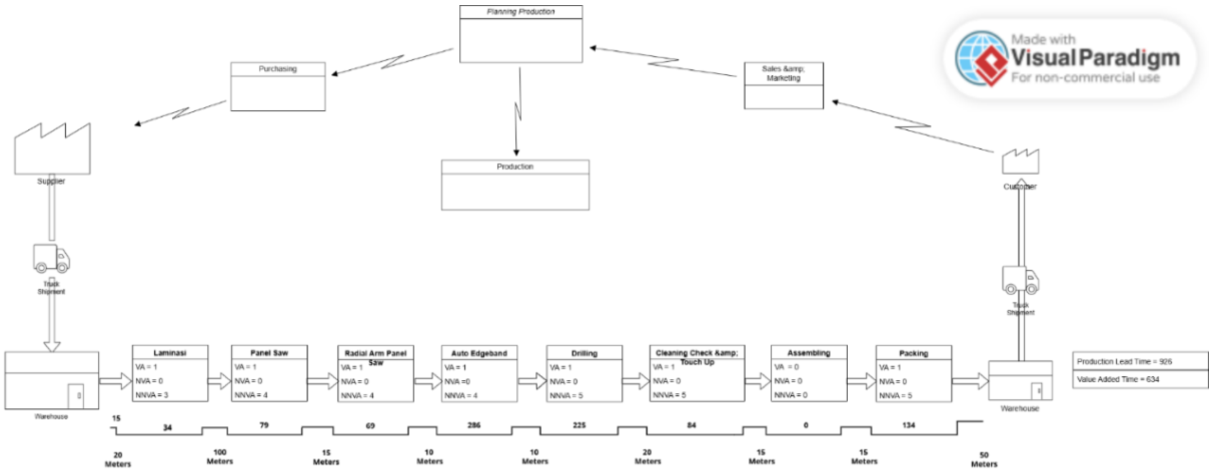

Figure 9. Big Picture Mapping Future

Source : Processed Data,2025

The use of one of the tools in the lean concept, namely VSM with the help of PAM tools, has proven to be able to reduce waste by reducing the lead time of the production process by eliminating non-value-added activities. There are 22 non-value added activities with a time range of 427 minutes that can be cut, where the production time which was originally 1353 minutes becomes 926 and the shorter the lead time will have an impact on the production process.

This study confirms that lean manufacturing tools succeed in practice to optimize manufacturing efficiency. The production system at PT Cipta Oggi Furindo received comprehensive assessment through VSM, PAM, Fishbone Diagrams and FMEA. The overall reduction of non-value-added time totaled 427 minutes along with a Process Cycle Efficiency (PCE) improvement reaching 68.4 percent. The changes implemented extended beyond normal minor alterations. The change impacted how companies use their production time alongside providing structured waste reduction methods.

The literature shows that many studies demonstrate manufacturing lead time is mostly eaten up by activities which bring no customer value addition (Zulfikar & Rachman, 2020; Fatma et al., 2022). Researchers of this study observed such tendencies in real-time data collection. The production process became inefficient because workers spent excessive time performing repeated rework and unnecessary movement and performing multiple long inspections and using ineffective storage systems. Research by Pratiwi and Widjajati (2023) demonstrates that operational inefficiencies normally evolve slowly then eventually become standard operational procedures.

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A study of seven waste types found overprocessing as the major concern because it obtained the highest Risk Priority Number (RPN) of 420. Separating this waste category exceeded regular work procedures. Structural problems at the production line required attention because they included deficiencies in preventive inspection and inconsistent material handling along with unclear standard operating procedures. Pamungkas & Irawan (2020) pointed out that insufficient workflow control produces repetitive operations that waste resources and create no significant business value. Increasing safety measures for storage systems together with strengthening quality control protocols were necessary practical changes for the workplace.

Excessive movement from employees represented a significant waste factor during operations. Staff members spent excessive time achieving operations as well as making movements due to disorganized layouts in combination with poorly located materials. The research conducted by Putra & Rochmoeljati (2024) along with Nelfiyanti et al. (2023) demonstrates that correct layout arrangements together with ergonomic design directly impact process efficiency. A minimal change in rearranging workstations with tools based on use frequency and weight distribution along with accessibility improves both safety and speed significantly. The research demonstrated that worker participation matters because it enables them to identify waste factors during the analysis process. The research team used structured questionnaires to let workers explain which types of waste affected them the most at the workplace. The gathered employee feedback supported existing time study results thus strengthening the research validity. The method of worker involvement follows lean principles by connecting directly with operational realities which is known in Gemba terms 'going to Gemba' (Boediono & Sutapa, 2020; Małysa et al., 2024). The research led by Graciella et al. (2020) together with the findings of Arif and Gunawan (2023) confirm that involving employees enhances both ownership and prolonged success during lean project executions.

The system of FMEA introduced clear improvements to the analysis process. To minimize chaos the team established a risk-driven framework that allowed them to handle critical problems before addressing secondary concerns. Novitasari & Rochmoeljati (2021) and Lu & Aidil (2024) proved through their research that lean initiatives deliver better results if improvement plans focus on likely risks and their impact potential. Corrective measures in this situation stemmed from addressing overprocessing along with motion waste and defects since they represented the clearest starting points.

The most beneficial modifications occurred without requiring any new technology or infrastructure development. Removing pointless inspections together with authorization of employee progress eliminated supervisor delays which substantially minimized operational slowdowns. The studies conducted by Baldah et al. (2021) and Oktavia (2021) confirmed that protracted waiting periods and numerous hierarchical command structures diminish productivity levels gradually. The research results indicated that specific value-added procedures failed to deliver genuine value for customer purposes. Existing procedures were unnecessary because initial steps lacked adequate weakness identification. In consequence, some of these tasks were repeated for no reason. According to Pattiapon et al. (2020) value needs to be redefined constantly from the customer’s point of view beyond what production line workers consider valuable.

Big Picture Mapping as a visual tool served to efficiently convey workflow problems and solutions throughout the entire team. Workers in high-speed manufacturing produce better results if information is displayed visually rather than by using written documentation or spreadsheets according to Larasati & Laksono (2022) and Nurwulan et al (2021). The improved accessibility allowed departments to collaborate across boundaries thus building team-based awareness of change initiatives.

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The study has certain restraining factors that need to be recognized. The study sustained its research on manufacturing within plant facilities yet disregarded how suppliers and clients affected the results. More research should analyze the effects of outside factors on internal waste while studying the potential benefits of digital tracking approaches and Internet of Things systems for lean implementation practices (Salmaa & Isnaini, 2022; Lu & Aidil, 2024). To link operational enhancements with customer satisfaction the research should integrate formal Voice of the Customer (VOC) information along with production worker feedback.

Conclusion

The research established vital benefits of lean manufacturing principles when teams used these methods to reduce waste during production at PT Cipta Oggi Furindo. The study incorporated Value Stream Mapping (VSM) together with Process Activity Mapping (PAM) and Fishbone Diagrams and Failure Mode and Effects Analysis (FMEA) to build an evidence-based approach which enhanced operational efficiency. The removal of twenty-two non-value-added activities produced 427 minutes of production waste elimination that subsequently improved Process Cycle Efficiency to 68.4 percent from its initial level of 46.8 percent.

Workers reported overprocessing combined with unnecessary movement as the two main sources of waste because they caused the most damage and occurred most often. FMEA allowed team members to select solutions for corrective actions by assessing risk levels which established both focused and effective measures. Structured questionnaire data collected from employees played an essential role in validating research results and developing practical improvement plans. Additionally these findings were communicated through visual coordination tools for interdepartmental implementation. This research underlines how lean manufacturing operates beyond technical solutions since it requires a cultural transformation along with strong managerial changes. True long-lasting improvements result from grasping original factors and letting employees participate in change implementation while basing choices on measurement data. The practical recommendations deliver application and scalability potential to replicate them in identical production setups.

At the same time the study mentions several imposed constraints. The study examined only the internal operations within the factory while neglecting to examine elements of either the supply chain or customer inefficiencies. Research should move forward to study external supply chain factors and digital tools and real-time monitoring systems alongside their capability to improve lean implementation.

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